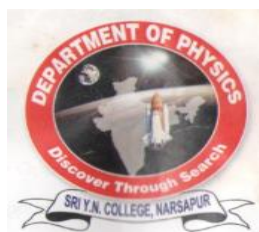




SRI Y N COLLEGE (A), NARSAPUR

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2023-2024

DEPARTMENT OF PHYSICS

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- 04. Dr.L Malleswara Rao (2023):** *Developing A Low-Cost Solar Cell using Nanotechnology "European Chemical Bulletin(ECB)", Volume-12, Special Issue 5*, pp: 494-502, July, 2023 ISSN: ISSN 2063-5346 , Impact Factor: **0.25 (SJR)**, Q3 Journal, Emerging Sources Citation Index, Index Copernicus, Scimago Journal Ranking (SCI)/Web of Science/Scopus Indexed, Elsevier Orcid, UGC- Approved Journal, Journal link: <https://www.eurchembull.com/issue?volume=Volume%20-12&issue=Special%20Issue-5&year=2023>. and article Link: <https://www.pnrjournal.com/index.php/home/article/view/2481> and DOI: 10.48047/ecb/2023.12.si5.049 DOI: [10.48047/ecb/2023.12.si5.0492023.04/05/2023](https://doi.org/10.48047/ecb/2023.12.si5.0492023.04/05/2023) Scopus Indexed link: <https://www.scopus.com/sourceid/21100898023>

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Abstract— Utilizing solar, wind, and other biomass energy sources will not reduce these resources available in the future. In order to keep up with the ever-increasing need for energy, people are turning to the sun. This analysis emphasizes public opinion on renewable energy and addresses the world's energy demands in light of the many renewable energy sources available for residential use. From 2009 to 2018, the literature was systematically reviewed. More than 300 publications were sorted into appropriate categories, and 42 studies were selected for in-depth evaluation. Despite widespread attempts to reduce reliance on fossil fuels and promote renewable energy, the literature assessment found that in 2017, energy sources accounted for 73.5% of the world's largest power production. However, only 26.5% of the power needed could be met by renewable sources. Moreover, the study demonstrates that the public's ignorance is a major barrier to the broad adoption of renewable energy. The findings of this study show that switching to renewable energy sources for electricity generation is an efficient way to deal with the world's pressing energy needs. In addition, this comprehensive study has highlighted the value of public opinion and analyzed worldwide comments in real time to aid in the development of renewable energy technologies.

Keywords—*Performance based-design, Renewable Energy Technology, Design criteria, Design procedures, Evaluation, Challenges, Future trends, Solar power, Electricity*

I. INTRODUCTION

Nowadays Electricity perception is changing dramatically. As time goes on, the grid will change from being managed by utilities to being managed by consumers. The smart grid upgrade will have profound effects on the industry's vertically integrated company model and interactions with stakeholders in the utility service chain. The energy industry as a whole, including regulators, technology as well as control vendors, and consumers, will be impacted [1-3]. In recent years, there has been much discussion on how to incorporate renewable energy sources into smart networks. In the early phases of smart grid

implementation in India, enhanced metering and remote sensing of renewable energy remain crucial. It's now being tested in certain regions around the country. Such technologies will undergo trials and intensive testing before they are spread globally. By reducing technical and economic losses, smart grids would aid India in balancing its supply and demand [4][5]. To promote long-term, low-carbon, high-growth economic development, India is upgrading its electricity infrastructure. India's smart grid rollout will be propelled by a number of factors. Growing all sources of sustainable power. Wind power is the fastest-growing programmed, and its installed capacity makes up two-thirds of all renewable energy output that is linked to the grid. In the long run, solar power is expected to have the most potential among all renewable energy sources, both off-grid and connected to the grid. In the early days of renewable energy research and development, these systems were installed independently. The advent of more powerful and more numerous units, notably wind energy plants, has made on-site connection to the grid a practical option. Intelligent or smart grids, which make use of advanced communication and information technology, are steadily evolving, allowing previously unconnected plants to join the grid [6-8]. The research aimed to fulfil the following objectives:

- To study renewable energy and distributed generation in smart grid
- PV Smart Grid System
- To study Large-scale grid-connected wind and solar energy

II. METHODOLOGY

Globally, important impediments to sustainable development include increased energy use and pollution of the natural environment. According to a recent study, global energy consumption has expanded at a rate that has surpassed population growth over the previous few decades. Furthermore, the use of fossil fuels contributes significantly to both global warming and greenhouse gas emissions. To address this issue, usage of renewable, sustainable, and ecologically friendly energy sources must be boosted that

emits zero emission [9-11]. According to most current studies, wind and solar energy are the most promising kinds of renewable energy. The primary challenges for continuous energy produced by these sources are their intermittent nature and reliance on weather events. As a consequence, sustaining a constant energy supply involves the use of an appropriate and trustworthy energy generation and storage system. Numerous evidence-based strategies have been developed for use in an energy storage system. The usage of lead-acid batteries is one of the most well-known and recently developed ways of energy storage. However, this technique has a number of drawbacks, including high upfront and continuing costs, the capacity to discharge energy on its own, and the emission of poisonous gases and soil contamination from the disposal of heavy metals such as lead. As an alternative option, the global scientific community has lately voiced growing interest in hydrogen-based storage technology. In light of these challenges, this study will look at the feasibility of manufacturing hydrogen energy using a mix of wind and solar electricity [12].

III. RENEWABLE ENERGY AND DISTRIBUTED GENERATION IN SMART GRID

It is not necessary to make significant adjustments to how power is generated anywhere in the globe in order to adapt to changing weather patterns and strengthen energy security. As a direct result of this, renewable energy sources and distributed generation (DG) are gaining support, and their percentages in the overall production of power are fast increasing [13]. The increasing amount of renewable energy inside a system that lacks flexibility is the primary problem that smart grid system practitioners and developers face. The incorporation of DG into the electrical distribution system has been the primary factor in the development of the distributed system; nevertheless, DG is not very responsive to market signals and does not take part in the management of the system for two reasons. To begin, a distributed generation often comes from renewable energy sources. As a result, it is typically structured on the basis of priority within set feed-in tariffs and is not required to be determined by market pricing. Second, the generators that are used in distribution networks are often undersized and do not have any modern technology. In addition, one of the issues that have arisen is the possibility that the growing percentage of renewable sources could lead to congestion in the distribution networks.

Congestion on the grid can be alleviated and the potential of our existing architecture can be maximized with the aid of smart grid technologies, which can be of assistance to utilities during the construction of new infrastructures. As smart grid technologies become more widely used, the electrical grid will become more efficient, resulting in fewer congestion-related issues. In order to transport power over longer distances, where it is required, a plethora of control systems and sensors will help automatically reroute electricity to other lines as necessary, making room for energy from renewable sources. With this, electricity may be more easily transmitted to locations that need it. A smart grid

is a system that distributes energy from power plants to homes and businesses using digital technologies. Automated control, constant monitoring, and distribution system optimization achieve this goal. Saving energy, reducing consumer prices, and boosting dependability are the three primary goals of smart grids.

PV Smart Grid System

The way PV generates energy is substantially different from how power has traditionally been generated. So, PV requires a power electronic interface to convert the generation's native format into one that can be safely sent over the grid. As reported by several researchers.

One of the most scalable types of renewable energy generation is photovoltaic energy, which can be produced in numbers ranging from some few kilowatts (kW) at the residential size to several megawatts (MW) there at utility scale. There seems to be more access points and opportunities for PV smart grid systems due to increased energy consumption, higher prices for petroleum products, and a little decrease in the cost of PV systems during the previous few years. Arrays of solar cells, which are the fundamental component of photovoltaic energy systems, are responsible for the generation of electricity when exposed to light. The amount of light that is shone on the photovoltaic (PV) cells and for how long is the primary factor that determines how much electricity is generated by the system. Solar power offers us a renewable energy choice that does not contribute to the depletion of natural resources, is site-specific, and is kind to the environment. PV provides a clean, emission-free, and noise-free method of energy conversion and does it without the need of any active mechanical mechanism. Due to the fact that this is entirely electric, it has a very long lifespan (more than 20 years). There is a significant amount of further work that has to be done in order to further improve the efficiency of the solar cell, which is the fundamental component of a PV system.

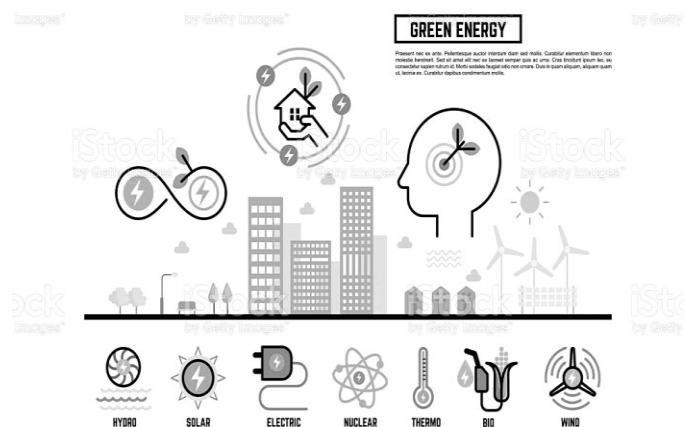


Figure 1. Green and Renewable Energy
(Source : <https://www.istockphoto.com/vector/green-and-renewable-energy-concept-for-ecology-web-banner-outline-gm607599524-104142797>)

IV. LARGE-SCALE GRID-CONNECTED WIND AND SOLAR ENERGY

It When renewable energy sources like wind and solar are incorporated into the grid, it improves the grid's reliability, efficiency, and self-sufficiency; it also enables groups of nearby communities to access electricity generated close to home; and it eventually leads to a shift from a non-self-healing architecture to a detection and monitoring infrastructure. Management of peak loads, delivery of new services tailored to the specific requirements of individual customers, and more efficient utilization of existing assets are three of the primary goals of this integration. Applying a systems-based method, we identify and illustrate the technological, regulatory, economic, and many other obstacles to deploying renewable energy through distributed generating systems.

While India is making progress in integrating renewable energy sources, the primary focus is on wind and solar, both of which have technical challenges related to intermittency, unpredictable variation, unpredictability, and geographical reliance. Grid operators and generator owners must overcome three major hurdles in order to efficiently integrate wind and solar energy into the system: uncontrollable fluctuation, broad unpredictability, and locational reliance.

When addressing renewable energy sources, it is critical to remember that unpredictability indicates non-steady output. It varies from unpredictability in that it remains even when operators are able to accurately estimate wind and solar output, posing additional challenges to the operator. Uncontrolled second to minute-scale voltage and frequency changes may cause significant harm to the grid and the equipment linked to it. One method is to inject power (either active or reactive) into the grid, which has the technical property of matching real to expected power production. This is critical for maintaining constant voltage and frequency. Such supplemental services may be labelled differently.

Among the several services that were monitored were:

- *Frequency Regulation*: This is often achieved in seconds to minutes by delivering automated generation control (AGC) signals to renewable generation. When a generator in the system fails unexpectedly, the spinning reserves kick in to keep the lights on for a brief time.
- *Non-Spinning Reserves*: they do the same task as spinning reserves but have a significantly longer response time. These generators provide reactive voltage to raise voltage as needed.
- *Black-Start Capability*: These generators are prepared to restart the electricity system in the event of a cascading blackout.

Grid operators must also monitor daily load changes in order to maintain supply and demand in balance. The load-following feature becomes increasingly important during the day's peak power demand. On the other hand, since the installation of the electrical grid, operators have continuously monitored voltage and frequency, adjusted for load

variations, and maintained reserves. This is due to the fact that loads vary in size. Furthermore, traditional producing often has difficulties and fails to deliver on its projected performance. Consumer requirements are seldom fully static, despite their regularity. Wind and solar power generation do not provide any novel issues to power plant operators. However, when implemented at scales not previously seen by grid operators, solar and wind generation inject non-uniformity into the energy system, creating a requirement for ancillary services including overall energy balance. Problems with the grid and devices, such harmonics as well as sub synchronous resonance, arise with modest penetrations of renewable energy.

Unpredictability is widespread

Uncertainty differs from variability, which is always present in solar and wind output owing to the system's reliance on variable sunlight and wind speed. However, we can never be certain if the wind and sun will be blowing and shining an hour or a day from now, and this uncertainty is what we mean by predictability. The overwhelming bulk of energy on the grid is managed by grid operators using unit commitment, thus hour-to-hour unpredictability has less of an influence. The term "unit commitment" describes the routine of scheduling generation in advance, often one day ahead, to meet anticipated demand. In the event of a production shortfall, the grid operator will activate supplementary services to meet the gap.

The cost of electricity rises as the renewable energy sector widens the differences between current and expected demand. At now, it is common practice to make deterministic unit commitments, which means that when a generator is run-scheduled, it is anticipated to operate at full capacity for the duration of that schedule. The greater predictability and controllability of conventional generation is reflective of this approach. Operators, also called generators, maintain resources by storing energy in anticipation of supply and demand balancing and protecting against any outages in generators and transmission lines.

Obtaining accurate estimates of unit commitment as well as reserves from hypothetical or unreliable data is a challenging task. Weather forecasting technology enhances prediction accuracy for wind and solar resources across a wide variety of time periods, which may subsequently be transmitted to grid operators for more effective resource scheduling and dispatch. If grid operators can properly forecast the quantity of solar and wind generation, they may be able to make more dynamic adjustments to generate operator may use advanced unit commitment approaches to prepare maximizing the utility of all system resources. To be prepared for outcomes ogives, the operator may use advanced unit commitment approaches.

Factors Dependent on Location

Day-to-day grid management does not priorities long-term planning, such as the installation of new transmission lines. However, although renewable energy generation is critical in this setting, it also introduces new challenges. Renewable energy sources such as wind and solar power are often

situated in unpopulated areas far from population centers. Renewable energy sources can only be effectively incorporated into the grid if sufficient transmission infrastructure is created due to their distance from population centers. Transmission planning tactics vary greatly and are often impacted by regional politics. Capacity for energy production may start in one state, pass into another, and then be employed in a fourth. Because of disparities in producing capacity, transmission capacity location, and demand size across various locations, the rise of renewable energy transmission is challenging, particularly when it comes to assigning costs.

Because renewable energy generation is unpredictable, there are unique technical requirements for the transmission technology that will be used in the new transmission system. To eliminate transmission losses and capital costs associated with transmission lines, distributed energy resources enable a more flexible future grid in which energy generation and consumption occur locally on a micro-grid. The national electric grid may be seen as a collection of n regional cluster networks spread around the country that work together to significantly reduce energy transmission costs.

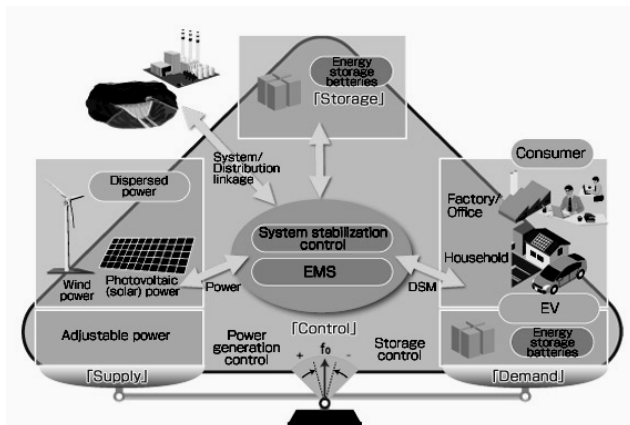


Figure 2. Renewable Energy in Smart Grid

(source :
https://www.hitachi.com/products/it/control_sys/cems/management.html)

V. SOLUTIONS

Dynamic static compensators (DSTATCOMs) may help power systems cope with changing renewable energy production. Wind and solar installations above 10-15 MW use such systems. Transmission system operators worldwide have severe connectivity requirements of renewable energy sources to safeguard transmission lines from output fluctuation. DSTATCOMs are good at VAR support, but actual power is required to smooth PV energy and handle PV ramping. New volt/VAR optimization (VVO) technology may assist power grids handle renewable energy supplies. The newest systems optimize and adapt voltage profiles for any and all distribution feeders serviced by a substation to reduce voltage fluctuations caused by renewable energy generation. VVO systems may also utilize sophisticated meters to monitor client voltage levels to maintain power quality standards.

Advanced metering infrastructure and residential energy management technologies may help real-time match

intermittent renewable energy demand with supply. Advanced meters and in-home technologies may allow users to utilize energy only after renewable energy sources are created, matching demand with supply. This technique is still a hypothesis. This isn't possible yet. Whether customers could utilize this technology, it's uncertain if they would adjust their power consumption, frequently inconveniently, unless they saved a lot on their electricity costs. The savings must offset the hassle. Because grid stability requires real-time electrical supply-demand balance, utilities must retain backup energy sources.

VI. CONCLUSION

The tremendous potentials of renewables as a source of electric energy, especially in wind and solar power, mean that they will contribute significantly to grid production in the years to come. While integrating a smart grid, which makes use of cutting-edge digital computer and communication technologies, the power system must be operated and controlled within acceptable ranges of parameters due to the variable and unexpected nature of its contribution. Regulatory mechanisms in India, some of which are already in effect and others of which are being rolled out, encourage the promotion of distributed generation and renewables and protect the concerned green energy sources so that they can be used alongside centralized conventional thermal but rather nuclear generation to meet the electricity demand at any given time. However, when linked to the grid, certain requirements must be met in operation, of course making use of the technological advances made accessible by the smart grid, which has evolved from its previous incarnation in terms on operation and control.

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Online Degree Courses: Issues & Challenges in Employment

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Abstract

Online degree programs are popular for their flexibility and convenience. Online degree holders confront employment obstacles. This study discusses job concerns for online degree holders. Online degree credibility is the first issue. Online degree recipients may be less employable due to company concerns about program rigor and quality. Online learning limits networking, which is essential for career prospects and referrals. Some online degrees lack practical experience. This may hurt your chances of getting hands-on jobs. Online degree holders must also demonstrate self-discipline and time management to allay company concerns about their professional success. Online degree holders are expected to use digital platforms and collaborative tools, thus employers may question their technology skills. Due to online education's growth, online degree holders compete for jobs. Online degree graduates can handle these issues by creating a strong professional network, acquiring practical experience through internships or volunteering, demonstrating transferrable talents, and effectively communicating the advantages of their online education. Online degrees are becoming more valued by businesses, despite hurdles. As technology advances and online education becomes more popular, online degree holders should have fewer employment hurdles and have more professional growth prospects.

Keywords: Online, Degree, Employment, Challenges, Courses, Issues, India

Introduction:

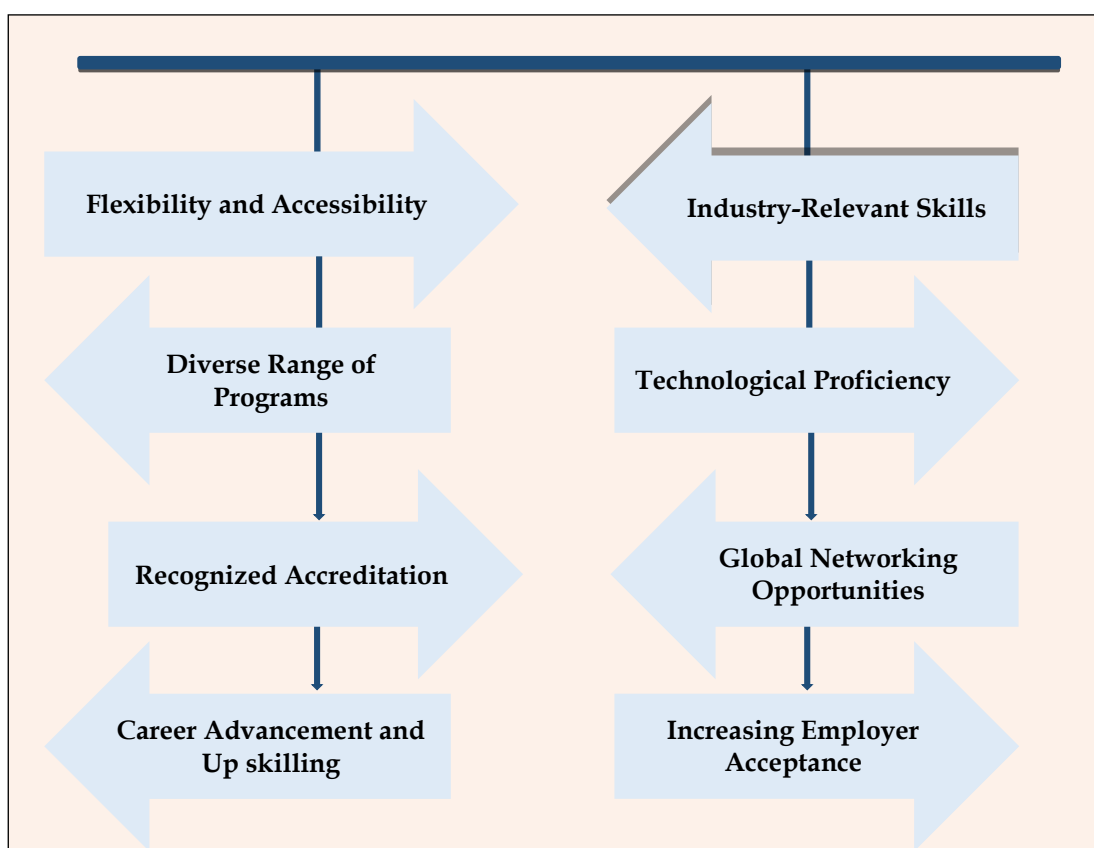
Individuals who are interested in advancing their education and broadening the scope of job options now have a popular and handy option available to them in the form of online degree programs. The conventional method of receiving a degree has been completely disrupted by the rise of online learning, which has become possible as a result of developments in technology and the pervasiveness of the internet. Education is now more available to a wider audience because to the proliferation of online degree programs, which provide students flexibility, accessibility, and a wide variety of academic disciplines.

Students have the opportunity to earn undergraduate, graduate, and even professional degrees entirely through virtual platforms when they enroll in an online degree program. These classes are structured to offer students the same high level of education and rigorous academic experience that they would receive at more conventional "brick-and-mortar" universities. Students have the ability to access course materials, participate in discussions, work collaboratively with other students, and communicate with their instructors from the convenience of their own homes or any other location with internet connectivity while using online platforms. Students have the ability to build individualized study plans that are catered to their specific requirements thanks to the adaptability of online degree programs. This flexibility is especially helpful for working professionals, parents, and other persons whose other responsibilities may make it difficult for them to attend traditional sessions. Students are able to learn at their own pace and maintain a healthy balance between their education and other duties when they take classes online because there are no time or location limits. The ability to contact students all over the world is one of the most significant benefits offered by online degree programs. Students from all over the world are able to enroll in the programs that are provided by universities and other types of educational institutions located all over the globe, which broadens their access to a variety of academic fields and the knowledge of faculty members. This international viewpoint enriches the learning experience by encouraging collaboration across cultural boundaries and cultivating a more global frame of mind in students.

In addition, online degree programs frequently include interactive multimedia components, such as movies, simulations, and virtual laboratories, to improve the quality of the student's educational experience. Students are able to apply theoretical information to actual circumstances, develop critical thinking skills, and improve their ability to solve problems thanks to the active learning that is facilitated by these interesting tools. Self-discipline, the ability to organize one's time effectively, and the ability to communicate clearly and concisely are all abilities that are essential for success in online degree programs. Students need to be self-driven and aggressive in their academic pursuits since they bear a bigger share of responsibility for their own academic growth. In addition, students must have access to a dependable internet connection and sufficient technical knowledge in order to successfully traverse the various digital learning platforms.

Scope of Online Degree Courses in employment

Because more businesses and fields are realizing the benefits and legitimacy of online education, the range of degree programs that may be completed entirely online is rapidly increasing. The growing importance of online degree programs in today's competitive job market can be attributed to the many benefits offered by these programs.



Here are some aspects that highlight the scope of online degree courses in employment:

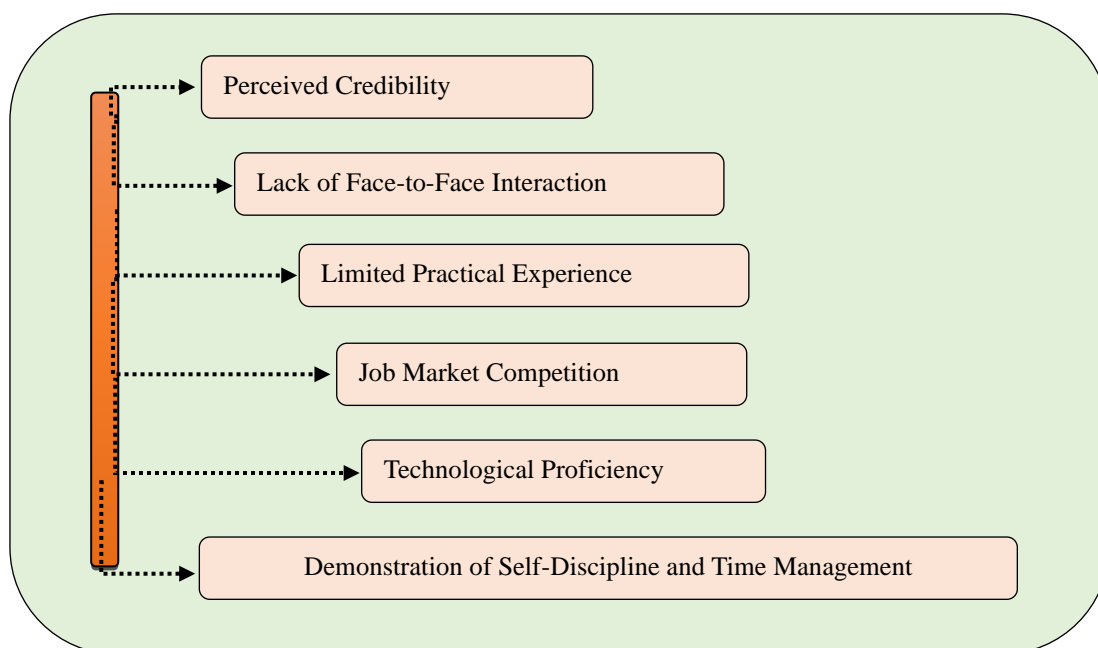
- Individuals now have the opportunity to further their education while still maintaining their commitments to work, family, and other responsibilities thanks to online degree programs. Because of this accessibility, individuals who might not have had the opportunity to pursue traditional on-campus education can still earn a degree and improve their employability by taking online classes.
- The curriculum for online degree programs encompasses a broad range of subject areas, some of which are business, healthcare, technology, education, and others. Because of this diversity, individuals are able to specialize in the areas in which they are most interested and gain the specialized knowledge and skills that are in demand by employers.
- There are numerous respected educational institutions that now offer degree programs online; these programs hold the same accreditation as their on-campus equivalents. Accreditation is a process that verifies whether or not a school's teaching methods, student outcomes, and course content are up to the required level of rigor and

quality. Because of this, more and more employers are beginning to recognize degrees earned online as being on par with those earned through more traditional means.

- Online degree programs frequently place an emphasis on the development of skills that are directly applicable to the workplace. Students are able to obtain the skills and knowledge necessary to flourish in their chosen professions by using interactive learning materials, virtual labs, and real-world case studies in their educational programs.
- Students who enroll in online degree programs naturally develop their technological competence. The capacity to navigate digital platforms, engage in online collaboration, and adapt to new technology is highly prized in the workplace of today. Online degree recipients are frequently well-prepared to make good use of technology in their respective professional responsibilities.
- Opportunities for networking and working together with people located in a wide variety of locations are made available through the use of online learning platforms. Students have the opportunity to participate in online forums, group projects, and conversations through the use of virtual platforms, which enables them to broaden their worldview and develop their professional networks.
- Individuals are able to improve their abilities and qualifications through the use of online degree courses, which in turn makes them more competitive in the job market. Employers value individuals who can demonstrate a dedication to ongoing learning and professional growth, and online degrees offer a flexible road for career advancement. Employers welcome applicants who can demonstrate this commitment.
- Employers have become more open to the idea of admitting degrees earned through online programs as time has gone on and the quality and reputation of online schools has continued to rise. A growing number of businesses realize the level of commitment, self-discipline, and motivation that is necessary to successfully complete an online program and actively seek out job prospects who have earned degrees online.

Online Degree Courses: Issues & Challenges in Employment

Online degree courses have gained popularity as a flexible and convenient option for obtaining higher education. However, they also present certain issues and challenges in terms of employment. While online degrees are increasingly recognized and accepted by employers, there are still some factors that can impact the perception of online graduates in the job market.



Some key issues and challenges related to employment for individuals with online degree qualifications:

- One of the issues that people who earned their degrees online confront is the perception of their trustworthiness in comparison to others who earned traditional degrees. It is possible that certain businesses will continue to

have biases and may question the rigor and quality of online programs. This is especially true if the employer is not familiar with the educational institution that is providing the online degree. It may be difficult to change this attitude and persuade potential employers of the worth and equivalent standing of a degree earned through online study.

- In most cases, students enrolled in online degree programs do not have the same possibilities for face-to-face engagement and professional networking as those enrolled in traditional classroom settings. In the context of online education, it may be more difficult to form personal ties with one's instructors, classmates, and industry professionals. These relationships are absolutely necessary in order to gain access to career possibilities, references, and recommendations.
- Some online degree programs might not provide as many opportunities for students to gain hands-on or practical experience, depending on the nature of the program itself. When competing for particular employment roles that demand actual skills and experience, this might be a significant disadvantage for job seekers. Candidates with traditional degrees who have had a greater amount of experience with internships, laboratory work, or field experiences may be given preference by potential employers.
- Employers may have reservations about whether or not individuals who have earned degrees online are equipped with the self-discipline, time management, and organizational abilities essential to thrive in a conventional job setting. Candidates need to be able to successfully explain and demonstrate these skills to potential employers in order to succeed in online programs, which frequently require students to be responsible for managing their own study schedules and deadlines.
- Those who earn degrees online are held to a higher standard in terms of their ability to work effectively with various digital platforms, communication tools, and online collaboration software. This is a skill that is becoming significantly more important in the digital workplace of today. However, there is a possibility that some employers will have reservations about the flexibility and technological capabilities of persons who have completed the majority of their education online.
- The rising number of students graduating from online degree programs has increased the level of competition for available positions in the workforce. Because of the increased number of candidates, it may be more difficult for those who have earned degrees online to distinguish themselves from the other candidates, particularly if the labor market is flooded with people who have earned degrees both online and the traditional way.

Review Literature

“Allen, I. E., & Seaman, J. (2017). Digital learning compass: Distance education enrollment report 2017. Babson Survey Research Group”. This study presents in-depth statistics and analysis on the developments and expansion of online education, including online degree programs. This study investigates enrollment trends, student demographics, and the perspectives of both students and educational institutions towards online education. “Xu, D., & Jaggars, S. S. (2014). The impact of online learning on students' course outcomes: Evidence from a large community and technical college system. *Economics of Education Review*, 39, 64-73”. The outcomes of students' classes are the primary focus of this investigation of the effectiveness of online education, which includes online degree programs. The performance of students in online courses is compared to the performance of students in face-to-face courses, and an analysis of the elements that contribute to the success or problems of online learning is conducted. “Li, Q., & Ma, X. (2010). A meta-analysis of the effects of computer technology on school students' mathematics learning. *Educational Psychology Review*, 22(3), 215-243”. This meta-analysis evaluates the effects of computer technology on students' learning results in mathematics. Although the study does not primarily focus on online degree courses, it does examine these effects. The findings bring to light the potential advantages of learning that is facilitated by technology, which can be used to online degree programs. “Cavanaugh, C., Gillan, K. J., Kromrey, J., Hess, M., & Blomeyer, R. (2004). The effects of distance education on K-12 student outcomes: A meta-analysis. Learning Point Associates/North Central Regional Educational Laboratory”. Despite the fact that it is focused on education from kindergarten through high school, this study offers important insights into the ways in which online learning and other forms of remote education affect the outcomes for students. The findings may be helpful in gaining a better understanding of the potential effects and benefits of taking higher education degree courses online.

These studies provide useful insights on a variety of areas of online education, including online degree courses, the impact that they have on student results, enrollment patterns, and attitudes of online education. It is important to

keep in mind that the individual findings and conclusions of these studies may differ from one another, and it is possible that additional study is required to investigate the context of online degree programs in particular.

Research Methodology

This study uses a descriptive approach to gather rich data on an event that affects people's behavior. Indeed, this circumstance is novel and its efficacy is unknown. This study uses a survey questionnaire to assess online learning's efficacy and its effects on students' learning. A structured survey questionnaire helps respondents share their personal experiences, perceptions, and opinions. With faculty help, a five-point Likert scale questionnaire with 11 online degree learning-related statements/questions was created and delivered. Convenience sampling was used to pick 150 18–21-year-old undergraduate students from a Pune, Maharashtra private college. This study is not investigating a research hypothesis to be extended to the population, but rather to understand students' impressions of online learning and degree courses' effectiveness and their online learning facilities' obstacles. 98 of 150 students were male, 52 were female.

Objective of the study

- To provide an overview of the issues and challenges related to employment for online degree holders.
- To suggest proper findings & conclusion.

Data Analysis & Interpretation

S.No .	Statements	Strongly Satisfied	Satisfied	Moderately Satisfied	Dissatisfied	Strongly Dissatisfied	Interpretation of results
1	Online degrees increase work prospects.	45%	30%	50%	15%	10%	R= HS Results indicated that majority of respondents (125%) are satisfies, strongly satisfied & moderately satisfied
2	Broadening their academic options and faculty competence	34%	67%	23%	11%	15%	R= HS Results indicated that majority of respondents (124%) are satisfies, strongly satisfied & moderately satisfied
3	Online degree courses improve education and employment.	30%	51%	31%	22%	16%	R= AS Results indicated that majority of respondents (112%) are satisfies, strongly satisfied & moderately satisfied
4	This global vision promotes cross-cultural collaboration and learning.	22%	20%	37%	45%	26%	R= LS Results indicated that majority of respondents (79%) are satisfies, strongly satisfied & moderately satisfied
5	International universities and institutions accept students from all over the world.	22%	15%	34%	48%	31%	R= LS Results indicated that majority of respondents (71%) are satisfies, strongly satisfied & moderately satisfied
6	Online degree programs let students set their own schedules.	45%	57%	21%	16%	11%	R= HS Results indicated that majority of respondents (123%) are satisfies, strongly satisfied &

							moderately satisfied
7	Online courses remove time and location constraints.	23%	53%	34%	27%	13%	R= AS Results indicated that majority of respondents (110%) are satisfies, strongly satisfied & moderately satisfied
8	Students can get undergraduate, graduate, and professional degrees online.	29%	31%	58%	20%	12%	R= HS Results indicated that majority of respondents (118%) are satisfies, strongly satisfied & moderately satisfied
9	Students can access course materials, participate in discussions, collaborate with classmates, and contact with instructors online from home or any internet-connected place.	66%	54%	16%	10%	4%	R= HS Results indicated that majority of respondents (136%) are satisfies, strongly satisfied & moderately satisfied
10	Online degrees make education more accessible.	17%	26%	29%	55%	23%	R= LS Results indicated that majority of respondents (72%) are satisfies, strongly satisfied & moderately satisfied
11	Online courses require adequate internet access and technical skills.	39%	48%	23%	25%	15%	R= AS Results indicated that majority of respondents (110%) are satisfies, strongly satisfied & moderately satisfied

Where,

R= Results; HS = Highly Satisfied; AS = Average Satisfied; LS = Lower Satisfied

Findings of the study

Based on the above analysis, the findings of the study on online degree courses are as follows:

- The study concluded that online degrees improve career prospects. Online education lets individuals study while working.
- Online degree programs provide students more academic possibilities, according to the report. Online programs also include knowledgeable, skilled teachers.
- The study concluded that online degree courses boost education and employment chances. Online education can improve abilities and professional prospects.
- The study found that online degrees foster cross-cultural learning and collaboration. Online education promotes international understanding and collaboration by attracting students from other nations.
- The survey indicated that international universities accept online degree holders. Online degrees are valued worldwide.
- The survey revealed that online degree programs give students scheduling freedom. This flexibility allows students to balance personal and professional obligations.
- Online classes minimize time and location barriers, the study found. Internet-connected students can access course materials, participate in discussions, collaborate with classmates, and communicate with instructors.

- The survey found online degrees made education more accessible. Online programs allow students with geographical or time constraints to pursue their educational aspirations.
- The study showed that online courses require internet connectivity and technical competence. Online degree programs require reliable internet and online platform and tool proficiency.
- Online degree courses have many benefits, including enhanced work possibilities, broader academic options, improved education and employment outcomes, cross-cultural collaboration, and no time or location limits. Online education requires internet connectivity and technical competence.

Conclusion

Traditional classroom-based education has been supplanted by a more adaptable and user-friendly alternative: online degree programs. This shift has had a profound impact on the landscape of higher education. Individuals have the opportunity to seek higher education and enhance their professions while overcoming the obstacles of time and geography when they enroll in online degree programs because of the ease of these programs, their worldwide reach, and the interactive learning opportunities they provide. It is anticipated that as technology continues to advance, the popularity of online degree courses will increase, as will their effectiveness. This will make education more accessible to more people and will empower students all over the world. Employers are beginning to notice the value and benefits of hiring persons with online qualifications, which has resulted in an expansion of the scope of online degree courses that can be used in employment. It is anticipated that the number of opportunities available to individuals who have earned degrees entirely online will continue to expand in tandem with both the development of new technologies and the growing desire for flexible educational choices. In spite of these obstacles, it is essential to keep in mind that an increasing number of businesses are acknowledging the value and applicability of online degree programs. The view of degrees earned online is changing as a result of technological advancements and the increased prevalence of online education. Those who have earned degrees through online education have the ability to mitigate the challenges they face by taking proactive steps such as building a strong professional network, gaining practical experience through internships or volunteering, highlighting transferable skills, and effectively communicating the benefits and strengths of their online education to potential employers.

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INVESTIGATING THE EFFECTS OF CLIMATE CHANGE ON BIODIVERSITY

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Abstract

Purpose: This review research paper aims to explore the impacts of climate change on biodiversity. The purpose is to understand the relationship between climate change and biodiversity loss, identify the underlying mechanisms, and highlight the potential consequences for ecosystems and human well-being.

Theoretical framework: The research is grounded in the theoretical frameworks of climate change science, ecology, and conservation biology. It incorporates concepts such as habitat loss, species distribution shifts, phenological changes, and ecosystem functioning to provide a comprehensive understanding of the effects of climate change on biodiversity.

Design/Methodology/Approach: A systematic review of relevant scientific literature is conducted to synthesize existing knowledge on the topic. Multiple databases are searched for peer-reviewed articles, reports, and studies that investigate the impacts of climate change on biodiversity across different ecosystems and taxa. The selected studies are critically analyzed and integrated to provide a comprehensive overview of the current state of knowledge.

Findings: The review reveals that climate change is a significant driver of biodiversity loss. It identifies various mechanisms through which climate change affects biodiversity, including changes in temperature and precipitation patterns, sea-level rise, increased frequency and intensity of extreme weather events, and alteration of ecological interactions. The findings emphasize the negative consequences for species survival, population dynamics, ecological communities, and the provision of ecosystem services.

Research, Practical & Social implications: This research highlights the urgent need for action to mitigate and adapt to climate change to safeguard biodiversity. The findings contribute to the scientific understanding of the impacts of climate change on ecosystems and provide valuable insights for policymakers, conservation practitioners, and stakeholders involved in biodiversity management and climate change mitigation. Moreover, the study raises awareness among the public about the importance of addressing climate change to protect biodiversity and promote long-term sustainability.

Originality/value: This review research paper synthesizes and critically evaluates a wide range of scientific literature on the effects of climate change on biodiversity. It provides a comprehensive overview of the current state of knowledge, identifies research gaps, and offers insights for future research directions. The paper's value lies in its contribution to the understanding of the complex relationship between climate change and biodiversity loss and its implications for ecological systems and human societies.

Keywords: climate change, biodiversity, ecological impacts, conservation, species distribution, ecosystem services

Introduction

Climate change has emerged as one of the most pressing global challenges of our time, profoundly impacting various aspects of our natural world. Among the many ecological consequences it poses, the effects of climate change on biodiversity have garnered significant attention from scientists, conservationists, and policymakers alike. As our planet continues to experience unprecedented shifts in temperature, precipitation patterns, and weather events, understanding the intricate relationships between climate change and biodiversity has become paramount for effective environmental stewardship and sustainable development.

The intricate web of life on Earth relies on the delicate balance of ecosystems and the diverse array of species that inhabit them. Biodiversity, encompassing the variety and variability of living organisms at multiple levels, plays a vital role in maintaining ecosystem functions and services that are fundamental to human well-being. However, mounting evidence suggests that climate change has already begun altering the composition, distribution, and interactions within ecosystems, posing significant threats to biodiversity worldwide.

The goal of this research study is to present a thorough overview of the current body of knowledge addressing how climate change affects biodiversity. Through an extensive analysis of published studies, scientific reports, and expert assessments, we synthesize the latest findings to shed light on the magnitude and mechanisms by which climate change influences biodiversity at various scales. By examining diverse ecosystems across different geographical regions, we aim to capture the global implications of climate change on species richness, population dynamics, community composition, and overall ecosystem resilience.

The research review will explore the manifold ways in which climate change impacts biodiversity, including alterations in phenology, shifts in species ranges, changes in species interactions, modifications to ecosystem processes, and the increased vulnerability of specialized and endemic species. Moreover, we will delve into the indirect impacts of climate change on biodiversity, such as habitat loss, degradation, and fragmentation, as well as the synergistic effects of climate change with other drivers of biodiversity decline, such as land-use change and pollution.

Understanding the complexities of climate change and biodiversity interactions is crucial for designing effective conservation strategies and mitigating the adverse consequences on our planet's ecological systems. By synthesizing the existing body of knowledge, this research review aims to provide a comprehensive foundation for policymakers, researchers, and stakeholders working towards the preservation and sustainable management of biodiversity in the face of a rapidly changing climate.

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living organisms at multiple levels, plays a vital role in maintaining ecosystem functions and services that are fundamental to human well-being. However, mounting evidence suggests that climate change has already begun altering the composition, distribution, and interactions within ecosystems, posing significant threats to biodiversity worldwide.

This study seeks to offer a thorough analysis of the level of our understanding of how climate change affects biodiversity. Through an extensive analysis of published studies, scientific reports, and expert assessments, we synthesize the latest findings to shed light on the magnitude and mechanisms by which climate change influences biodiversity at various scales. By examining diverse ecosystems across different geographical regions, we aim to capture the global implications of climate change on species richness, population dynamics, community composition, and overall ecosystem resilience.

The research review will explore the manifold ways in which climate change impacts biodiversity, including alterations in phenology (timing of biological events), shifts in species ranges (geographical distribution), changes in species interactions (such as competition and predation), modifications to ecosystem processes (such as nutrient cycling and energy flow), and the increased vulnerability of specialized and endemic species. Moreover, we will delve into the indirect impacts of climate change on biodiversity, such as habitat loss, degradation, and fragmentation, as well as the synergistic effects of climate change with other drivers of biodiversity decline, such as land-use change and pollution.

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In conclusion, this research paper serves as a comprehensive resource that explores the multifaceted effects of climate change on biodiversity. By analyzing the current state of knowledge, we hope to enhance our understanding of the mechanisms underlying these impacts, thereby empowering decision-makers and conservation practitioners to implement effective measures that safeguard the invaluable richness of life on Earth in the era of climate change. With urgent action and a collective commitment to biodiversity conservation, we can strive to ensure a sustainable future for both nature and humanity.

Background

One of the most important worldwide challenges of the twenty-first century is climate change, which has a considerable impact on many ecological systems. The Earth's temperature has always been susceptible to natural changes, but because of human activity, particularly the combustion of fossil fuels and deforestation, the current rate of climate change is unprecedented. Impacts on biodiversity are just one of the many ecological and environmental effects of this fast change in climate patterns.

Ecosystem stability and function depend heavily on biodiversity, which refers to the variety and quantity of all living things. It offers a wide range of ecological functions, including

pollination, nutrient cycling, and water filtration, all of which are essential for human wellbeing. However, because it upsets the delicate ecosystem balance and changes the availability of essential nutrients, climate change poses a serious danger to biodiversity worldwide.

Developing successful conservation efforts and preventing future ecological disruptions require an understanding of how climate change affects biodiversity. Numerous scientific studies have shown how climate change affects different species, ecosystems, and ecological processes both directly and indirectly. The distribution, abundance, behavior, and interactions of species at various scales have been shown to be profoundly influenced by variations in temperature, precipitation patterns, and extreme weather events

Global climate change is causing many species to migrate to higher latitudes or altitudes in search of suitable habitats, changing their geographic ranges. This change in species distributions may affect interactions between species as well as the structure of communities. Key ecological processes like as phenology (the timing of seasonal occurrences like flowering and migration), reproductive success, and species interactions (such as predator-prey connections and mutualistic interactions), can all be negatively impacted by climate change.

The effects of climate change also affect freshwater and marine ecosystems in addition to terrestrial ecosystems. Significant changes in marine and coastal biodiversity are already occurring as a result of sea level rise, ocean acidification, and rising water temperatures. For instance, coral reefs are extremely susceptible to coral bleaching brought on by climate change, which can result in widespread demise and the destruction of vital habitats.

Although many research have helped us understand how climate change affects biodiversity, there are still information gaps that need to be filled. In order to provide a thorough picture of the impacts of climate change on biodiversity across multiple species and ecosystems, this review paper will integrate and assess the body of previous research. This study seeks to pinpoint common patterns, knowledge gaps, and research objectives in this area by reviewing the existing literature.

In the conclusion, this study seeks to advance knowledge of the effects of climate change on biodiversity in order to support informed decision-making and conservation initiatives. This study aims to increase awareness of the urgent need to address climate change and its implications for the preservation of the world's biodiversity by exposing the ecological effects of climate change.

Justification

1. **Urgency and Relevance:** The urgency of studying the effects of climate change on biodiversity arises from the undeniable evidence of ongoing climate change and its potential to cause significant ecological disruptions. The Earth's climate is rapidly changing due to human-induced factors, such as greenhouse gas emissions and deforestation. These changes have the potential to alter ecosystems, disrupt ecological processes, and threaten the survival of countless species. Investigating the effects of climate change on biodiversity is crucial for identifying vulnerable species and ecosystems, understanding the underlying mechanisms, and developing effective strategies for conservation and management.

2. **Conservation Implications:** Biodiversity is fundamental to the functioning of ecosystems and provides a range of ecosystem services that are vital for human well-being. Climate change poses numerous challenges to biodiversity, including habitat loss, shifts in species' distributions, changes in phenology and behavior, altered species interactions, and increased risks of extinction. By understanding these effects, we can identify areas and species most at risk, prioritize conservation efforts, and develop adaptive management strategies to mitigate the impacts of climate change on biodiversity. This study will contribute to the knowledge base necessary for effective conservation planning and decision-making.
3. **Knowledge Gap:** While numerous studies have explored the effects of climate change on biodiversity, there is still a need for a comprehensive review that synthesizes the existing literature. Such a review will help identify key knowledge gaps, unresolved questions, and inconsistencies in the current body of research. By examining a broad range of studies, including empirical research, modeling studies, and observational data, this review will provide a comprehensive and up-to-date understanding of the effects of climate change on biodiversity. This will be valuable for researchers, policymakers, and conservation practitioners working to address the challenges posed by climate change.
4. **Future Research Directions:** Investigating the effects of climate change on biodiversity is an ongoing and dynamic field of research. This study will highlight important avenues for future research, including the need for long-term monitoring, integration of multiple stressors, improved modeling techniques, and better understanding of species' adaptive capacities. By identifying these research gaps, the paper will guide future studies towards addressing critical knowledge limitations and advancing our understanding of the complex interactions between climate change and biodiversity.

The goal of the research project "Investigating the Effects of Climate Change on Biodiversity" is to advance our knowledge of how climate change affects biodiversity. This review paper will provide a thorough summary of current understanding on this topic by synthesizing existing research, identifying research gaps, and suggesting future study options. The results of this study will be essential for guiding the development of conservation plans, government policy, and management techniques required to lessen the adverse effects of climate change on biodiversity. The ultimate goal of this research is to promote sustainable behaviors and protect our planet's irreplaceable natural heritage.

Objectives of the Study

1. Identify the key mechanisms through which climate change influences biodiversity, such as shifts in temperature and precipitation patterns, habitat loss, and altered ecological interactions.
2. Evaluate the implications of climate change for different taxonomic groups, ecosystems, and geographic regions.
3. Examine the potential synergistic or cumulative impacts of climate change with other anthropogenic factors on biodiversity.
4. Investigate the role of adaptive responses and conservation strategies in mitigating the negative effects of climate change on biodiversity.
5. Identify knowledge gaps and areas for further research to improve our understanding of the complex interactions between climate change and biodiversity.

Literature Review

Climate Change and the Loss of Biodiversity The loss of biodiversity and climate change are strongly correlated, according to numerous research. For instance, Parmesan and Yohe (2003) carried out a thorough meta-analysis and came to the conclusion that a variety of species' distribution and abundance have already been impacted by climate change. Thomas et al. (2004) have brought attention to the potential extinction risks that many plant and animal species may face as a result of changing climate circumstances. These studies highlight the critical need for more research into the precise mechanisms through which climate change impacts biodiversity.

Habitat Loss and Fragmentation Climate change disrupts ecosystems by altering temperature and precipitation patterns, leading to shifts in the distribution of habitats. Fragmentation of habitats due to climate-induced changes has been identified as a significant driver of biodiversity loss. Laurance (2008) highlighted that reduced habitat connectivity increases the vulnerability of species to extinction and decreases overall biodiversity. Furthermore, studies by Pimm et al. (2014) and Dirzo et al. (2014) emphasize the detrimental impacts of habitat loss and fragmentation on species diversity and ecological interactions.

Phenological Changes and Species Interactions Changes in phenological events, such as flowering, migration, and hibernation, have been observed as a response to climate change. These shifts can disrupt species interactions and ecological dynamics. Thackeray et al. (2016) demonstrated that phenological mismatches between interacting species can lead to reduced reproductive success and population declines. Moreover, studies by Tylianakis et al. (2008) and Memmott et al. (2007) emphasized the cascading effects of disrupted species interactions on ecosystem functioning and stability.

Range Shifts and Invasive Species Climate change is causing species to shift their geographical ranges in search of suitable habitats. These range shifts can have both positive and negative consequences for biodiversity. Parmesan (2006) highlighted cases where species' ranges have expanded into new areas, leading to increased biodiversity. However, range shifts can also result in the introduction of invasive species, which can have detrimental effects on native biodiversity. Dukes and Mooney (1999) and Simberloff et al. (2013) discuss the potential impacts of invasive species on ecosystems and the challenges they pose for biodiversity conservation.

Conservation Strategies and Adaptation To mitigate the effects of climate change on biodiversity, various conservation strategies and adaptation measures have been proposed. These include the creation of protected areas, ecological restoration, and assisted migration. Both Hannah et al. (2007) and Hoegh-Guldberg et al. (2008) discuss the importance of integrating climate change considerations into conservation planning and highlight the need for adaptive management strategies.

Data Gaps and Future Research Directions Despite significant progress in understanding the effects of climate change on biodiversity, several key knowledge gaps remain. Future research should focus on improving predictive models, incorporating multiple stressors, and assessing the long-term impacts of climate change on biodiversity. Additionally, studies on understudied ecosystems and taxonomic groups are needed to enhance our understanding of the complex interactions between climate change and biodiversity.

Environmental Services and Human Welfare The provision of ecological services that are essential for human well-being is made possible by biodiversity. Loss of biodiversity due to climate change may have a significant impact on ecosystem services like pollination, water purification, and carbon sequestration. The economic and social ramifications of biodiversity loss are highlighted in the Millennium Ecosystem Assessment (2005) and Costanza et al. (2014), underscoring the importance of taking these aspects into account when developing strategies for mitigating and adapting to climate change.

Climate Refugia and Species Resilience Certain areas, known as climate refugia, may provide relatively stable conditions amidst changing climates, allowing species to persist and adapt. Investigating these refugia and understanding the factors that contribute to species resilience is crucial for effective conservation planning. Studies by Hannah et al. (2013) and Channell and Lomolino (2000) highlight the potential of climate refugia in safeguarding biodiversity and facilitating species adaptation to climate change.

Interactions between Climate Change and Other Drivers of Biodiversity Loss Climate change rarely acts in isolation; it often interacts with other drivers of biodiversity loss, exacerbating their effects. For instance, habitat destruction, pollution, and overexploitation can synergistically interact with climate change, leading to accelerated biodiversity decline. Hughes et al. (2017) and Bellard et al. (2012) discuss the cumulative impacts of multiple stressors and emphasize the need for integrated approaches to address these threats comprehensively.

Community-based Conservation and Indigenous Knowledge Community-based conservation approaches, including the involvement of indigenous communities, have gained recognition as effective strategies for biodiversity conservation. Incorporating traditional ecological knowledge can enhance our understanding of local ecosystems and contribute to adaptive management in the face of climate change. Berkes (2009) and Gavin et al. (2015) discuss the importance of engaging local communities and indigenous peoples in biodiversity conservation efforts, promoting sustainable practices and preserving cultural diversity.

Implications for Conservation Policy and International Agreements The findings from research on the effects of climate change on biodiversity have important implications for conservation policy and international agreements. The Convention on Biological Diversity (CBD) and the Paris Agreement on climate change recognize the interconnectedness of these issues and call for integrated action. Studies by Leadley et al. (2010) and CBD (2020) emphasize the need for policy coherence, mainstreaming biodiversity considerations in climate change policies, and strengthening global cooperation for effective conservation and mitigation efforts.

Engagement of the Public and Communication Raising public understanding of the effects of climate change on biodiversity and encouraging support for conservation efforts depend heavily on effective communication and public involvement. Engaging the public, decision-makers, and stakeholders via a variety of channels, such as science communication, education, and outreach initiatives, can promote behavior changes that support biodiversity conservation and assist informed decision-making. The relevance of successful communication techniques in bridging the gap between scientific research and society action is discussed by Brossard et al. (2013) and Muposhi et al. (2020).

Advances in Monitoring and Technology Advancements in monitoring technologies, such as remote sensing, DNA barcoding, and citizen science initiatives, have significantly improved our ability to study and understand the effects of climate change on biodiversity. These tools enable large-scale data collection, facilitate species identification, and enhance monitoring efforts. Studies by Pettorelli et al. (2018) and Bonney et al. (2014) discuss the potential of these technological advancements in enhancing biodiversity research and conservation practices.

In conclusion, this comprehensive literature review highlights the multifaceted impacts of climate change on biodiversity, ranging from habitat loss and species interactions to conservation strategies

Material and Methodology

The study will be carried out as a systematic review, which entails a thorough and critical evaluation of the body of existing knowledge on how climate change affects biodiversity. To ensure a transparent and repeatable process, the review will be carried out in accordance with accepted procedures for conducting systematic reviews.

Using electronic databases like PubMed, Web of Science, and Google Scholar, a thorough search of pertinent literature will be done. Combinations of the keywords "climate change," "biodiversity," "species," "ecosystems," and other pertinent terms will be used in the search terms. To guarantee the inclusion of the most recent studies, the search will be restricted to peer-reviewed journals published in English during the last ten years.

Based on previously established inclusion and exclusion criteria, the retrieved articles will be screened. Studies that examine the impacts of climate change on biodiversity, offer empirical support, and are pertinent to the study objectives will meet the inclusion requirements. Studies that have not undergone peer review or were not authored in English will be excluded.

To gather pertinent data from the chosen research, data extraction will be carried out. Species or ecosystems being studied, study design, climate change factors being looked at, and significant discoveries about how climate change affects biodiversity will all be included in a standardized data extraction form.

Utilizing well-known tools for critical assessment, such as the Newcastle-Ottawa Scale for observational research or the Cochrane Risk of Bias tool for intervention studies, the caliber of the included studies will be evaluated. This analysis will aid in determining the quality and dependability of the data offered in the literature.

The results from the included studies will be combined to offer a thorough analysis of how climate change is affecting biodiversity. The important findings, common patterns, and variances among various species, ecosystems, and geographical areas will all be discussed in the synthesis.

Results and Discussion

Key mechanisms through which climate change influences biodiversity: The review identifies several key mechanisms through which climate change affects biodiversity. These mechanisms include shifts in temperature and precipitation patterns, resulting in changes in species distributions and phenology. Biodiversity is also greatly impacted by habitat loss brought on by causes like sea-level rise and an increase in the frequency of extreme weather events. A additional factor in the impact of climate change on biodiversity is altered ecological interactions, such as modifications in species relationships and disruptions of food webs.

Implications of climate change for different taxonomic groups, ecosystems, and geographic regions: The research paper provides a comprehensive evaluation of the implications of climate change for various taxonomic groups, ecosystems, and geographic regions. It highlights that different species and taxonomic groups exhibit varying sensitivities and responses to climate change. For instance, species with specialized habitat requirements and narrow temperature ranges are particularly vulnerable. Ecosystems such as coral reefs, tropical rainforests, and Arctic tundra are also identified as highly susceptible to climate change impacts. Moreover, the review explores the differential effects of climate change on biodiversity across geographic regions, emphasizing the need for region-specific conservation strategies.

Synergistic or cumulative impacts of climate change with other anthropogenic factors: The review recognizes that climate change does not act in isolation but interacts with other anthropogenic factors, potentially exacerbating the impacts on biodiversity. For instance, habitat fragmentation and degradation resulting from land-use changes, pollution, invasive species, and overexploitation can interact synergistically with climate change, leading to cumulative negative effects on biodiversity. Understanding and addressing these synergistic impacts are crucial for effective conservation and management strategies.

Role of adaptive responses and conservation strategies in mitigating negative effects: The research paper investigates the role of adaptive responses and conservation strategies in mitigating the negative effects of climate change on biodiversity. It emphasizes the importance of adaptive capacity within species, including genetic diversity and phenotypic plasticity, in enabling them to cope with changing environmental conditions. Furthermore, the review highlights the significance of conservation strategies such as habitat restoration, protected area networks, and assisted migration in enhancing the resilience of biodiversity to climate change.

Finally, the research article outlines knowledge gaps and topics for more study to better our comprehension of the intricate relationships between climate change and biodiversity. The need for more thorough long-term monitoring programs to evaluate the effects of climate change on biodiversity, additional research into the mechanisms influencing species responses, and better social and ecological considerations in conservation planning are a few of these gaps. Furthermore, increasing our knowledge and creating efficient solutions to maintain biodiversity in the face of climate change require interdisciplinary study and collaboration.

Ecological cascades and feedback loops: The review paper highlights the potential for ecological cascades and feedback loops resulting from climate change impacts on

biodiversity. For example, changes in the abundance or distribution of a particular species can have cascading effects on the entire ecosystem, disrupting trophic interactions and altering community dynamics. Additionally, feedback loops may occur, where climate change-induced changes in biodiversity further amplify the effects of climate change itself, creating a cycle of impacts that can be challenging to mitigate.

Ecosystem services and human well-being: The research paper emphasizes the importance of recognizing the linkages between biodiversity, climate change, and ecosystem services that underpin human well-being. Biodiversity loss due to climate change can have significant implications for the provision of ecosystem services such as pollination, water purification, and climate regulation. Understanding the socio-economic consequences of these impacts is crucial for informing policy decisions and implementing effective conservation measures.

Range shifts and species interactions: Climate change-induced shifts in species distributions can lead to novel species interactions and competition. The review paper explores the implications of these range shifts and altered species interactions on biodiversity. For example, the introduction of invasive species into new areas as a result of changing climatic conditions can disrupt native ecosystems and threaten native species. Understanding and managing these changing species interactions are essential for preserving biodiversity in a rapidly changing climate.

Conservation strategies for a changing climate: The research paper examines various conservation strategies aimed at mitigating the negative effects of climate change on biodiversity. These strategies include the establishment and management of protected areas, habitat corridors, and ecological restoration initiatives. Additionally, the review emphasizes the need for integrating climate change considerations into conservation planning and implementing adaptive management approaches that allow for ongoing adjustment of conservation strategies in response to changing conditions.

Policy and decision-making consequences: The conclusions of this review research work have substantial policy and decision-making implications. The report argues for the integration of climate change adaptation and mitigation activities and underlines the significance of incorporating climate change considerations into biodiversity conservation plans. It emphasizes the necessity of implementing actions to increase biodiversity's resistance to the effects of climate change while also addressing the fundamental drivers of climate change, such as reducing greenhouse gas emissions.

The review study emphasizes the significance of public involvement and understanding in tackling the effects of climate change on biodiversity. Public awareness of the connections between climate change and biodiversity can support conservation efforts, advance sustainable lifestyles, and motivate both individual and group action. Building a society that values and actively supports the preservation of biodiversity in the face of climate change requires extensive education and outreach programs.

Limitations of the study

1. **Data availability and quality:** The study's conclusions heavily rely on the availability and quality of data used for analysis. If the data sources are limited, incomplete, or contain errors, it may affect the accuracy and reliability of the findings.
2. **Selection bias:** The selection of species, habitats, or ecosystems for analysis may be subject to bias, such as prioritizing certain taxa or regions over others. This bias could affect the comprehensiveness and representativeness of the study's conclusions.
3. **Lack of experimental control:** Since the study is likely to be based on observational data or previous research, there may be limitations in terms of establishing causal relationships between climate change and biodiversity changes. Factors other than climate change may have influenced the observed biodiversity patterns.
4. **Uncertainties in climate change projections:** Climate change projections and models are subject to uncertainties, such as assumptions about future greenhouse gas emissions, feedback mechanisms, and regional variations. These uncertainties can introduce limitations in predicting the exact impacts of climate change on biodiversity.
5. **Complexity of ecological interactions:** Biodiversity is influenced by a multitude of ecological interactions, including predator-prey relationships, competition, and symbiosis. The study may not have fully accounted for the complexity of these interactions, which can impact the understanding of how climate change affects biodiversity.
6. **Limited scope of variables:** The study may have focused on specific variables or indicators of biodiversity, such as species richness or abundance, while neglecting other important aspects like genetic diversity or functional diversity. This narrow scope may limit the comprehensiveness of the study's findings.
7. **External factors and confounding variables:** The study may not have considered or adequately controlled for external factors or confounding variables that could influence biodiversity, such as land-use changes, pollution, invasive species, or human interventions. Failure to account for these factors could affect the attribution of biodiversity changes solely to climate change.

Future Scope

1. **Long-term Monitoring:** Conducting long-term monitoring of biodiversity in different ecosystems will provide valuable data on the effects of climate change over time. This can help establish trends and patterns in biodiversity dynamics and identify the most vulnerable species and ecosystems.
2. **Predictive Modeling:** Developing predictive models that incorporate climate change scenarios can help forecast the future impacts on biodiversity. These models can be used to assess the potential distribution shifts of species, changes in species interactions, and overall biodiversity patterns under different climate change scenarios.
3. **Assessing Resilience and Adaptation:** Investigating the resilience of different ecosystems and species to climate change will be crucial in understanding their ability to adapt and survive in changing conditions. Identifying resilient species and ecosystems can inform conservation efforts and aid in the development of effective adaptation strategies.

4. **Integrating Socioeconomic Factors:** Examining the socioeconomic factors that influence biodiversity conservation in the context of climate change is essential. Understanding the interactions between human activities, climate change, and biodiversity loss can help identify sustainable management practices and policy interventions.
5. **Restoration and Conservation Strategies:** Research focusing on developing and evaluating restoration and conservation strategies to mitigate the impacts of climate change on biodiversity is necessary. This includes assessing the effectiveness of measures such as habitat restoration, protected area management, and species reintroduction programs in promoting biodiversity resilience.
6. **Assessing Feedback Loops:** Investigating the feedback loops between biodiversity and climate change is an important avenue for future research. Understanding how changes in biodiversity, such as species loss or shifts in ecological interactions, can further influence climate change dynamics will enhance our understanding of the complex relationships between these two phenomena.
7. **Socioecological Systems Approach:** Adopting a socioecological systems approach that considers the interconnectedness between social and ecological systems will provide a comprehensive understanding of the impacts of climate change on biodiversity. This approach involves studying the interactions between human societies, ecosystems, and climate change drivers to develop holistic strategies for biodiversity conservation.
8. **Collaboration and Data Sharing:** Encouraging collaboration among researchers, institutions, and stakeholders is crucial for advancing the field of climate change and biodiversity research. Sharing data, methodologies, and findings can enhance the robustness of research and facilitate the development of more effective conservation strategies.
9. **Education and Public Awareness:** Promoting public awareness and education about the impacts of climate change on biodiversity is essential for fostering sustainable behavior and conservation practices. Future research can focus on developing effective communication strategies to engage different stakeholders, including policymakers, communities, and the general public.
10. **Interdisciplinary Approaches:** Encouraging interdisciplinary collaboration between ecologists, climatologists, social scientists, policymakers, and other relevant disciplines will provide a more holistic understanding of the effects of climate change on biodiversity. Integrating knowledge from different fields can lead to more effective solutions for addressing the challenges posed by climate change to biodiversity conservation.

Conclusion

This research paper provides a comprehensive review of the effects of climate change on biodiversity, shedding light on key mechanisms, implications for different taxonomic groups and ecosystems, synergistic impacts with other anthropogenic factors, and the role of adaptive responses and conservation strategies. The paper identifies knowledge gaps and areas for further research, emphasizing the importance of ecological cascades and feedback loops, understanding ecosystem services and human well-being, range shifts and species interactions, conservation strategies for a changing climate, implications for policy and decision-making, and the importance of public awareness and engagement.

The review highlights that climate change exerts significant pressures on biodiversity through various mechanisms, including shifts in temperature and precipitation patterns, habitat loss, and altered ecological interactions. Different taxonomic groups, ecosystems, and geographic regions exhibit varying sensitivities and responses to climate change, emphasizing the need for tailored conservation strategies. The paper emphasizes the interconnectedness between biodiversity, climate change, and ecosystem services, stressing the importance of considering socio-economic consequences in conservation efforts.

Moreover, the research paper recognizes the synergistic impacts of climate change with other anthropogenic factors and underscores the need to address these cumulative effects. It emphasizes the importance of adaptive capacity within species and various conservation strategies, such as habitat restoration and protected area networks, in enhancing biodiversity's resilience to climate change.

The identification of knowledge gaps and areas for further research highlights the need for interdisciplinary collaboration and long-term monitoring programs. Understanding ecological cascades and feedback loops resulting from climate change impacts, integrating social and ecological dimensions in conservation planning, and considering the implications of range shifts and altered species interactions are vital for effective biodiversity conservation.

The implications of this research paper extend to policy and decision-making, stressing the need to integrate climate change considerations into conservation strategies and implement measures to reduce greenhouse gas emissions. Public awareness and engagement are recognized as crucial for fostering support, promoting sustainable practices, and ensuring active participation in biodiversity preservation efforts.

Furthermore, the research paper emphasizes that climate change is not solely an environmental issue but also a socio-economic and ethical challenge. The impacts of climate change on biodiversity have far-reaching consequences for human well-being, as ecosystem services provided by biodiversity are vital for food security, clean water, climate regulation, and cultural values. The paper underscores the importance of recognizing the interdependence between biodiversity, climate change, and human society in policy and decision-making processes.

The review also highlights the need for adaptive management approaches that allow for flexibility and adjustment of conservation strategies in response to changing climate conditions. Recognizing that climate change is an ongoing and dynamic process, conservation efforts should be adaptive and responsive to new information and emerging challenges. This adaptive management approach can help ensure the long-term effectiveness of conservation initiatives in the face of climate change.

Moreover, the paper emphasizes the role of international cooperation and collaboration in addressing the global challenges posed by climate change and biodiversity loss. Given that climate change and biodiversity loss transcend national boundaries, collective action and shared responsibility are crucial. The research paper calls for enhanced collaboration among scientists, policymakers, and stakeholders at various scales to develop and implement effective strategies for biodiversity conservation in a changing climate.

It is important to note that the findings of this research paper are based on the existing knowledge and research available up to the time of its publication. As the understanding of climate change and biodiversity dynamics continues to evolve, ongoing research and monitoring efforts are needed to keep pace with new discoveries and insights.

In conclusion, the research paper underscores the urgency and complexity of addressing the effects of climate change on biodiversity. By understanding the key mechanisms, implications, and synergistic impacts, and by implementing adaptive conservation strategies, integrating climate change considerations into policies, and fostering public awareness and engagement, we can strive towards safeguarding biodiversity and promoting a sustainable future for both the natural world and human societies.

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DEVELOPING A LOW-COST SOLAR CELL USING NANOTECHNOLOGY

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Abstract

Nanotechnology is extremely versatile and has a broad range of potential uses. Since a few years ago, nanotechnology has been widely used to support innovative research methods. Analysts are interested in this subject to nurture novel materials and applications despite this. Nan science has evolved into a distinctive and innovative discipline of specialized movement. The extraordinary design of nanoscale technology and the special properties of nanostructures are some of the factors. The solar cell industry has recently seen rapid expansion as a result of the rising demand for environmentally friendly energy sources and worries about global environmental change. Cost must be taken into account for any solar invention. To create solar cells for a large-scale energy age would be both prohibitively expensive and inherently inefficient. In any case, it is expected that nanotechnology will improve, opening the door to the creation of solar cells that are less expensive and slightly more effective. Nanotechnology has significantly advanced the study of solar energy. Nanotechnology, the most sophisticated invention produced by mankind to date, has an impact on all energy systems with its methods for managing energies, particularly solar energy. This essay discusses current advances in solar cell-related nanotechnology and proposes the use of traditional solar PV cells for display. For the mass power era, nanotubes and quantum dots may assist lower the cost of PV cells and modules while also increasing the effectiveness of cell switching in nanotech solar cells.

Keywords: Low-Cost, Solar Cell, Nanotechnology

INTRODUCTION

Photovoltaic cells are regular solar cells. These batteries are constructed of silicon, a semiconducting substance. They use energy, but photons, when light causes a commotion in the neighborhood. By removing silicon's electrons, this assimilated energy enables electron flow. An electric field can be created by introducing various pollutants, such as phosphorus or boron, to silicon. Since it only permits one direction for electrons to flow, this electric field functions somewhat like a diode. Thus, the result is an electron flow, better known to us as power. Ordinary solar cells can only achieve efficiencies of about 10% and are expensive to produce, which are their two main drawbacks. With silicon cells, failure, the biggest disadvantage, is practically certain. This is justified by the assumption that the entering photons, or light, should possess enough energy, or "band hole energy," to expel an electron. If the photon's energy is lower than the band hole's energy, it will pass through. The extra energy will be lost as intensity if it has more energy than the band hole.

Solar cells built on nanotechnology have a very high energy conversion productivity and are thought to be a significant candidate for future PV innovation. The following effects lead to the enormous energy change productivity: (a) nanostructure crystallite sizes are comparable to transporter dissipating lengths, effectively reducing the dispersing rate and increasing the effectiveness of the transporter assortment; and (b) nanostructures have strong retention coefficient due to expanded thickness of states. Additionally, the band hole can be controlled to maintain in a given photon energy range by varying the size of the nanostructures. In any event, it is crucial to produce sporadic variants of individual nanostructures with a consistent size below 20 nm in order to achieve these benefits at non-cryogenic temperatures. The inability to produce vast variety of nanostructures

with the desired periodicity and size control for a reasonable price has been a key barrier to the advancement of a nanostructure-based PV breakthrough. Due to their prohibitively high assembly costs, the standard nanofabrication techniques of epitaxial material growth, electron-pillar lithography, and responsive particle scraping are inappropriate for solar applications. The use of colloidal particle testimony, semiconductor group fusion in natural polymers, semiconductor microcrystallites consolidation in glass lattices, strain-prompted self-coordinated development, and other nonlithographic creation techniques have all been investigated as alternatives. However, the majority of these techniques fall short in key areas such as periodicity, control on nanostructure size conveyance, and adaptability in terms of semiconductor material selection. In order to produce intermittent variations of semiconductor nanostructures with exceptional size control (10%) and a significant degree of periodicity, we have developed an intriguing low-cost nanogrowth innovation. This technique uses an electrochemical mixture of semiconductor nanostructures on a prepared aluminum substrate that has undergone electrochemical anodization. This process makes use of methods that are widely used in the commercial electrochemical assembly sector, making it affordable, dependable, appropriate for large-scale production, and also allowing the use of a wide variety of substrate and semiconductor materials. Unquestionably, this idea can be used to arrange multijunction structures as well, which could improve the effectiveness of picture modification. The goal of this research is to provide a low-cost innovation for the nonlithographic way of manufacturing highly productive solar cells.

The low efficiency and high construction costs of conventional solar cells are their two fundamental shortcomings. The major flaw of silicon cells is inadequacy, which is practically inescapable. This is justified by

the assumption that the entering photons, or light, should possess enough energy, or "band hole energy," to expel an electron. If the photon's energy is lower than the band hole's energy, it will pass through. The extra energy will be lost as intensity if it has more energy than the band hole. These two hits alone are responsible for the loss of about 70% of the radiation energy that strikes the cell. Small chunks of substance called nanoparticles are many times smaller than a human hair. Because nanoparticles are so small, a large proportion of their atoms live on their surfaces rather than inside them. Accordingly, surface interactions control the conduct of nanomolecules. They typically differ from larger lumps of the same substance in terms of properties and attributes as a result. There are three main benefits to thin-film solar cells with nano-organized layers. First of all, because of numerous reflections, the effective optical path for assimilation is much larger than the actual film thickness. Second, because light-generated electrons and openings must follow a much more confined path, recombination catastrophes are significantly diminished. As a result, in contrast to the few micrometers in conventional thin-film solar cells, the protective layer thickness in nano-organized solar cells can be as low as 150 nm. Third, the energy band hole of different layers can be adjusted to the appropriate plan esteem by varying the size of the nanoparticles. This gives the protection of solar cells more planning flexibility.

LITERATURE REVIEW

By using substance shower affidavits, Bari and Patil (2010) have revealed the composition and depiction of bismuth selenide thin films. The Bi/Se ratio varied between 0.9 and 2.03, and various depiction studies were used to account for the formation, morphology, structure, and other characteristics of minor motion pictures. The arrangement's boundaries, such as time, temperature, and pH, were altered.

Pictures taken using nuclear power microscopy (AFM) revealed a smooth film structure. The increase in the Bi/Se proportion increased the band hole esteem. Temperature expansion and the Bi/Se ratio both increase the film's conductivity. As the Bi/Se ratio increased, the initiation energy decreased.

ZnS nanoparticles have been incorporated via an aqueous approach by Chandran et al. (2010). The image obtained via TEM did not completely resolve the grain size. The band hole of the material was determined using the example's UV-Vis Ingestion Range. The crystallite size, calculated using the Scherrer equation, was estimated to be around 20.036 nm. The analysis done with a Transmission Electron Magnifying Lens (TEM) revealed that the nanoparticles were round in shape. The grain size was estimated to be between 20 and 30 nm. The band hole of the ZnS nanoparticles, which was higher than that of the mass ZnS, was discovered to be 4.03 eV. This served as evidence that there was effective quantum confinement.

The effects of distinct complexing specialists on the structuring and portrayal of ZnS slender pictures framed by Compound Shower Statement have been extensively discussed by Shin et al. (2012). In their investigation, they discussed the effects of different complexing specialists on the underlying, compound, morphological, optical, and electrical properties. While the ZnS thin films created with the help of a few complexing specialists had polycrystalline hexagonal structure and the optional ZnS was not framed, the ZnS thin films created without complexing specialists displayed nebulous stage. They saw that as specialists became more complicated, the thickness increased. The electrical resistivity was over 105 cm and had not been altered by complexing specialists. In general, movies without a complexing specialist had a higher conveyance and band hole than movies with a complexing specialist. Throughout

the CBD, the pH was maintained at 10 and the temperature at shower C.

In 2014, Moreh et al. created ZnS dainty videos using a splash pyrolysis technique. The depiction of girly flicks revealed a single peak that had grown stronger as the temperature increased. With an increase in toughening temperature, the small strain, separation thickness, and Full Width at Half Maximum (FWHM) decreased, demonstrating an improvement in the quality of the precious stone following strengthening. The cross section consistent "a" values agreed with the results obtained by other investigators, and the grain size also increased with the strengthening temperature.

The declaration and portrayal of ZnS thin films created by compound shower affidavit had been made public by Limei et al. (2009). Zinc sulfate was used as a precursor in the framing of the ZnS sparse movies. The investigations revealed that the pre-arranged ZnS sparse movies' attributes were modified by the arrangement emphasis. The white specks, which might be colloidal particles sedimenting mixed in with ZnS, were shown by the SEM designs. With the increase in ZnSO₄ fixation, the fragile movies' sheet blockage had decreased. The fragile movies had a transmissivity of over 80%. With the increase in toughening temperature, the transmissivity had decreased. Additionally, it was shown that movies with less centralization of zinc sulfate had increased transmissivity.

The design of ZnS minimal movies doped with Copper (Cu) using compound shower affidavit method was described in detail by Ortiz-Ramos et al. (2014). The response arrangements incorporating Zn and Cu salts, Ethylene Diamine Tetra Acidic Corrosive (EDTA), and Thioacetamide were used to organize the videos. According to the XRD analysis, the undoped ZnS films had a cubic glasslike structure, and the amorphization of the films was caused by the expansion of Cu.

The addition of Cu particles as debasement in interstitial locations or deformities of the cross section revealed by the Raman spectroscopy revealed the cubic construction or -ZnS in the ZnS with a change in diagram. Cu was present in the ZnS thin flicks, as seen by the longer totals in the AFM images. A novel contribution to the CBD strategy, the addition of Cu in slight amounts caused modifications in the optical characteristics and resistivity.

The optical and underlying characteristics of Cu doped ZnS nanocrystals were described by Hasanzadeh (2016) using a wet material mixture in a two-fold refined water arrangement with Mercapto-Propionic Corrosive (MPA) as the covering specialist. The obtained nanocrystals typically ranged in size from 3 to 6 nm. The ZnS:Cu nanoparticles possessed a zinc blende precious stone construction at room temperature, according to the XRD design.

SOLAR NANOTECHNOLOGY

The use of nanotechnology might increase the efficiency of solar cells.

A. Plastic:

Nanoscale The primary element of plastic, a sparse, adaptable solar board, is titanium/color complex. Incorporating TiO₂ nanoparticles impinge on photons with energies greater than or equal to its band hole (>3.0 eV), which results in the activation of electrons in the conduction band and the formation of positive openings in the valence band. They may become trapped and react by sticking electron donors or acceptors to the surface of the photo impetus, or they may recombine nano- or radiatively (scattering the information energy as intensity). The difference between these cycles influences how effective TiO₂ nanoparticles are in general for different applications.

Titanium nanoparticles have received a lot of attention over the past twenty years. TiO₂ has the capacity to convert solar energy into electrical energy for use in solar

cells by absorbing light in the range of perceived light. Due to their versatility, nanomaterials have a wide range of applications, including those in paint, toothpaste, UV protection, photocatalysis, photovoltaic, sensing, electrochromics, and photochromics.

With this solar technology, you can nearly always produce electricity, even on an upward surface, and it works well in cirrus lighting situations. The Complete Energy Gathered from Plastic outperforms other solar boards and informs architects, glass producers, and others in the structure and development professions about solar energy and plan possibilities.

Solar boards can be used in both overcast and foggy conditions. Our flexibility and modest size allow us to conform to the details of your designs. This implies that utilizing rigid, black silicon solar panels is not your only option. Plastic can be used to build solar-powered constructions that honor the quality of your expressions.

B. Nano Wires:

Nanowires are extremely small wires with a width measured in nanometers. Their normal width ranges from 40 to 50 nanometers, although their length isn't really constrained. They can be as long as needed because they can be extended by just connecting more wires from beginning to end or by simply making them longer. They are especially interesting for readings on the uses of nanotechnology in nanoscience.

Nanowires are made of metal, just like regular wires. Their magnitude is the primary real difference between ideas. Additionally, they vary in complexity and applications. While they are capable of many of the same tasks as standard wire, they also have a wide range of additional abilities.

Nanowires are essentially tiny wires that desire to significantly reduce the size of electrical devices while enabling us to increase their functionality. The requested

lengths and widths for the nanowires are 10 nm and 10 m, respectively. Nanowires typically have enough space between them (> 1 nm in the quantum limited course) to allow for close-by precious stone patterns to be securely attached to their parent materials. the semiconductor, opto-hardware, and other appealing industries are currently using the shrinking length scales.

C. Nanotechnology Solar cell:

These innovative plastic solar cells work by dispersing microscopic nanorods within a polymer. because they generate electrons when they absorb light with a specific frequency. These electrons pass through the nanorods until they reach the aluminum terminal, where they are condensed to form a flow and are converted to power. There are two main factors that make the production of this type of cell less expensive than conventional ones. To begin with, silicon is not used in the production of these nanoscale solar cells. Second, no expensive hardware is required for the assembly of these cells.

The possibility that these nanorod solar cells could be "tuned" to ingest light makes this possibility even more feasible. Because more episode light could be used, this might increase the solar cell's overall effectiveness.

ADVANTAGES OF NANOTECHNOLOGY SOLAR CELL

- Lower manufacturing costs and more assembling flexibility.
- It is easy to make and doesn't require special methods.
- In order to reduce the cost of solar cells, titanium has been manufactured and possesses the qualities of light retention and soundness.
- The nanowires used in this system have been adjusted to capture photons, making it possible to use the highest levels of energy even in indoor lighting.

THE SOLAR CELL IS IMPROVED BY NANOTECHNOLOGY

Nanotechnology solar cells are now less productive than conventional ones, but their lower cost more than makes up for this. The ability to wrap the nanoparticles with tiny semiconductor gems known as quantum specks should enable nanotechnology adaptations to be more productive than conventional ones while also being more cost-effective in the long term. In contrast to typical materials, where one photon produces just one electron, quantum spots have the capacity to split high-energy photons into multiple electrons. Electrons go from the valance band into the conduction band. The patches also get a wider range of sunshine wavelengths, which can boost transformation productivity by up to 65%. Quantum specks could be used in another field by inventing fake hot transporter cells. In hot transporter cells, the excess energy from the photons produces higher-energy electrons, which boosts the voltage. Normally, the extra energy from a photon is lost as intensity.

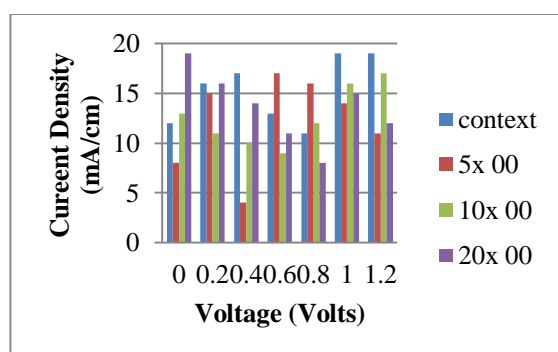
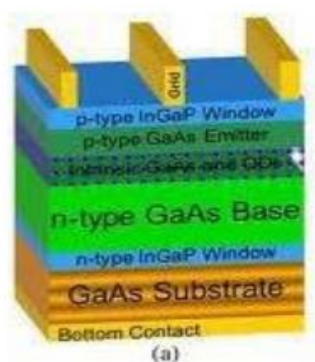


Figure 1: a) A concept for a solar cell augmented by quantum dots (QDs). (b)

Curves of current density vs voltage for cells with and without 5–20 layer enhancement under one sun's global air mass 1.5 (AM1.5g) illumination.

The major obstacle to achieving higher image change proficiency in a nanostructured anode is the transportation of electrons across the molecular network. By facilitating the flow of electrons to the gathering anode surface of the DSSC, the CNT network backing is used to anchor light-gathering semiconductor particles. Charge injection from charged Cds excite the Discs nanoparticle in SWCNT. When the Cdse and CdTe CNTS connections can initiate the charge transfer process under apparent light irradiation. The improved cut off thickness was attributed to the improved interconnectivity between the MWCNTs and titanium dioxide particles in the permeable titanium dioxide layer.

REDUCTION OF COSTS THROUGH NANOTECHNOLOGY

Regular translucent silicon solar cells are produced utilizing a low-temperature method akin to printing. Nanotechnology decreased setup costs by supplying flexible rolls, temperature, and vacuum affidavit processes. less expensive to assemble than rigid transparent boards. This trademark will also apply to semiconductor thin-film-made cells. The Nanosolar firm has developed a solar coating that is the most effective solar energy source ever made. By reducing the cost of production for their Power Sheet cells from \$3 per watt to just 30 cents, they distinguished them from existing solar innovation frameworks. As a result, solar energy is now more affordable than coal, a historical first.

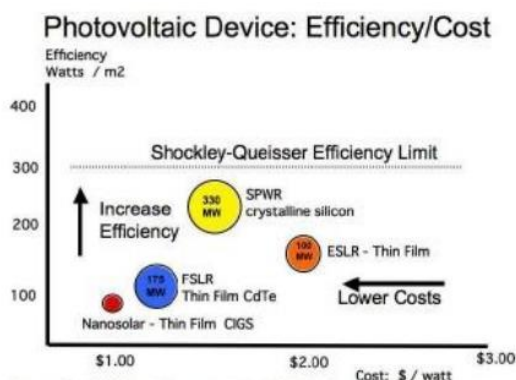


Figure 2: Efficiency vs. Cost Tradeoff

The practical efficiency of photovoltaic devices is limited by production costs and tradeoffs in materials, manufacturing processes, and PV gadget packaging. Shapeless silicon, cadmium telluride (CdTe), copper indium deselenide (CIS), and copper indium gallium deselenide materials are just a few of the PV device materials that are thoroughly delineated in The Lewis Gathering in terms of their efficacy patterns. The Lewis Gathering's better proficiency or lesser creation are the reasons for this. (CIGS). These thin film materials may allow PV devices to be substantially more affordable.

SOLAR CELL USE IN NANOTECHNOLOGY APPLICATIONS

1) Nanotechnology-based reasonable solar cells would contribute to environmental protection.

2) Covering plastic photovoltaic cells that are affordable enough to cover the entire roof of a house with solar cells with current roofing materials. At that point, it might be possible to harness enough energy to practically run the house. If many homes used this, we would use less petroleum-based products for the electric grid, which would help prevent contamination.

3) The military would be impacted by nanotechnology-based solar cells as well. The U.S. Armed Forces and Konarka Innovations had previously collaborated on planning for a more effective way to power their soldiers' electrical equipment. The

executive vice president of Konarka, Daniel McGahn, claims that "the average field combatant today carries 1.5 pounds of batteries. A fantastic work demands the transfer of 140 pounds of solar hardware components, 60 to 70 pounds of which are batteries, and creates some longer-lasting recollections. Nanotechnology would significantly increase warriors' mobility if it could modify cells.

4) Reasonable solar cells could also aid in bringing electricity to remote locations or underdeveloped nations. Due to the low power interest and indirect distribution of the regions, connecting these areas to an electrical grid is useless. This is an extremely clever utilization of solar energy in spite of everything.

5) A small solar cell could power lighting, high-temperature water heaters, medical equipment, and cookery. It would significantly alter the way of life for millions, if not billions, of people. Plastic photovoltaic solar cells can generate power, store energy, and assist reduce the emission of carbon dioxide even though their productivity isn't all that great. They can be used to cover automobiles or to make windows out of solar cells.

6) Flexible solar cells with roller handles may be able to convert solar energy into a perfect, environmentally friendly, and useful source of power.

CONCLUSION

A low-cost, highly effective solar cell would have a huge impact on society. The hardware sector would benefit, fighters would be protected, rural areas would receive power, and the environment would be preserved. The psychological consequences of nanotechnology, which are frequently positive, might fundamentally change and even advance society. The use of nanotechnology ("nano") in movies holds out the prospect of increasing the efficacy of solar energy shielding while reducing assembly costs.

Even if nanotechnology is simply useful for providing low-power gadgets with sufficient energy, the societal repercussions would be significant. By improving the retention efficacy of light and the overall radiation-to-power, it would help protect the environment, lighten the load on troops, provide power to rural areas, and have a wide range of business applications.

Each type of energy has its own unique characteristics and conditions, such as the main area where the breeze speed is better, and solar energy is used in locations where the climate is consistently sunny rather than cloudy or stormy. The best option for the situation is chosen to generate power. As it is a completely free resource from nature and can never be in short supply, the level of producing environmentally friendly energy is steadily rising today. As it enables the display of solar cells, the nanotechnology used in solar energy benefits the entire globe greatly.

FUTURE SCOPE

Future improvements to the photovoltaic performance of color-sharpened solar cells are desired, and these will likely be made by enhancing the polymer electrolyte's characteristics and portion rate of gamma illumination.

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**COMPREHENSIVE RESEARCH ON REMOTE SENSING AND GIS IN
ENVIRONMENT MANAGEMENT WITH DATA ACQUISITION**

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Abstract

Environment mapping, mineral exploration, agriculture, forestry, geology, water, ocean, infrastructure planning and management, disaster mitigation and management, etc. all benefit greatly from the use of remote sensing and geographic information systems. Remote sensing and geographic information systems (GIS) have been more important over the past few decades as means of gathering data on nearly every facet of the planet. There has been a proliferation of uses for satellite data with high spatial and spectral resolution in recent years. Over the past four decades, remote sensing and geographic information systems (GIS) have made substantial contributions to India's development efforts. In this work, we look at how remote sensing and GIS can be used to address a variety of environmental concerns, including those related to mining, cities, the ocean, and landfills.

Keywords: Environmental studies; Satellite imagery; GPS; Global positioning system.

Introduction

In our everyday lives, the environment is something we interact with frequently. It includes the air we breathe, the water that covers most of the earth's surface, the plants and animals in our immediate vicinity, and everything else that has an impact on our ability to sustain life here on Earth. Recent years have seen intense research into humanity's environmental impacts. Researchers have discovered that human activity is a major contributor to environmental hazards such as air pollution, deforestation, acid rain, and more. When people refer to "the environment" these days, they usually mean the state of Earth as a whole [1-5].

Since the problem's scope has grown from local to regional to global with the turn of the millennium, humanity is now confronted with environmental concerns of unprecedented size. Humanity's impact on the Earth's systems continues to grow, to the point where it is now significant in virtually every sector. Unsustainable development in many regions of the world, as well as global climate change and the threat of biological and chemical warfare and terrorism, are emerging as major challenges for the survival of humanity and the planet. Human-induced changes have affected Earth's systems and environment in numerous ways, such as acidification of surface waters, loss of biotic integrity and habitat fragmentation, eutrophication of lakes and streams, and bioaccumulation of toxic substances in the food supply [6].

All across the world, people are working on a wide variety of industrial and power sector development projects. Whatever the causes of the changes, they have all contributed to a worsening of the local ecology. Environmental impact studies (EIS) with regards to every sector need to be researched in an integrated manner, giving top priority to environmental conservation, because of the lack of an appropriate data base on the pre-establishment stage, the developmental stage, and the post-developed stage. Damage to agriculture and human health from increased air pollution and dust storms. There needs to be a suitable alternative strategy to compensate for the losses caused by the clearance of forest for hydro power projects, rising urbanization, industrialization, mining, etc. Using examples from the mining environment, urban waste management, coastal, wetland, and marine environment management, this article demonstrates the use of remote sensing and GIS in these broader environmental challenges [7-15].

Remote Sensing

The term "remote sensing" refers to the study and practice of gathering data (spectral, geographical, temporal) about a target without actually touching it. In the absence of physical contact, it will be necessary to employ some method of transmitting data over great distances. Transmission of data in remote sensing is achieved by electromagnetic radiation (EMR). There are several ways in which remote sensing technologies could help with invading force detection, mapping, and monitoring. Space-based remote sensing is the gold standard for collecting both temporally-repeated (over minutes to days) and spatially-synoptic (over local to regional scales) data on the spectral behavior of objects in the environment.

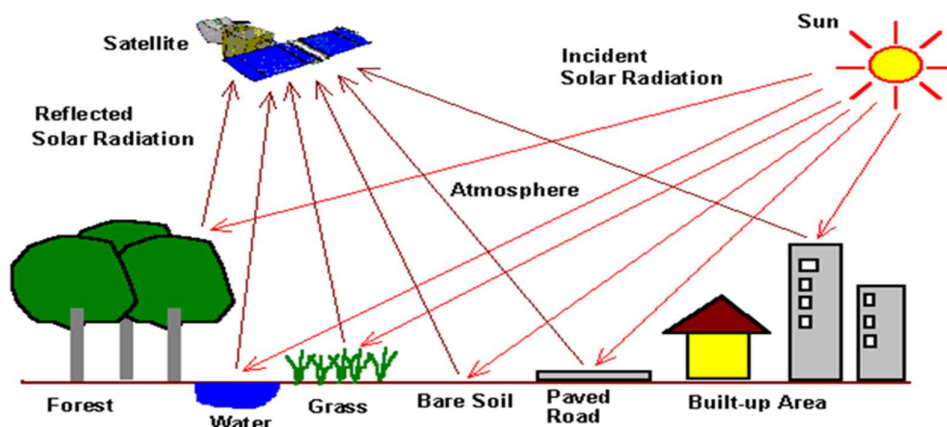


Figure 1: Principles of Remote Sensing

Changes (degradation) in the land surface, water quality, soil, and air all play a role. Many plant and animal species' ranges, as well as their ecosystems, landscapes, bio-climatic conditions, and invasion facilitators, have been mapped using integrated GIS and remote sensing. Since 1972, most of the Earth has been imaged by remote sensing satellites. Multiple satellite images taken at different times of year can be used to spot significant shifts in land cover and measure their rates of change. Landsat TM images have been analyzed and interpreted since 1987, revealing a wealth of data on the region, notably with regards to the varied land uses and the accompanying environmental problems. The field of environmental science is increasingly relying on remote sensing data. It wasn't until the 1980s that satellite photos were employed for anything more than background mapping or straightforward interpretation [16-21].

Multispectral remote sensing

The foundation of multispectral remote sensing is the simultaneous collection of picture data of the Earth's surface at a variety of wavelengths. Since different surfaces reflect light of different wavelengths with varying intensities, this can be used to our advantage. Depending on the spatial, spectral, and radiometric resolution of the employed sensor, different spectral behavior is leading to comprehensive classification of specific types of land surfaces. Acquiring images in a number of different wavelength bands is what multispectral remote sensing is all about. Materials vary in their ability to reflect and absorb light at various wavelengths. Therefore, spectral reflectance characteristics can be used to distinguish between materials in these remotely sensed images, allowing for differentiation where direct identification would otherwise be impossible.

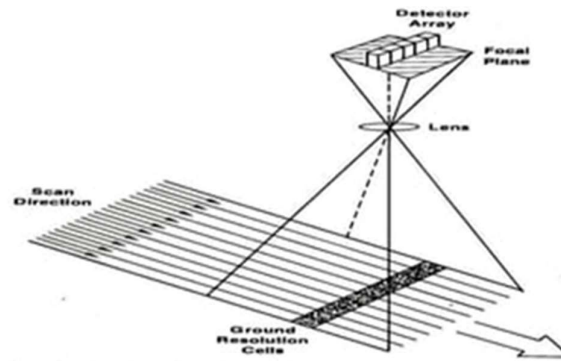


Figure 2: Multispectral remote sensing

The NASA multispectral imager Landsat is used to keep tabs on a wide variety of features at the landscape level. Before the advent of Hyperion and other aerial hyperspectral data, environmental impact feasibility mapping was often performed using multispectral remote sensing data. The use of multispectral satellite data is crucial for tracking changes over time and keeping tabs on the long-term effects of mining on the ecosystem. Synthetic Aperture Radar pictures can also be used to detect morphological changes in land use caused by mining [22-25].

Hyperspectral remote sensing

When compared to multispectral data, which often consists of hundreds of adjacent spectral bands with limited spectral coverage, hyperspectral data offers numerous benefits. Reflectance spectra and high spectral resolution make it possible to directly identify materials based on their reflectance properties. Material spectra can be measured, allowing for the high-resolution identification of minerals, rocks, soils, and plants as well as the tracking of their temporal shifts across time. Successful applications for the detection of mine waste have been reported due to its ability to resolve mineral absorption characteristics [26].

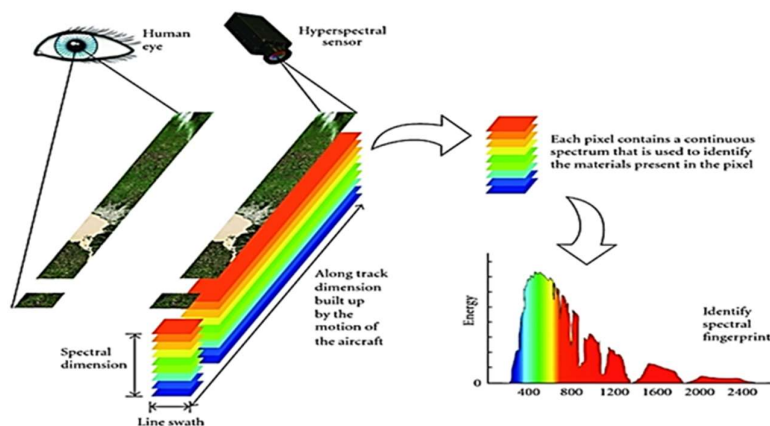


Figure 3: Hyperspectral remote sensing

Geographic Information System

Collecting, storing, analyzing, disseminating, and manipulating data that can be tied to a specific location are all tasks that can benefit from the usage of a geographic information system (GIS). Representative GIS application areas include improving the quality of both short- and long-term decision-making in regards to transportation, local government, and

business, as well as addressing social and environmental issues. To collect, store, retrieve, process, and display spatial data from the real world for specific purposes, GIS is a potent set of tools, as defined by Burrough and McDonnell (1998). When it comes to environmental planning and management, GIS is making huge strides. Remote sensing and field-based analysis now have far-reaching implications thanks to Geographic Information System (GIS) technology.

Over the past two decades, GIS as a discipline and field has seen profound changes. Although GIS was once an underdog technology, it has quickly developed into a multibillion-dollar enterprise and a prominent player in the broader field of ubiquitous information technology. The utility and demands for GIS technology have grown as a result of developments in computer hardware and software, the availability of large volumes of digital data, the standardization of GIS formats and languages, the increasing interoperability of software environments, the sophistication of geo-processing functions, and the rising use of real-time analysis and mapping on the Internet. In addition, scientists, planners, and policymakers are beginning to appreciate GIS for its potential to advance environmental concerns. When used to analyze and control the effects of human activities on the environment, GIS can shed light on previously opaque processes [27-30].

Applications

An approach has been made in this research to review the applications of remote sensing and geographic information system applications to the mining environment, the management of the urban environment, the coastal and marine environment, the wasteland environment, and other environments [31].

Mining Environment

Because of its multispectral mode, synoptic view, and repeating coverage, the application of remote sensing techniques in mining environmental studies has a number of distinct features that set it apart from other approaches. Because of recent advancements in high resolution multispectral satellite data and imaging spectrometry, researchers now have access to great tools with which to investigate the environmental damages caused by mining activities. Remote sensing techniques have been successfully employed to monitor the land use changes that have occurred as a result of opencast strip mining, the influence of underground mining and subsidence, the progression of the dumping of mine wastes, and the erosion that has occurred as a result of mining activities.

Changes in the ecosystem are brought about by mining in a way that is both rapid and significant. Monitoring these kinds of environmental shifts is becoming an exceedingly challenging task due to the fact that the mining area is home to a variety of complicated difficulties and is subject to consistent alterations in its topography. Mining not only directly alters the terrain, but it also frequently makes it possible to release harmful compounds into the atmosphere. The impact of this shift might range from relatively trivial to very significant occurrences. Techniques for hyperspectral remote sensing have the potential to give essential information on a variety of environmental factors, including land use, changes in land cover, the status of vegetation, the quality of soil water, and the locations of acid mine drainage.

The field and laboratory-based radiometric approaches have been used successfully to forecast certain aspects of surface features, including water bodies, grasslands, minerals and rocks, forests, crops, and various other surface features, based on their reflectance spectra.

Environmental monitoring data collected from neighboring areas of mining region water quality, mineralogical, and geochemical research. The problem of environmental monitoring and land-use/land cover changes over the lignite open-cast mine and power plant area was investigated using airborne remote photography along with Landsat TM and SPOT imageries in the central part of Poland by Mularz. The goal of this research was to differentiate, evaluate, and even measure these destructive phenomena. Prakash and Gupta investigated the impact of coal mining on land use by employing remote sensing techniques at the Jharia coal field. Their findings showed that coal mining had a negative impact on land usage. Open pit mining activities, such as those for lignite and other resources, are responsible for the destruction of rich agricultural land, the disappearance of surface water bodies, and the depletion of ground water in deeper aquifers.

According to Ramanathan et al. (2000), the oxidation process that takes place at the surface of dumped mining waste has the potential to produce acid water drainage. This can have an impact on the quality of both surface and groundwater. (Das and Nizamuddin, 2002) have successfully utilized the hyperspectral sensor ('Hyperion') data to map the mineral abundance, lithological mapping, and processing methodology for detecting iron and manganese mines in parts of Singhbhum district, Orissa. They have also successfully utilized spectral signature and spectral mixture modeling techniques for targeting laterite and bauxite ore deposits. Levesque et al., (2001) monitored and evaluated the process of rehabilitating mine tailing sites using hyperspectral remote sensing data. Chevrel et al. (2001) used airborne hyperspectral remote sensing sensors to great effect in order to analyze the mining-related contamination and its influence on vegetation in six different mining regions across Europe and Greenland. Using hyperspectral data analysis, Ellis et al. (2004) were able to identify a variety of main granites as well as kaolinization that occurred afterward in the mining region. In their study of underground mining, Lalan Kumar et al. (2007) employed Geographical Information system to analyze a variety of factors, such as land ownership and mineral claims, exploration management production, and mine site.

Infra-red imaging with multiple time periods It was determined by Akiwumil and Butler (2007) that using Landsat pictures was the most effective method for researching environmental shifts in Sierra Leone, which is located in West Africa. According to Satish Kumar et al. (2011), there was an attempt made to identify the magnesite ore deposits in Salem by utilizing hyperspectral remote sensing data. This endeavor demonstrates the potential of employing narrow band hyperspectral data for further mapping of the impact mining has on the ecosystem. The management and controlling components of the environment that has been impacted due to mining must be implemented both during production and after the mine has been closed. For the purpose of controlling and planning the environmental management, sufficient data should be collected, and it should be processed accurately. This should be done with regard to both place and time [32-36].

Urban Environment Management

An indicator of the transition from traditional agricultural economies to contemporary industrial economies is urbanization. It refers to the gradual accumulation of people within an urban area. The global population has increased dramatically over the course of the past fifty years, and as a consequence, most urban settlements are characterized by shortages in stock housing and water supply, urban encroachments in fringe area, inadequate sewerage, traffic

congestion, pollution, poverty, and social unrest, making it a difficult task for urban governance to maintain a healthy urban environment. The high rate of urban population expansion is a source for worry among urban and town planners in India for the purpose of achieving efficient urban planning. Therefore, there is an immediate need to adopt contemporary technology of remote sensing, which includes systems that are based both in the air and on satellites. This will enable us to gather a large amount of physical data very easily, quickly, and on a repeating basis, and will, in conjunction with GIS, enable us to evaluate the data in a geographical context.

Floods inflict harm to natural resources and environmental quality and indirectly contribute to increased poverty. This, in turn, further adds to the vulnerability of both natural and human systems, particularly in urban areas as compared to rural ones. Many environmental activities, such as reforestation, forest protection, upland permanent farming, and resettlement, might have been undertaken by remote sensing and geographic information systems (GIS). This linkage between the environment and floods has been identified.

GIS has seen widespread application in characterization and assessment studies, particularly those that call for a watershed-based approach to the management of water level and waste management in metropolitan settings. Digital Elevation Models (DEMs), which are easily accessible, can be used to infer the fundamental geological and hydrological features of a watershed, such as its flow routes and drainage network. When faced with challenges involving water quality and quantity as a result of natural as well as human-induced hazards (for example, droughts, hazardous material spills, floods, and urbanization), planning becomes extremely important in order to mitigate their impacts and ensure optimal utilization of the available resources.

According to Patkar (2003), remote sensing can serve as a valuable source of data for the mapping of urban land use and land cover as well as for environmental monitoring. A number of important studies were conducted for the purpose of environmental quality management. Unchecked urbanization is to blame for a variety of issues that our cities are currently confronted with. These issues include a terrible living environment, acute difficulties with drinking water, noise and air pollution, disposal of garbage, traffic congestion, and other similar issues. Technology advancement in related disciplines has to solve the difficulties generated by fast urbanization in order to mitigate the environmental degradations that are occurring in and around cities. Only then can the benefits of development trickle down to those who are the most economically disadvantaged. Together with GIS, the modern technology of remote sensing, which includes both aerial and satellite-based systems, enables us to collect physical data rather easily, quickly, and on a repetitive basis. Additionally, this technology enables us to analyze the data spatially, which offers the possibility of generating a variety of options (modeling), thereby improving the efficiency of the entire planning process.

Due to the dynamic character of the urban environment, analysis at both the macro and the micro level are required. Because of this, it is essential for those who determine policy to include remote sensing into urban planning and administration. The application of remotely sensed data in urban studies had its start with first-generation satellite sensors like Landsat MSS. A number of second-generation satellites like Landsat TM, ETM+, and SPOT gave the trend a significant boost. Excitingly, a third generation of very high spatial resolution satellite sensors with a pixel size of 5 meters or less has just recently become available. The high-

resolution PAN data and the LISS III merged data have the potential to work well together for usage in urban applications. According to Rai and Kumra (2011), the data from IRS P-6 satellites with sensors on board, particularly LISS IV Mono and Multispectral (MX) with 5.8 m/pixel spatial resolution, is very helpful for in-depth research on metropolitan areas [37-39].

Coastal and Marine Environment

Coastal zones in India are constantly undergoing wide-ranging changes in shape and environment due to natural as well as human development activities. Natural processes such as waves, erosion, changes in river courses etc., cause long time effect at slower rate; but manmade activities, such as settlement, industrial activities, recreational activities, waste disposal etc., affect the coastal environment at comparatively much faster rate. Continued loss of these wetlands may lead to the collapse of coastal ecosystems. It is, therefore, necessary to monitor coastal zone changes with time. Remote sensing technology in recent years has proved to be of great importance in acquiring data for effective resources management and hence could also be applied to coastal environment monitoring and management. The high temporal resolution provided by the satellite data is found to be a major improvement in studying the behavior of suspended sediments in the coastal waters, which would help in understanding the movement of sediments and pollutants.

GIS in addition to providing efficient data storage and retrieval facilities also offers a cheaper option of monitoring forest conditions over time. Remote sensing and GIS are increasingly used in mangrove forestry worldwide to assist in gathering and analyzing images acquired from aircrafts, satellites and even balloons. The notable advantages of using GIS include the ability to update the information rapidly, to undertake comparative analytical work and making this information available as required. The area covered by mangroves in the islands of Andaman was calculated using SPOT 1993 and IRS 1D LISS III 2003 imageries. The change in mangrove area within a span of ten years has presented in the form of a table (IOM report, 2003). Twumasi and Merem (2006) assessed change within a coastal environment in the Niger delta region of Nigeria using remotely sensed satellite imagery and GIS modeling, quickened the analysis of the spatial distribution of environmental change involving land use, land cover classification, forest and hydrology and demographic issues facing the Niger Delta and successfully implemented some of the strategies could lead to effective management of the coastal environment in the Niger Delta region.

Satellite based remote sensing techniques have proved successful in providing a comprehensive, reliable and up-to date information on land use/land cover in the offshore areas of east coast of Andhra Pradesh in the most cost-effective manner. Environmental Sensitivity Index (ESI) and Reach Sensitivity Index (RSI) identified through modern methods like Digital Image processing and GIS for preparedness in case of oil spill incidents in offshore areas. The combination of remote sensing and GIS technologies provides an ideal solution for understanding the spatial/temporal distribution of oil spills in the marine environment and is considered as the core of the oil spill monitoring system. The advantages of the remote sensing and GIS provides the ability to extract the oil pollution parameters such as location and spill areas including spatial and temporal information allows the users to establish the major cause and source of oil spills and then outline the risk areas to save the marine environment. One of the major advantages of GIS is the ability to extract oil pollution parameters such as location, size and spill areas. Spatial and temporal information (oil spill distribution at sea and its

evolution in time) allows the users to establish the major cause and source of oil spills, and then outline the risk area. The products derived from geospatial technologies support informed decision making with respect to marine spatial planning and management [40].

Wasteland Environment

Wetlands account for only 3–6% of the Earth's land area, but they provide essential resources and functions such as floodwater retention, wildlife habitat, and soil erosion management. Wetlands are a transition zone between the terrestrial and aquatic systems; they help with flood mitigation, water quality management, wildlife habitat, and soil erosion control, among other things. Wetlands and the uplands surrounding them need to be monitored and catalogued in order to slow their decline, protect the ecology they support, and ensure that future generations can benefit from the wealth of life found there. Wetland area has been steadily declining over the past few decades as a result of human activities such as wetland reclamation, population growth, water diversion, dam building, pollution, biological invasion, desertification, global warming, and poor policymaking. The qualitative and quantitative changes in land cover on Earth have been measured using remotely sensed data. Over the past two decades, many different approaches to detecting changes using remotely sensed data have been developed and evaluated.

The spatial-temporal dynamic multiplicity and distribution of wetlands can be monitored with the help of RS data and GIS. Remotely sensed data from satellites have been used extensively for wetland inventory and monitoring, and they can also reveal trends in the use of land in the area over time. Using four Landsat images from 1985 (Landsat MSS), 1999 (Landsat ETM+), 2002 (Landsat ETM+), and 2011 (Landsat ETM+), Ghobadi et al. (2012) successfully used Multi-temporal remote sensing data and GIS to map wetlands near the Karkheh River in southwestern Iran and discovered that increased agricultural activity, climate change, and construction engineering projects had reduced the wetlands' surface area. The use of satellite remote sensing offers various benefits, including the ability to keep track of wetland areas, track changes in land use, and more. Wetland classification and its spatial-temporal dynamic change are typically analyzed using Landsat MSS, TM, or SPOT data.

As satellite data may be re-visited at any time of year or any season, wetland areas can be tracked on both of these time scales. Remote sensing data can be used to classify land cover at a fraction of the expense and in a fraction of the time required by using aerial photography. In poor nations, when funds are tight and data on the wetland, such as wetland acreage, land use, and wetland losses, are scarce, the use and application of satellite remote sensing data can be appropriate for wetland research like monitoring and inventory. As a result of its development, remote sensing has become a reliable tool for studying glaciers. GIS and GPS, two relatively new technologies, have provided a convenient framework for analyzing collected data, allowing for more precise monitoring and mapping of glaciers' temporal dynamics. Numerous glaciology investigations have benefited from the use of GPS, GIS, and remote sensing [41].

Conclusion

When planning large-scale projects that could have a negative impact on the environment and human health, it is crucial to first develop a baseline of relevant data for that project's sector. Because of this, the industrial, mining, and urban sectors must work together to develop methods of expansion that are less taxing on the environment, particularly in regards to the use of energy, power, irrigation, and other critical resources. Remote sensing and geographic

information systems (GIS) offer practical resources for tracking environmental threats and figuring out how to mitigate them.

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DOCUMENTATION OF THE EFFECT OF ENVIRONMENTAL CHANGES ON AQUATIC ECOSYSTEM

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Abstract

The physical and biological properties of coastal systems, as well as the structure and function of their ecosystems, will be modified as a result of the consequences of higher atmospheric CO₂ concentrations, such as changes in ocean chemistry. Consequently, coastal nations are losing marine life, fish stocks, and coastlines. Coral reefs, which are extremely sensitive to changes in sea surface temperature, are among the most biologically diverse ecosystems on Earth. Most coral reefs are at risk of being destroyed by a 2°C temperature rise, which is associated with CO₂ concentrations of 500 ppm. As the ocean becomes more acidic due to absorbed CO₂ from the Earth's atmosphere, it poses a threat to living reefs, which could eventually be replaced by seaweed-dominated mounds of rubble as temperatures continue to rise. The global biosphere faces an unprecedented challenge from these impacts, which will compound the strain caused by local anthropogenic effects. While everyone on the planet will feel the effects, certain places will feel them more keenly than others.

Keywords: Physical and biological properties, ecosystem and coral reefs.

Introduction

Human interference with ecosystems has a major impact on global biodiversity. The climate's constant flux has a profound effect on biodiversity. The loss of biodiversity is already threatened by previous human pressures, and now a new kind of climate change brought about by human activity is being added to this natural variability. Seventy percent of Earth's surface is made up of water. The distribution and quantity of aquatic ecosystems are already being altered by climate change. Surface ocean currents are sensitive to even little shifts in water temperature and will respond accordingly. There are two main types of aquatic ecosystems: those found in salt water (marine) and those found in fresh water (fresh) environments. The ocean's response to a warming climate [1-5].

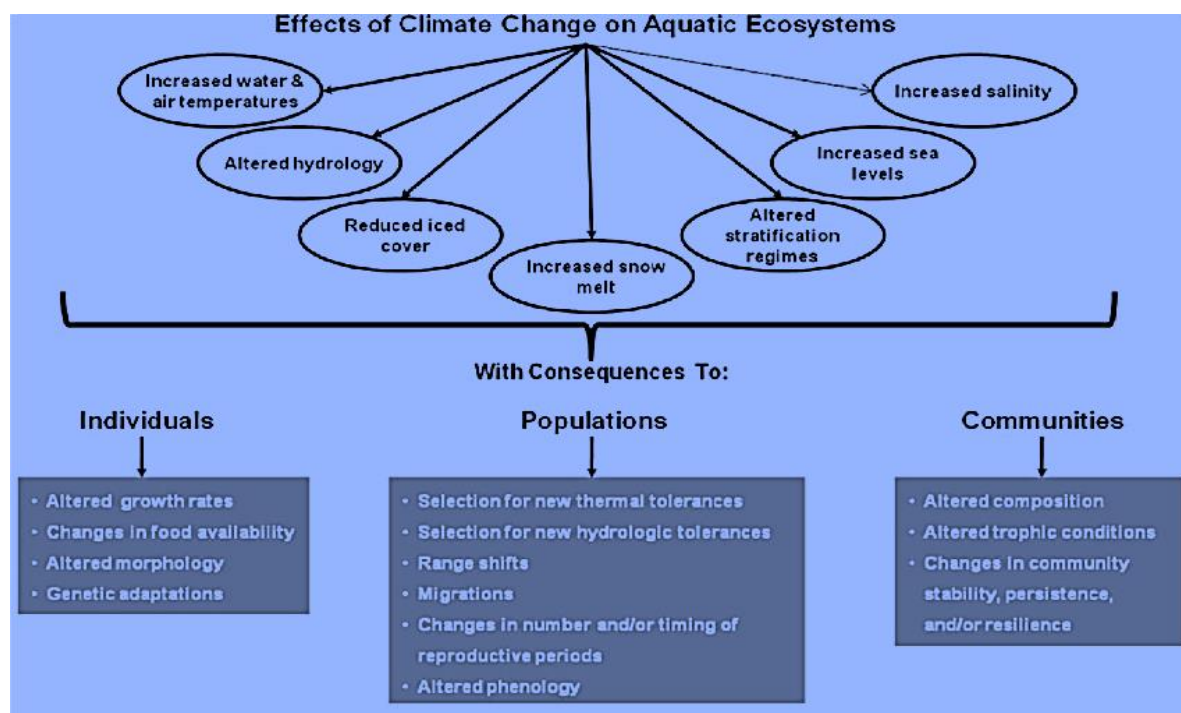


Figure 1: Illustration of climate change effects on aquatic ecosystems

THE BUILDUP OF GREENHOUSE GASES IN EARTH'S ATMOSPHERE WILL ALTER THREE PRIMARY FACTORS:

Total carbonate alkalinity decreased

As atmospheric CO₂ levels rise, oceans will become less alkaline due to a drop in total carbonate alkalinity. It is anticipated that this variable will have a major impact on the acidity and carbonate ion pool of the world's oceans. The saturation state of aragonite in the tropics

will decline by 30% by 2050 as a result of a doubling of atmospheric carbon dioxide concentrations.

Rising Sea Levels

Rising sea levels have had far-reaching effects on the distribution and richness of marine and terrestrial life. As climate change raises global temperatures, sea levels will also rise. This happens because the ocean water is warming, glaciers are melting, and ice sheet distribution is shifting. In the next 40 years, sea levels are projected to rise by anything from 9 to 29 centimeters. Up to 22 percent of the world's coastal wetlands could be lost by 2080 due to sea level rise, according to research by Nichols and colleagues. When added to the loss of coastal wetlands caused by other human activities, this figure is projected to rise to 70 percent by the end of the 21st century [6].

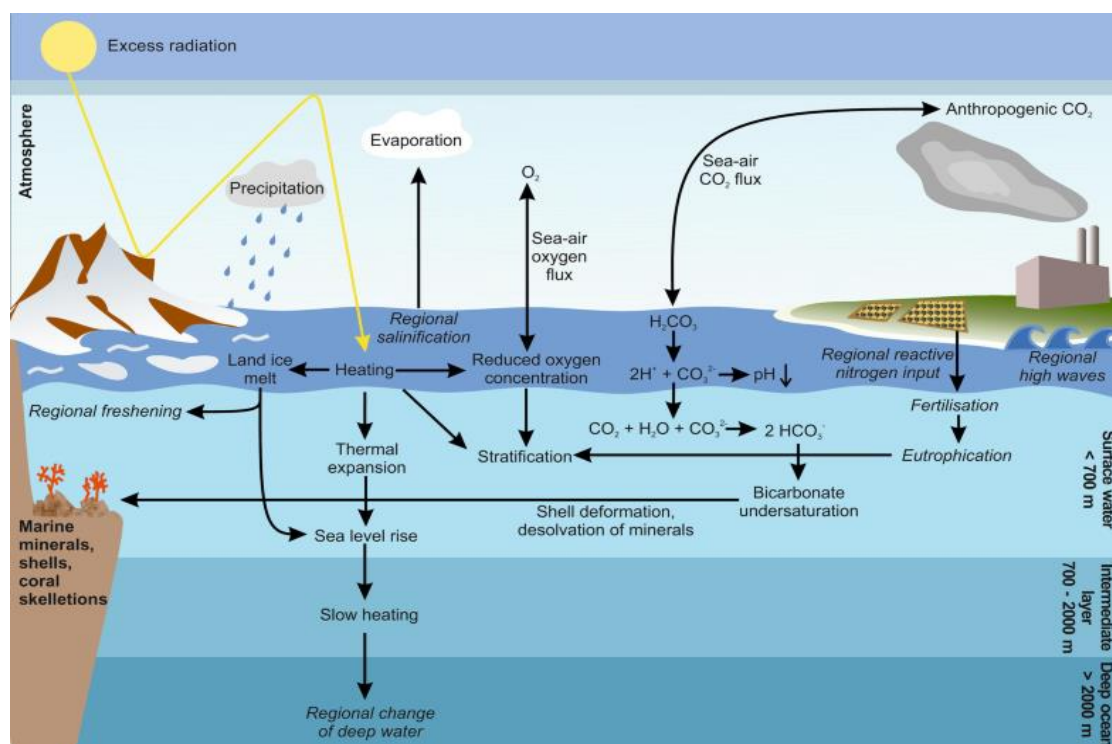


Figure 2: Effects of climate change on oceans

A rise in ocean temperatures

There has been an inequitable rise in temperature. The marine ecosystem is affected by the sea's temperature. Changes in global temperatures can have an immediate impact on the velocities and courses of ocean currents because of their impacts on the density of saltwater.

Oceanic life forms

The vast variety of the ocean floor is becoming increasingly appreciated. It is

hypothesized that more species can be found in the deep sea than in any other marine habitat. While pollution, shipping, military activities, and climate change all pose a risk to marine life and ecosystems, fishing is currently the greatest hazard facing these systems.

The primary danger to marine life at the ocean's depths

Means fishing by dragging a net down the floor. Seamounts and the cold-water corals they support are especially vulnerable to this form of fishing on the high seas. Several species of commercially important bottom-dwelling fish can be found in these environments.

The Fish Stocks

Many hundreds of millions of people rely heavily on coastal fishing. Overfishing and the accompanying collapse of fish populations has been blamed by many scientists for the drastic shifts observed in ecosystems over the past two centuries. New information suggests that climate and oceanic conditions play a major effect on fish populations. There is likely a lot of nuance involved in the way climate change affects fish populations. Conditions and the fish's life cycle may undergo dramatic shifts as a result of seemingly insignificant human interventions. Climate change has the greatest impact on marine ecosystems' main and secondary productivity.

Coral Reef

Scleractinia corals provide the backbone of the ecosystems that dominate the tropical ocean's intertidal and subtidal zones. Over the past 20 years, they have undergone significant alterations, many of which may be traced back to the effects of climate change and other pressures. Large populations of fish, birds, turtles, and marine mammals are maintained in these ecosystems due to the rich and complicated food chains that exist there. The creation of carbonate reefs is hampered by a decrease in light, temperature, and the carbonate alkalinity of seawater as one travels toward the poles. Major impacts from climate change have already been felt by coral reefs. Over the past 30 years, we have seen a huge rise in the frequency and severity of major disturbances to coral reefs, and this rise is inextricably related to times of warmer-than-average sea temperatures.

Bleaching happens when corals lose their cells too quickly. When colonies are bleached, they go from brown to white, and the host organism's magnificent colours become visible. Changes in reef-building coral communities are predicted to have large effects on marine biodiversity if reef-building corals lose these critical symbionts, which can reduce death rates by as much as 90 percent. Corals provide the structural support for an ecosystem that is

home to a wide variety of different organisms. Reef-building coral communities are anticipated to have major implications on marine biodiversity, especially on fish that rely on corals for food, shelter, or settlement. Corals provide the structural support for an ecosystem that is home to a wide variety of different organisms. The quantity of fish that rely on corals for food, shelter, or settlement cures may drastically shift, if not completely disappear. Threats to marine biodiversity affect tens of thousands of more species. Corals provide the structural support for an ecosystem that is home to a wide variety of different organisms. Reef-building coral communities are anticipated to have major implications on marine biodiversity, especially on fish that rely on corals for food, shelter, or settlement. Corals provide the structural support for an ecosystem that is home to a wide variety of different organisms. The quantity of fish that rely on corals for food, shelter, or settlement cures may drastically shift, if not completely disappear. There are thousands upon thousands of other species that are at risk [7].

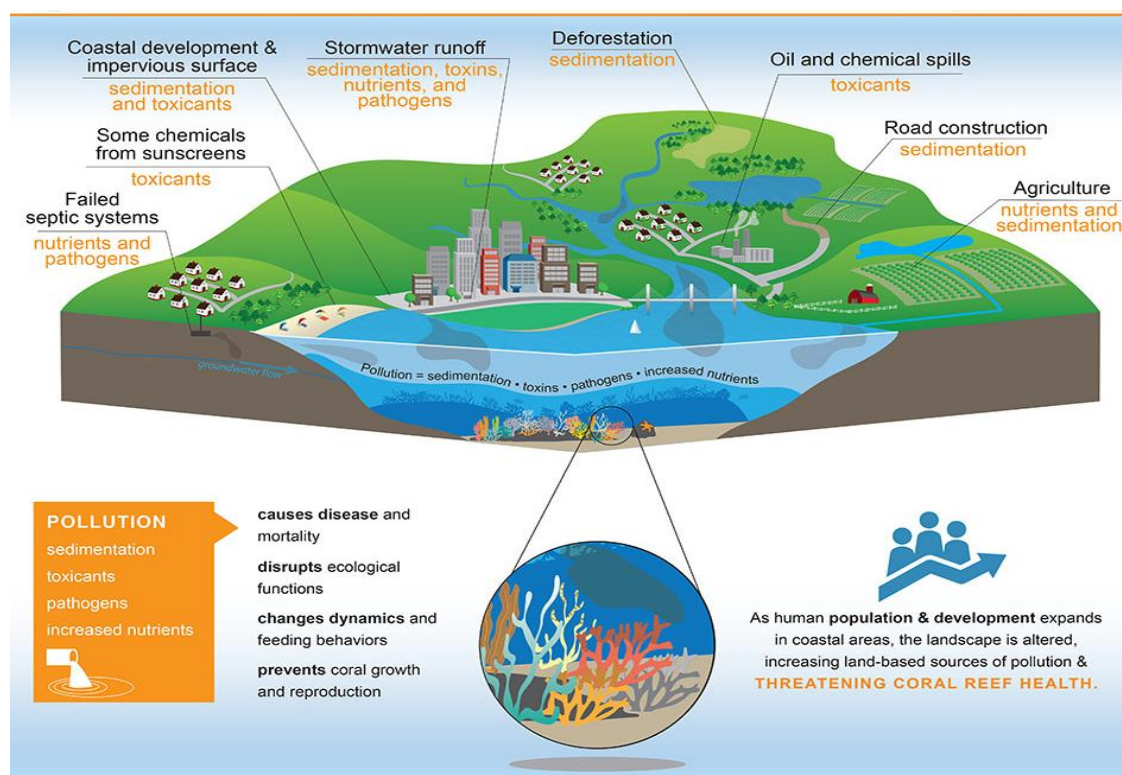


Figure 3: Pollution threaten coral reefs

Ecosystems in Fresh Water

Nutrient enrichment, hydrological modifications, habitat loss and degradation, pollution, and invasive species are all major hazards to freshwater fauna. Extreme weather events and higher UV radiation levels present new dangers on top of those already present.

Rapid land use change, habitat disruption, and a changing climate are seen as a triple whammy that poses a significant threat to aquatic ecosystems.

Value of inland water systems

A negligible portion of the world's water is freshwater found on the surface. Clean water for human consumption, agriculture, fisheries, and recreation are just a few examples of the many important ecosystem services provided by thriving freshwater ecosystems. In many parts of the world, people lack access to safe drinking water that is adequate for their most basic needs [8].

Adapting to a changing climate: the hydrologic cycle

Changes to the hydrologic cycle will have an unpredictable impact on freshwater habitats. Increased transpiration from plants and increased evaporation from water surfaces both contribute to a more robust water cycle in a warmer climate. Warmer temperatures and shifts in the hydrologic cycle are two ways in which future climate change will have an immediate impact on lake ecosystems.

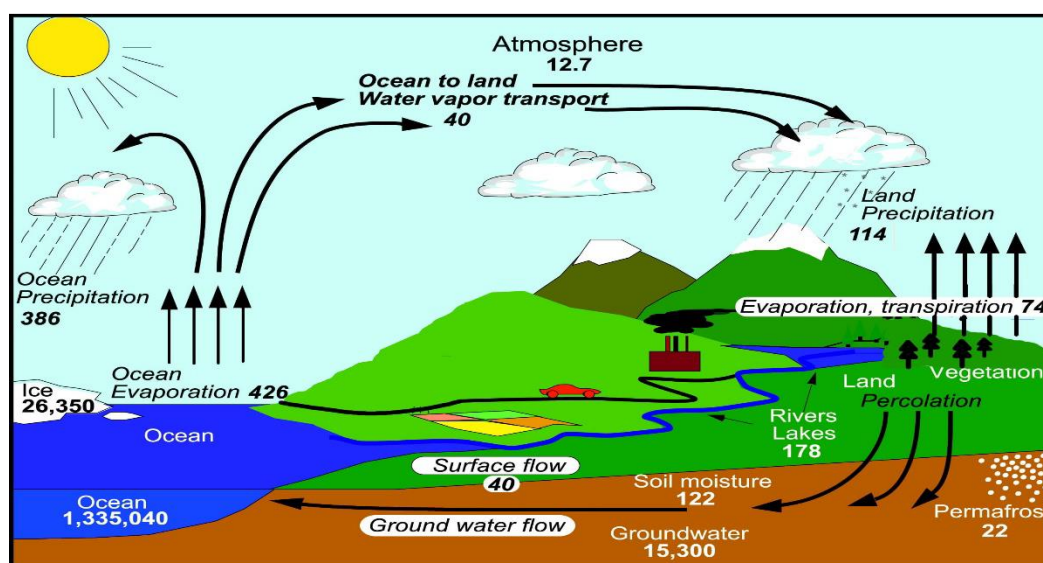


Figure 4: Hydrologic cycle

Influences on Biology

There are many different ways in which rapid climate change poses a threat to the biodiversity of rivers and streams. The effects of climate change may result in the extinction of multiple trophic levels of organisms. Because of the limitations imposed by the environment, certain species run the risk of becoming extinct on a global scale if they have a limited distribution. The entire diversity of species is in jeopardy of extinction, but this is especially true in the case

of fish, as more specialized species have a tendency to congregate in particular places. [9].

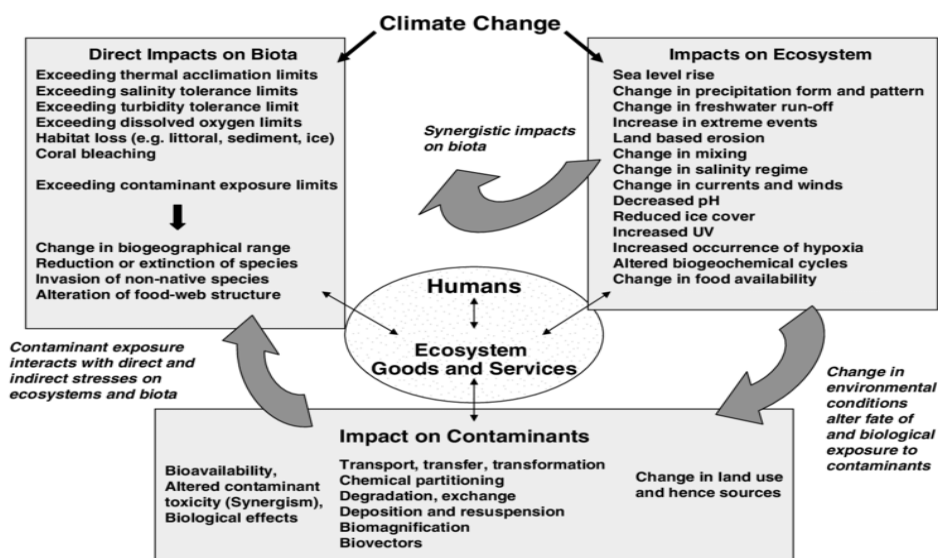


Figure 5: Biological impact of climate change

Conclusion

As a result of human needs, aquatic ecosystems are under increasing stress. Future climate change will interact with the various human stressors that affect aquatic ecosystems. Human activities continue to play a major role in driving changes in biodiversity. Changes in global climate, even slight ones, can have a significant impact on biodiversity. When this need is met with a single desire, we can create a sustainable biodiversity that benefits all people. There is no single person or group to hold responsible for the present nationwide food shortage. All the problems plaguing society, such as poverty, hunger, corruption, etc., are interconnected and perpetuate themselves in a vicious cycle. There is an urgent need for public discussion and localized action. Good governance and political will need to be translated into concrete reforms. People in our country who are struggling with poverty need our collective assistance.

To organize and manage biological resources in a way that ensures their widespread use and steady supply while also preserving their quality, value, and diversity is the goal of biodiversity conservation. Extinction must be avoided at all costs, which is why careful preparation and administration are essential. More needs to be done now to slow biodiversity loss and institute permanent safeguards for this precious resource. Decisions on where and how much to invest in the future of humanity and other people's wealth are necessary. Conservation of biodiversity cannot be achieved through legal mandate alone. Because we care about the

planet and all its inhabitants, it has to originate from within ourselves. Biodiversity is life is the motto for the International Year of Biodiversity. Life itself is biodiversity. Remember that biodiversity is nature's safety net in times of crisis.

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**EMERGING TRENDS IN MULTIDISCIPLINARY
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MESSAGE FROM CHIEF EDITOR



It is indeed a pleasure and honour to be part and involvement to releasing the book entitled “**EMERGING TRENDS IN MULTIDISCIPLINARY RESEARCH (ETMR)**” by Association of Global Academician and Researchers (AGAR), Tamil Nadu. This remains as a history due to its tremendous response across the globe. I am indeed grateful to the members of the association for providing me an opportunity and for reposing faith in me. All this has been made possible with their guidance. My thanks to the faculty members, Research scholars and students who have contributed the chapters to this dynamic publication. I am very thankful to Dr. I. Niyas Ahamed, President of AGAR for assisted me in times of need. I am very fortunate and blessed to be part of this prestigious publication.

With Regards,

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MESSAGE FROM EDITOR - I



Dear Friends,

It is wonderful to see the Association of Global Academician and Researchers (AGAR), Tamil Nadu taking up an important experimental education and research strategies and at the same time an important problem in the society to publishing the book entitled on “EMERGING TRENDS IN MULTIDISCIPLINARY RESEARCH (ETMR)”

The topic “Recent Trends in Multidisciplinary Research” gives much room to search for the latest trends in dealing with important education role and emerging research strategies. This publication offers more strategic, holistic education and research approach to integrate aspects from the different field of research. It will enlighten the broaden minds of the young researchers to search for new solutions to real life strategies.

Congratulations and God Bless Your Effort.

With Regards,

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MESSAGE FROM EDITOR - II



Being a part of the publication of the book chapters collected in “EMERGING TRENDS IN MULTIDISCIPLINARY RESEARCH (ETMR)” by the Association of Global Academician and Researchers (AGAR), Tamil Nadu, is both a joy and an honour. Due of the phenomenal response it received all across the world, this is still considered history. The association's members have my sincere gratitude for giving me this chance and having faith in me. Due to their leadership, everything has been made possible. Thank you to the professors and students who contributed the essays to this exciting magazine. I'd want to express my gratitude to Dr. I. Niyas Ahamed, President of AGAR, for helping me out when I needed it. Being a part of this is a huge blessing for me.

With Regards,

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MESSAGE FROM ASSOCIATE EDITOR - I



This book provides us with a snapshot of what is going on in this fascinating field, and I would like to congratulate all contributors on making their wonderful posts vibrant and full of material for this edition. I am sure readers can find material that is very helpful and interesting, and my sincere gratitude goes to the publisher, my fellow associates, and all those who have taken care to get this wonderful edition out of it.

This Contributed book entitled “EMERGING TRENDS IN MULTIDISCIPLINARY RESEARCH (ETMR)” by Association of Global Academician and Researchers (AGAR), Tamil Nadu. I am very glad that all authors took the opportunity to exchange their knowledge, experiences and ideas and also made contacts and established further collaboration. This educational material, rich in events, provided more relaxing atmosphere during the meetings among colleagues in this pandemic situation.

With Regards,

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MESSAGE FROM ASSOCIATE EDITOR - II



Research is “creative and systematic work” undertaken to increase the knowledge of humans, culture and society and devise new applications. Education can be thought of as the transmission of the values and accumulated knowledge of a society. It’s a great privilege and honour to be associated with this “**EMERGING TRENDS IN MULTIDISCIPLINARY RESEARCH (ETMR)**” released by Association of Global Academician and Researchers (AGAR), Tamil Nadu. RTMR has facilitated the academicians and researchers to get connected and share their knowledge and dramatically provided an opportunity for collaboration with colleagues who are dispersed across time zones, countries, and continents. I thank the contributing academicians and researchers for making this great success.

With Regards,

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MESSAGE FROM ASSOCIATE EDITOR - III



Research can be defined as "creative and systematic work" done with the goal of expanding our understanding of people, societies, and cultures and developing useful new technologies. Education can be understood as the dissemination of a culture's norms and knowledge. This publication, **"EMERGING TRENDS IN MULTIDISCIPLINARY RESEARCH (ETMR)"**, was put out by the Association of Global Academician and Researchers (AGAR), Tamil Nadu, and it is an honour and privilege to be a part of it. Academics and researchers can now easily communicate across time zones, national boundaries, and oceans with RTMR, greatly expanding their opportunities for knowledge sharing and interdisciplinary work. I'd want to express my appreciation to all of the involved professors and researchers.

With Regards,

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MESSAGE FROM ASSOCIATE EDITOR - IV



Congratulations to all the authors for making their great postings lively and full of material for this edition of the book, which gives us a glimpse of what's going on in this fascinating sector. Please accept my heartfelt gratitude to the publisher, my fellow colleagues, and all those who have taken care to get this excellent edition out of it; I am confident that readers will discover material that is both useful and entertaining.

This collection of articles was compiled by the Association of Global Academicians and Researchers (AGAR), Tamil Nadu, and is named "EMERGING TRENDS IN MULTIDISCIPLINARY RESEARCH (ETMR)". I'm happy to hear that everyone involved was able to network and continue working together after this event was held. This event-packed educational content helped ease tensions during pandemic talks between co-workers.

With Regards,

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BOOK CHAPTERS

CHAPTER-1

PHYTOCONSTITUENTS FOR THE TREATMENT OF ULCERATIVE COLITIS

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ABSTRACT

Inflammatory bowel diseases (IBDs), consisting mainly of ulcerative colitis (UC) and Crohn's disease (CD), are significant immune-mediated diseases of the gastrointestinal tract. Ulcerative colitis (UC) is a chronic IBD of unknown etiology. Several conventional treatments for UC involved as corticosteroids, immunosuppressive agents, integrin blockers, and interleukin antagonist, and salicylates are available but are associated with the various disadvantages and side-effects. None of the aforementioned treatments helps to achieve the ultimate goal of the therapy, i.e., over a long-term basis, maintaining remission. The adverse effects of natural UC treatments are considerably less severe and are affordable. The current study provides information on how herbal medications are used to treat and cure UC. Natural treatments have been used

for generations to treat UC. Gymnemic acid, shagoal, catechin, curcumin, arctigenin, and boswellic acid are some of the key herbal ingredients with antiulcerogenic activity. Recent pre-clinical investigations have revealed that some dietary agents, spices, oils, and dietary phytochemicals ingested on a daily basis have favorable benefits in preventing/ameliorating UC. Although numerous plant-derived medications have been hailed for their ability to treat UC, more study into the exact molecular process is required to confirm their clinical utility.

Keywords Ulcerative colitis · Herbal constituents · Anti-ulcerogenic activity · Inflammatory bowel disease.

INDRODUCTION

UC has an incidence (the number of people in a population who develop an illness or condition over time) of 9-20 cases per 100,000 people per year and a prevalence (the number of people in a population who have a disease or condition at any given moment) of 156-291 cases per 100,000 people per year. According to a World Health Organization (WHO) assessment, more than 80% of the world's population relies on traditional medicine to address health issues (World Health Organization 2019). Traditional medicines, primarily herbal items, serve as a lead chemical for identifying other bioactives since they have been used for thousands of years to treat various sorts of ailments and have the benefits of fewer side effects, comparative availability, and cost efficacy.

Inflammatory bowel disease (IBD), characterized clinically by bloody diarrhoea, abdominal cramps, and pain, is a recurrent and chronic immunologically mediated disease that affects the intestinal mucosa. Patients with IBD are also more likely than the general population to develop colorectal cancer. The two most frequent types of IBD are Crohn's disease (CD) and ulcerative colitis (UC). These disorders have symptoms and some mucosal pathology in common, but they are distinct enough to be considered separate ailments. [1,2,3] Despite considerable effort and research, the origin and precise illness causes remain unknown. The prevalence of IBD is widely documented in the Dietary Agents and Phytochemicals in the Prevention and Treatment of Experimental Ulcerative Colitis.

EPIDEMIOLOGY

Prevalent source of gastrointestinal morbidity, IBD is a term used to refer to a set of chronic symptoms that affect both the small and large intestine. [3,4] Free radical overproduction and lowered antioxidant capability are risk factors for IBD. UC and Crohn's disease (CD) are the two main types of IBD. The prevalence of it is rising globally and is more prevalent in western nations. Although UC can begin at any age and affects both sexes equally, the disease often manifests itself between the ages of 15 and 30.

ETIOLOGY

Despite considerable effort and research, the specific causes and illness mechanisms are still unknown. It is widely known that Dietary Agents and Phytochemicals in the Prevention and Treatment of Experimental Ulcerative Colitis have a high incidence of IBD. The multifactorial condition is primarily influenced by hereditary factors, infectious agents, oxidative stress, immune system irregularities, excessive prostaglandin (PG) E₂ synthesis, and loss of luminal microbiota tolerance. [6,7] The interaction between reactive oxygen species (ROS) and reactive nitrogen species (RNS), which is to blame for many physiological processes and many pathological processes, is what causes oxidative stress, which accounts for the majority of these factors. In order to treat and prevent oxidative gastrointestinal illnesses, there has been an increase in interest in the possible benefits of exogenous antioxidants. Release of inflammatory cytokines by macrophages, B-cells, and T-cells also causes and promotes UC.[7] Tumour necrosis factor (TNF), interleukin-1 (IL-1), IL-6, IL-8, granulocyte-macrophage colony-stimulating factor, and transforming growth factor (TGF- β) are only a few examples of pro-inflammatory cytokines that contribute to the degeneration of articular cartilage.

SYMPTOMS OF ULCERATIVE COLITIS

The extent and location of inflammation can affect the symptoms of ulcerative colitis. There are a number of warning signs and symptoms that can be present,

including anorexia, weight loss, malaise, slowed growth, arthritis, abdominal discomfort, cramping, rectal pain, and occasionally anaemia.

AVAILABLE TREATMENT APPROACHES FOR ULCERATIVE COLITIS

The main objective of treating ulcerative colitis is to assist patients in better immune system regulation. While there is currently no proven treatment for UC and flare-ups may recur, a variety of treatment alternatives can help patients maintain control of their condition and lead fulfilling lives. The ultimate objectives of currently prescribed antiulcerogenic medications include not only slowing the progression of the disease but also inducing a rapid remission and maintaining it for an extended period of time, all the while minimizing disability, preventing disease-related complications, and extending patient life. [7,8] The severity of the illness, or the degree of colon involvement and its localisation, determines the appropriate course of treatment. Further treatment is dependent on the primary outcome of induction therapy for UC, which consists of two steps: the first is to induce remission (with induction agents) and resolve all inflammatory symptoms, and the second is to maintain remission (with repair agents) [7,8]. Salicylates (such as mesalazine and olsalazine); immunomodulators (such as azathioprine, 6-mercaptopurine, cyclosporine, and methotrexate); corticosteroids (such as methylprednisolone and prednisolone); tumour necrosis factor signaling inhibitors (such as

infliximab, adalimumab, and golizuma. In addition, in the event of fatal problems, colectomy (surgical therapy) may be an option. In addition to traditional medications, some unorthodox treatments for UC have been investigated, notably leukocytapheresis, inorganic nitrite or nitrate, and faecal bacteriotherapy.

HERBAL APPROACHES FOR THE TREATMENT OF ULCERATIVE COLITIS

Herbal products are used all over the world for their therapeutic potential in a variety of diseases. Phytoconstituents with anti-inflammatory and antioxidant properties, such as catechins, flavonoids, terpenes, alkaloids, anthocyanins, quinines, and anthoxanthins, can influence the expression of proinflammatory signals and are considered prospective agents for the treatment of UC [4,5,6]. All of these drug's work through a variety of mechanisms, including the inhibition of TNF-, IL-1, cyclooxygenase (COX), lipoxygenase (LOX), and nuclear factor B (NF-B). Plant biologically active substances such as gymnemic acid, shagol, catechin, curcumin, glycyrrhizin, boswellic acid, aloein, arctigenin, and cannabidiol have all been used efficiently to treat UC [6,7].

Aloin

Aloin, the active ingredient of Aloe vera (AV) (Liliaceae), is renowned for a variety of biological properties such as hepatoprotective, antioxidant, anti-ulcer, anti-arrhythmic, antibacterial, antidiabetic and anti-aging, chemotherapy for cancer, and anti-inflammatory. Anthraquinones (aloin, aloe-emodin,

anthranol, and barbaloin) are bioactive elements of aloe, as are amino acids, hormones (auxin and gibberellins), and steroids (cholesterol, campesterol, lupeol, and sitosterol) [1,2]. Aloe's significance in the therapy of UC is mostly owing to its reduction of PGE2 and IL-8 release, which is also accountable for its anti-inflammatory properties. It has also been shown to reduce ROS production by phorbol 12-myristate 13-acetate (PMA) activated human neutrophils.

Bahrami et al. investigated the preventive and therapeutic impacts of AV gel on UC in rats with acetic acid (AA)-induced colitis. The drop in inflammation, ulcer score, and tissue damage in AV-treated rats when contrasted with negative control animals demonstrated its utility in UC. Pre-treatment with AV gel reduced inflammation, lesions to the serous layer, and fibrosis, with results similar to positive control animals demonstrating therapeutic efficacy in colitis mice. Hassan Shahi et al. calculated the healing efficacy of AV gel in rats with AA-induced UC. According to histology AV gel treatment was found to decrease and mend colon tissue damage in induced colitis. This gel additionally lowered apoptosis in the rat colon, with a substantial decrease in Bax messenger ribonucleic acid (mRNA) expression and a large rise in B-cell lymphoma 2 (BCL-2) mRNA expression. Furthermore, histological results showed that AV gel had an inhibitory impact on the colon, which was supported by reduced cell infiltration and the emergence of healthy tissue.

CURRENT STATUS OF KNOWLEDGE

Molecular events responsible for UC

From a clinical standpoint, the main symptom of UC is inflammation of the mucosal lining of the colon, which is caused by the interaction of several molecular constituents of the cells. The inflammatory pathway in UC is characterized by the ubiquitous expression of pro-inflammatory eukaryotic transcription factors [activator protein (AP) 1 and nuclear factor kappa light chain enhancer of activated B cells (NF B)], which results in the synthesis of pro-inflammatory cytokines, including tumour necrosis factor (TNF), interleukin (IL) 6, and IL 1, with T helper (Th) 17 cytokines such as IL 23 and IL 17. The upsurge in cytokines that are pro-inflammatory is accompanied by a boost in the synthesis of cyclooxygenase (COX) 2, inducible nitric oxide synthase (iNOS), myeloperoxidase, and signal transducer and activator of transcription, all of that contribute to increased inflammation, oxidative stress, and a decline in antioxidant levels.[9,10] Each one of these processes result in an increase in cell inflammation, infiltration of immune cells, particularly neutrophils, and epithelial cell injury and colonic barrier failure. UC also serves as a known risk factor for colon cancer, which is generated by a recurring cycle of inflammation that results in spontaneous mutations in the DNA repair process, oncogenes, and tumor suppressor genes such as p53. The change in the component, number, and action of the colon microflora is another factor

important for the emergence of UC, as experiments with germ free mice have definitively shown reduced or no inflammation developing in chemical and genetic models of colitis.

Conventional treatments in UC

Chemotherapy served as the basis of UC treatment; in instances of mild severity, anti-inflammatory medications such as sulfasalazine and 5 amino salicylic acid are given, whereas in severe and chronic cases, treatment with rectal and systemic corticosteroids and immunosuppressants is given. In most situations, the positive effects are limited to the reduction of inflammation and related consequences. However, in extreme cases, surgery is the last resort. Long-term use of these medications, on the other hand, is risky because they can cause serious adverse reactions such as gastric ulcers, Cushing's syndrome, hyperglycaemia, muscle weakness, fragile skin, purple striae, reactivation of latent infections, delayed wound healing, cataract, osteoporosis, glaucoma, and a higher probability of opportunistic infections and lymphoma development.

Preclinical research suggests that medicinal plants such as Aloe vera gel, Boswellia serrata, Cassia fistula, Lepidium sativum, Bunium persicum, Plantago ovata, Pistacia lentiscus, Bunium persicum, Solanum nigrum, Commiphora mukul, Commiphora myrrha, Ocimum basilicum, Linum usitatissimum, From an individual's standpoint, it is always preferable to ingest dietary agents that also have medical benefit since their regular usage is simple and easy to

acquire. Hippocrates, the Father of Medicine, realized this element when he said about 25 decades ago, "Let food be thy medicine, and medicine be thy food." To substantiate the importance and relevance of this adage, observations from around the world clearly show that the rate of diet-related diseases is progressively increasing as a result of increased availability of hypercaloric food and a sedentary lifestyle, both of which cause low-grade inflammation in a person[11].

According to recent research, functional foods and nutraceuticals high in polyphenols and antioxidants are beneficial due to their inherent capacity to scavenge free radicals, induce anti-inflammatory responses, maintain homeostatic regulation of the gut microbiota, and activate intestinal T regulatory cells. All of these qualities are particularly useful in the prevention and treatment of IBD. Studies have shown that the dietary agents like apple, bilberry, black raspberry, cocoa, Bael, green tea; spices like garlic, Malabar tamarind, saffron , fenugreek, ginger , turmeric; oil of olive; nutraceuticals like grape seed polyphenols; and the dietary phytochemicals like resveratrol, ellagic acid, zerumbone, quercetin, kaempferol, rutoside, and rutin are consumed regularly and are commonly used. They will be examined in depth, with an emphasis on the mechanism of action.

DIETARY AGENTS WITH ANTI-IBD EFFECTS**Apple**

Apple, additionally referred to as Malus, is a member of the Rosaceae family and a significant nutritional ingredient. It has a prominent place in human dietary and nutritional needs, and epidemiological studies have connected its intake to a lower risk of various malignancies, cardiovascular illnesses, asthma, and diabetes. Apple is high in flavonoids and phytochemicals such as quercetin glycosides, catechin, epicatechin, procyanidin, cyanidin 3 galactoside, coumaric acid, chlorogenic acid, gallic acid, and phlorizin. D'Argenio et al. discovered that rectal treatment of apple polyphenols protected rats against TNBS-induced colitis by lowering the transcription and protein levels of COX 2, TNF, calpain, and tissue transglutaminase. As a result, polyphenolic chemicals derived from apples might be used as possible therapeutic agents for UC patients.[12]

Bilberry

A native of Europe, the bilberry plant is also known by the names whinberry, mountain bilberry, whortleberry, whortles, myrtle whortleberry, tracleberry, and huckleberry. It is widely utilized to make jams, pies, cobblers, and cakes. It is known by its scientific name, *Vaccinium myrtillus* L., and is a member of the Ericaceae family. [13,14] According to phytochemical research, it contains tannins, anthocyanins including myrtillin, malvidin, cyanidin, and delphinidin, as well as flavonoids such hyperoxide, isoquercitrin, and astragaline. Regarding

its application in UC, a randomized pilot trial by Biedermann and co-workers with individuals with UC has shown that the daily intake of a standardized bilberry preparation caused 63.4% remission and 90.9% response in the volunteers. Bilberry has been utilized for the treatment of ocular disorders and is thought to be helpful for enhancing night vision, preventing the onset and progression of cataracts, treating diabetic retinopathy and macular degeneration, and preventing glaucoma.

Ginger

Ginger, a plant native to India's northern region, is one of the world's most significant culinary and therapeutic substances in a variety of different complementary medicine systems. 10 gingerol, 8 gingerol, 6 gingerol, and 6 shogaol are some of the major biologically active components of ginger extract, with 6 gingerol being antiproliferative. It has been shown to treat colds, headaches, nausea, stomach trouble, diarrhea, and aid digestion. It has also been shown to treat arthritis, rheumatological diseases, and muscle soreness, as well as work as a carminative and antifatulent. Ginger has been demonstrated in research to have antibacterial, anti-inflammatory, antipyretic, antioxidative, hypoglycemic, hepatoprotective, diuretic, and hypocholesterolaemic properties. Preclinical investigations have revealed that ginger extract pretreatment significantly reduced the amount and severity of acetic acid-induced edematous inflammation in the colon by attenuating the

degree and severity of edema, necrosis, and inflammatory cell infiltration in the mucosa. The activity of colonic MPO was similarly reduced, as were levels of lipid peroxides, protein carbonyl content, TNF, and PGE2. Ginger supplementation restored GSH, catalase (CAT), and SOD levels. The greatest dosages of ginger had a protective effect equivalent to normal sulfasalazine.[26]

Garlic

Garlic, which is formally known as *Allium sativum* and a member of the Liliaceae family, is well-known across the world for its therapeutic and culinary properties. The plant is native to Asia, and historical texts indicate that early physicians such as Hippocrates, Pliny, and Aristotle employed it for its myriad medicinal purposes. It is still used in different traditional and folk remedies today. Garlic, both raw and aged, is used in conventional medicine as a natural antiviral, antibacterial, and antifungal agent, to reduce common coughs, cure gastrointestinal illnesses, and to serve as a cardioprotective medication. [27-30]

Both water-soluble and lipid soluble organosulfur substances like S allylcysteine and S allylmercaptocysteine, as well as non metals like selenium and phytoalexins like allicin, are present in various garlic preparations and are responsible for garlic's protective properties in a number of disease models. The colon weight of rats administered garlic orally for 4 weeks and 3 days

during acetic acid-induced colitis was significantly reduced. When compared to placebo-treated colitis groups, garlic supplementation restored GSH and antioxidant enzyme levels while decreasing lipid peroxidation. In addition, garlic administration in the presence of the amino acid l arginine reduced changes in colon weight and the peroxidation of lipids and GSH concentration.

CONCLUSION

Despite there are multiple traditional and non-traditional therapy options for UC, all of them have limitations such as effectiveness, safety, and high cost. Because UC treatment typically entails treatment and maintenance of remission for the rest of one's life, these side effects take on more relevance. Herbal medications are alternative treatments used to treat UC that have considerably less adverse effects than the current medical system. As per WHO report, 80-85% of the world's population depends on plant-derived medicines, which provide significant assurance for the treatment of UC but still require more research in preclinical and clinical sectors to verify their safety, effectiveness, and utility. Despite there are multiple traditional and non-traditional therapy options for UC, all of them h. In experiments with animals, a variety of dietary supplements and phytochemicals are commonly employed to avoid or alleviate the symptoms of UC. More clinical trials are required before these bioactive substances can be declared entirely secure and efficient.

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CHAPTER-2

POLYPHENOLS AS NUTRACEUTICALS: FOCUS ON CANCER PREVENTIVE AND IMMUNO-FORTIFYING PROPERTIES

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ABSTRACT

In 21st century cancer has been considered as the major medical issue also the most serious issues among the human being globally. Cancer is the second leading cause of mortality even the availability of advanced treatment still lacks in successful therapies. In 2050, WHO estimated approximately 27 million cases with 17.5 million as annual mortality rate and it can increase the life expectancy in every human being and considered as major public health problem. The onset of cancer is associated with different pathophysiological factors like genetic mutation, inflammation, infection, exposure to radiation, occupational stress, environmental hazards and unhealthy habits of eating leads to extensive DNA damage. In cancer cases about 30-35% are linked with

dietary factors. Recent studies highlighted that plant derived foods are getting much attention due to its natural bioactive compounds, safety and biological activity. Plant phenolic compounds either monophenolic or polyphenolic compounds are natural and water-soluble compounds shown to have both treatment as well as preventing the cancer. In addition, natural polyphenols in fruits and vegetables as rich diet can reduce the occurrence of specific cancers by killing the cancer cells by its anti-inflammatory and antioxidant properties without toxicity. Nutraceuticals as food supplement can be considered as a new anticancer therapy for cancer patients with improved patient compliance. However, to establish conclusive evidence for the effect of polyphenols as dietary component in disease prevention by defining its mechanism, bioavailability and their biological activity can be evaluated. In this chapter, the authors focus on prospective application of polyphenols in nutraceuticals, with the aim of providing valuable insights into the development and utilization with specific reference towards cancer prevention and immuno fortifying properties.

Keywords: Polyphenols, phytochemicals, Natural drugs, Bioavailability, immuno fortifying properties.

Introduction

Cancer is group of disease involving abnormal cell growth with the potential to invade or spread to other parts of the body. The infections or inflammation, the

particular mutations, work stress, unhealthy eating habits or intake of toxins have been found to contribute the development and advance to cancer diseases states. Several nature bioactive compounds possess the anticancer properties have the ability to kill the cancerous cells without being toxic to their normal counterparts. By introducing the nutraceuticals supplementation may contribute to successful anticancer therapy, chemotherapy, radiotherapy, hormonal therapy and surgery. Polyphenols are a category of plant compounds that offers various health. Regularly consuming polyphenols is thought to boost digestion and brain health, as well as protect against heart diseases, type 2 diabetes, and even certain cancers. Red wine, dark chocolate, tea and berries are some of the best-known sources. A plenty of uses of grapes in making wine, beverages and other related products has made it one of the most economically important worldwide [1,2,3]. Phytochemical compounds, antioxidants and antibacterial properties of berries which have been indicate to the therapeutic or health promoting properties. Grape's polyphenols, flavonoids are considered to have biological properties, including but not limited to antioxidant, anti-inflammatory, anticancer, antimicrobial, antiviral, cardio protective, neuroprotective, and heptaprotective activities.

CLASSIFICATION OF POLYPHENOLS

In research there are more than 8000 different types of polyphenols has been

identified.

- They can be classified into different classes, according to the number of phenolic rings in their structure, the structural elements that bind these rings each other, and the substituents linked to the rings. Therefore, two main groups can then be identified: the flavonoid group and the non-flavonoid group.[4]
- Flavonoids share a structure formed by two aromatic rings, indicated as A and B, linked together by three carbon atoms forming an oxygenated heterocycle, the C ring; they can be further subdivided into six main subclasses, as a function of the type of heterocycle that is involved (flavones, flavanols, flavanones, flavanonols, neoflavanoids, isoflavones)

Non-flavonoid can be subdivided into: Simple phenols, phenolic acids, benzoic aldehydes, hydrolysable tannins, coumarins, stilbenes.

FLAVONOIDS

Phytonutrients like flavonoids have beneficial anti-inflammatory effects and they protect your cells from oxidative damage that can lead to diseases. Flavonoids are a class of poly phenolic secondary metabolites found in plants, and thus commonly consumed in the diets of humans. Therefore, two main groups can then be identified:

- The flavonoid group.
- The non-flavonoid group

FLAVONOIDS GROUP

Flavonoids share a structure formed by two aromatic rings, indicated as A and B, linked together by three carbon atoms forming an oxygenated heterocycle, the C ring; they can be further subdivided into six main subclasses, as a function of the type of heterocycle (the C ring) that is involved: flavones, flavanones, flavanonols, flavanols or flavanols, Chalcones.

NON-FLAVONOIDS GROUP

Non-flavonoids include phenolic acids, stilbenes and lignans. Several subclasses include hydroxycinnamates, stilbenes and benzoic acids. Chemically, flavonoids have the general structure of a 15-carbon skeleton, which consists of two phenyl ring and a heterocyclic ring. The main dietary sources of flavonoids include tea, citrus fruit juices, berries, red wine, apples, and legumes [4,5,6].

Example: Red peppers, Mint, Chamomile, Ginkgo biloba.

PHENOLIC ACID

Phenolic acid is one of the organic compounds that consists both a phenolic and a carboxylic group. Plant phenolic including simple phenols, phenolic acids, flavonoids, stilbenes, hydrolysable and condensed tannins, lignans, and lignin's are the most abundant secondary metabolites, produced by mainly through the

shikimate pathway from L-phenylalanine and L-tyrosine, and containing one or more hydroxyl groups attached to aromatic ring [8].

Example: p-hydroxybenzoic acid (PHBA), caffeic acid.

POLY PHENOLIC AMIDES

Poly phenolic amide type include capsaicinoids and aventhamides which are found in minimal amounts in chilli peppers and oats respectively.

Example: Cocoa powder, nuts, olives, flaxseeds.

STILBENES

Stilbenes contain two benzene rings joined by a molecule of ethanol or ethylene. Among these compounds, the trans isomer of resveratrol is produced by vines in response to fungal infections. It is mainly localized in the skin of the grapes and is therefore mainly extracted during the production of red wines; it is found at concentrations of between a few tenths of a milligram and a few milligrams per liter [9]. Stilbenes do not make a notable contribution to the colour or other sensory properties of wine, but they do appear to protect against cardiovascular disease.

Example: phytoalexins, resveratrol and piceatannol.

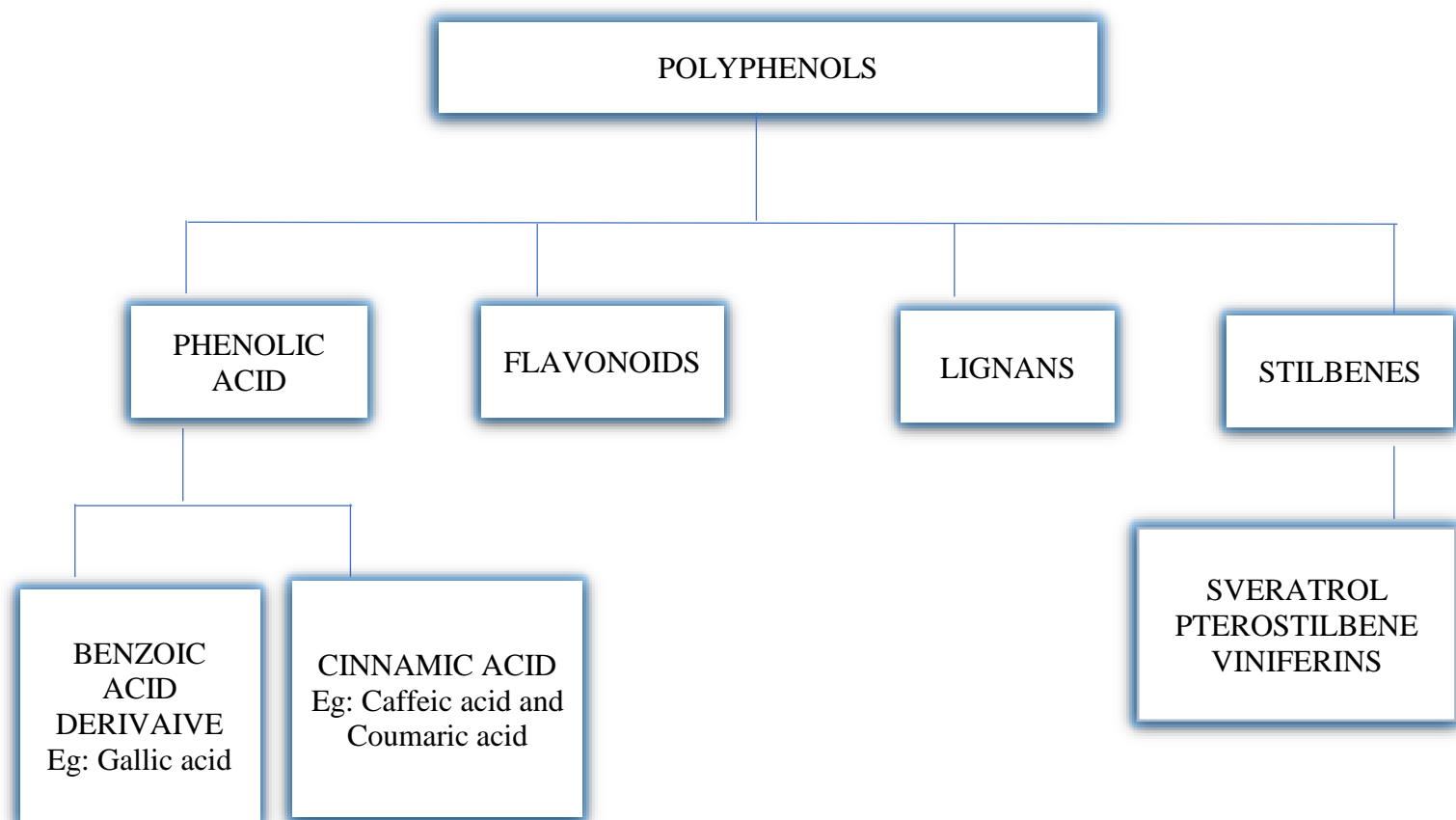
LIGNANS

Lignans are chemical compound, plant lignans in high-fibre food are precursors of mammalian lignans, which are associated with a reduced risk of cardiovascular disease and cancer. Lignans act as antioxidants and can bind to

estrogen receptors in the breast tissue.

Example: Broccoli, white cabbage, wheat bran.

CLASSIFICATION OF POLYPHENOLS



PHYTOCHEMICAL

Phytochemicals are chemical compounds produced by plants. They are generally useful to fight against the fungi, bacteria and plant virus infections.

Intake of large amount of brightly coloured fruits and vegetables, whole grain, cereals and beans containing Phytochemicals may decrease the risk of growing certain cancer cells as well as diabetes, heart disease etc., The bioactivity of phytochemicals is varied by colour and type of the food content [10,11]. They

prevent the carcinogens (cancer causing agent) for forming.

POTENTIAL BENEFITS OF PHYTOCHEMICALS

- Decrease the cancer cell growth
- Hormone regulation
- Preventing damaged cells from reproducing
- Useful to prevent and repair the DNA
- Developing the immune system

“If you are eating a high number of vegetables and fruits, then you are getting a high number of phytochemicals”, says Lindsay Wohlford, MD Anderson wellness dietitian.

PHYTOCHEMICALS	SOURCE	HEALTH BENEFITS
Carotenoids	Spinach, radish, cabbage, Tomato, orange, carrots, watermelon, broccoli, kale, corn, pink grapefruit, cantaloupe.	Dietary carotenoids are thought to provide health benefits in decreasing the risk of disease, particularly certain cancers and eye disease.
Phytosterols	Vegetable, nuts, fruits, seeds,	The consumption of phytosterol provides potential anti-cancer

	<p>bread, cereals, properties, including the legumes. downregulation of cholesterol synthesis and stimulation of immune function</p>
Limonoids	<p>Citrus fruits, seeds, peel. They reduce blood cholesterol and also reduce the incidence of several forms of Cancer</p>
Glucosinolates	<p>Cruciferous vegetables, Brassica vegetables. It inhibits Cancer by alerting the enzymes involved, by inhibiting the transcription process, and thus by blocking the cell cycle.</p>
Phytoestrogen	<p>Legumes, berries, whole grains and have been ascribed to cereals, red wine, phytoestrogens, such as a lowered risk of menopausal symptoms like hot flushes and osteoporosis, lowered risk of cardiovascular disease, obesity, breast cancer, prostate Cancer, bowel cancer.</p>
Terpenoids	<p>Mosses, liverworts, Useful in prevention and therapy</p>

(Isoprenoids)	algae, lichens, of several diseases including mushrooms, Cancer and also to have cannabis, antimicrobial, antifungal, ginkgolide, antiparasitic, antiviral, bilobalide in ginkgo antiallergenic, anti-inflammatory biloba. and immuno modulatory properties
Fibers	Fruits and Fiber is the part of plant foods vegetables, oats (fruits, vegetables, grains) that avocado, our bodies cannot digest or break raspberry, down. Fiber can help lower artichokes, cholesterol, better regulate blood almond, sugar levels, and may prevent intestinal cancer. Aim for 14 grams of fiber per 1,000 calories.
Polysaccharides	Fruits and Polysaccharides act on tumour vegetables cells are direct action (inhibition of cancer cell growth and induction of programmed cell death/apoptosis) and indirect

action (stimulation of immunity)

Saponins Oats, leaves, Saponins possess high structural flowers, and green diversity, which is linked to the fruits of tomato anticancer activities. Several studies have reported the role of saponins in cancer and the mechanism of actions, including cell-cycle arrest, antioxidant activity, cellular invasion inhibition, induction of apoptosis and autophagy.

BIOAVAILABILITY

The objective of the current analysis was to evaluate the major polyphenol classes' bioavailability to humans while taking into consideration their dietary sources and the key determinants of in vivo accessibility. Using the following terms in combination with "bioavailability," "disease," and "health," as well as "human studies" AND "controlled trials," the most significant life-science reference and abstract databases (PubMed, MEDLINE, Embase, and CAB-Abstract) were methodically analyzed (from the database's inception to October 2020). The inhibition of NADPH oxidase, which results in a decrease in

superoxide production and, consequently, an increase in endothelium NO bioavailability, is one possible mechanism by which CGA and its main plasma metabolites (5-cholorogenic acid, ferulic-4' -O-sulphate, and isoferulic-3'-O-glucuronide) mediate the vascular effects [12].

POLYPHENOL CLASS	ORAL AVAILABILITY	BIO-MAIN CYTOCHROME INTERACTION	POLYPHENOL INTERACTION	NUTRIENT INTERACTION
Anthocyanidins	1-2%	Weak CYP450 inhibitors	Not known	Lipids, cartoneoids, digestible carbohydrate s, hydrophilic, lipophilic vitamins, alkaloids, P-glycoprotein

inhibitors

Improves

flavanoids

and curcumin

Bioavailabilit

y

Flavan-3-ols 2-15% in EGCG: Green, black, Lipids,
 green tea; 5- inhibition of oolong tea cartoneoids,
 10% in cocoa activity of phenolic digestible
 CYP1A2, complex carbohydrate
 CYP3A, improves s,
 CYP2E1 EGCG hydrophilic,
 bioavailabilit lipophilic
 y vitamins,
 alkaloids, P-
 glycoprotein
 inhibitors
 Improves
 flavanoids
 and curcumin

				Bioavailabilit y
Hydroxytyrosol	High	Plausible interaction with CYP450	In olive oil tyrosol is converted into the hydroxytyrosols, ol CYP2A6 and CYP2D6	Lipids, cartoneoids, digestible carbohydrate hydroxytryos s, hydrophilic, lipophilic vitamins, alkaloids, P-glycoprotein inhibitors Improves flavonoids and curcumin Bioavailabilit y
Isoflavones	High	Genistein: PY450	Not known	Minerals, proteins and

				dietary fibres
				decrease
				flavoniods
				bioavailabilit
				y
Quercetin	<1%	CYP1A2	Not known	Minerals,
		CYP2A6		proteins and
		Inhibition		dietary fibres
				decrease
				flavoniods
				bioavailabilit
				y
Resveratrol	<1%	CYP3A4	Red wine	Minerals,
		CYP2A6	phenolic	proteins and
		CYP1A1	complex	dietary fibres
		CYP2A2	improves	decrease
		(Inhibition)	resveratrol	flavoniods
			bioavailabilit	bioavailabilit
			y	y

Curcumin	<1%	CYP3A4	Not known	Lipids,
		(Inhibition)		cartoneoids,
				digestible
				carbohydrate
				s,
				hydrophilic,
				lipophilic
				vitamins,
				alkaloids, P-
				glycoprotein
				inhibitors
				Improves
				flavanoids
				and curcumin
				Bioavailabilit
				y

MECHANISM

The second biggest cause of mortality and a significant public health issue is still cancer. It happens as a result of significant DNA damage brought on by therapeutic drugs, ionizing radiation, environmental toxins, and other factors.

In terms of all cancers, lung (12.7%), breast (10.9%), colorectal (9.7%), and stomach cancer (7.81%) are the most often diagnosed. Natural substances are the best defense against cancer since they are effective, accessible, and anti-cancerous. When it comes to natural substances, polyphenols (which include flavonoids, catechin, hesperetin, flavones, quercetin, phenolic acids, ellagic acid, lignans, stilbenes, etc.) make up a sizable and varied class that is employed in the diagnosis and treatment of cancer [13]. Natural flavonoids are obtained from a variety of plants, including *Petroselinum crispum*, *Apium graveolens*, *Flemingia vestita*, *Phyllanthus emblica*, and others that are used as medicines. Natural flavonoids have antioxidant, anti-inflammatory, and anti-cancerous properties through a variety of pathways; for example, they cause apoptosis in breast, colorectal, and prostate cancers, reduce nucleoside diphosphate kinase-B activity in lung, bladder, and colon cancers, and prevent cell proliferation and cell cycle arrest by suppressing the NF-kB pathway in a variety of cancers. The current review summarized the anticancer activities of natural polyphenols and their mechanisms of action. Chemotherapeutic drugs are used to treat advanced stages of cancer or following surgery. However, cancers often develop resistance against drugs, leading to failure of treatment and recurrence of the disease. Polyphenols are a family of organic compounds with more than 10,000 members which have a three-membered flavan ring system in common. These natural compounds are known for their beneficial

properties, such as free radical scavenging, decreasing oxidative stress, and modulating inflammation. Herein, we discuss the role of polyphenols (mainly curcumin, resveratrol, and epigallocatechin gallate [EGCG]) in different aspects of cancer drug resistance. The anticancer properties of natural polyphenols and their modes of action were described in the current review [14]. Chemotherapeutic medications are used to treat cancer in its advanced stages or after surgery. However, tumors frequently acquire drug resistance, which results in treatment failure and recurrence of the illness. More than 10,000 different chemical compounds make up the family of polyphenols, which all have a flavan ring structure with three components. These organic substances are well-known for their advantageous traits, which include fighting free radicals, reducing oxidative stress, and controlling inflammation. In this article, we go through the various facets of cancer treatment resistance and the impact of polyphenols, particularly curcumin, resveratrol, and epigallocatechin gallate (EGCG). Some of the ways through which polyphenols increase the sensitivity of cancer cells to chemotherapeutic treatments include increasing drug absorption by tumor cells, lowering drug metabolism by enzymes (e.g., cytochromes and glutathione-S-transferases), and minimizing drug efflux. Other targets for overcoming chemoresistance in cancer cells are also impacted by polyphenols, such as cell death (such as autophagy and apoptosis), EMT, ROS, DNA repair mechanisms, cancer stem cells, and epigenetics (such as

miRNAs). A significant amount of research suggests that a diet high in fruits and vegetables may help lower the risk of developing some malignancies, mostly because they contain natural polyphenols. Among the most thoroughly investigated polyphenols are resveratrol, epigallocatechin gallate, and curcumin. These chemicals' anti-inflammatory and antioxidant characteristics are responsible for the majority of the effects that have been attributed to them. Modulation of molecular activities and signaling pathways linked to cell survival, proliferation, differentiation, migration, angiogenesis, hormone activities, detoxifying enzymes, and immunological responses are a few of the numerous mechanisms at play. Although polyphenols show promise in the prevention and treatment of cancer, a significant barrier to their usage is that they frequently have a low bioavailability when given as pure active ingredients. However, these compounds can be administered in conjunction with other phytochemicals, anticancer medications, or in polyphenol-loaded nanotechnology-based delivery systems to increase their bioavailability and consequently their effectiveness. Polyphenols may be used in combination with traditional medications to create anticancer treatments that are more effective while having less negative health effects on patients [15,16]. In order to better understand the various processes by which specific foods and food components may be used to lower cancer risk, the current study concentrates on the state of knowledge about the connections between natural polyphenols

and cancer development.

CONCLUSION

Polyphenol compounds are being used for wide applications in the field of cancer biology and immunology. On broad prospect, they have been used as functional food ingredients. In lights of the report in this review, it will be interesting to use polyphenols in anticancer therapy. Although there is little information provided on the bioavailability, and their mechanism also have been discussed. This leads to their development in cancer biology and immunology. Polyphenols as nutraceuticals can be considered as a valid support in anticancer therapy. Thus nutraceutical supplementation along with anticancer properties being considered for better responses and compliance in patients. In conclusion, polyphenol have been shown to be effective against multiple targets in cancer development and progression and being considered as safe and effective approaches in cancer therapy and prevention. Therefore, future researchers must focus on extending the work on polyphenol as nutraceuticals and it is being considered as a cost effective therapeutic solution to cancer.

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CHAPTER-3

NANOFORMULATIONS FOR CENTRAL NERVOUS DISORDERS

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ABSTRACT:

Central Nervous System (CNS) disorders, encompassing conditions like Alzheimer's, Parkinson's, and brain tumors, pose immense challenges to modern medicine. Traditional treatments often face significant barriers in reaching the brain effectively. However, the advent of nanomedicine has brought forth a new era in CNS therapeutics through the development of nanoformulations. In this article, we delve into the innovative world of nanomedicine and explore how nanoformulations are revolutionizing the treatment of CNS disorders. From enhancing drug delivery across the blood-brain barrier to targeted therapies, these tiny particles are making big strides in improving the lives of patients with neurological conditions.

Key words: CNS disorder, nanoformulation, drug delivery, blood-brain

barrier, targeted therapies, neurodegenerative diseases, sustained drug release

INTRODUCTION⁽¹⁾:

The complexity of the Central Nervous System (CNS) has long been a formidable challenge in the field of medicine. Treating conditions that affect the brain and spinal cord, such as neurodegenerative diseases, brain tumors, and neurological disorders, often requires therapeutic agents to traverse the blood-brain barrier (BBB) – a highly selective and protective shield that prevents many substances from entering the brain. Traditional medications face significant hurdles in effectively reaching the CNS. However, recent advancements in nanomedicine have paved the way for innovative solutions, one of which is the use of nanoformulations.

NANOFORMULATIONS: A GLIMPSE INTO THE NANOSCALE WORLD⁽²⁾:

Nanoformulations, often referred to as "nanoparticles," represent a revolutionary approach in drug delivery at the nanoscale level, typically measuring between 1 to 100 nanometers in size. These minuscule particles are engineered with precision to encapsulate therapeutic agents, marking a significant departure from conventional drug delivery methods. Within the context of Central Nervous System (CNS) disorders, nanoformulations are increasingly being recognized as game-changers in the field of medicine.

One of the primary challenges in treating CNS disorders, such as Alzheimer's,

Parkinson's, and brain tumors, is ensuring that medications reach their intended targets within the brain and spinal cord effectively. The human body has evolved a highly selective and protective shield known as the blood-brain barrier (BBB) to protect the delicate CNS from potential harm. However, this natural defense system often poses significant obstacles to the delivery of therapeutic agents. Traditional drugs, due to their larger size and biochemical properties, encounter difficulties in bypassing the BBB and reaching the CNS in adequate quantities.

NANOFORMULATIONS, WITH THEIR MINUSCULE SIZE, OFFER A UNIQUE ADVANTAGE IN OVERCOMING THESE BARRIERS ⁽²⁾:

WORKING:

1. Encapsulation of Therapeutic Agents: Nanoformulations serve as tiny carriers designed to encapsulate therapeutic agents. These agents can include drugs, genes, proteins, or other therapeutic molecules specifically chosen to address the underlying neurological condition. The encapsulation process ensures that these agents are protected from degradation and remain stable during their journey to the target site within the CNS.

2. Precise Transport: Nanoformulations act as precision vehicles for delivering therapeutic cargo to precise locations within the CNS. This precision is crucial, especially in the treatment of CNS disorders, where pinpoint delivery is paramount. Unlike traditional medications, which may diffuse throughout

the body, nanoformulations navigate the intricate pathways of the CNS with exceptional accuracy.

3. Bypassing BBB: Perhaps one of the most significant advantages of nanoformulations is their ability to bypass certain restrictions posed by the BBB. Due to their small size and unique surface properties, these nanoparticles can traverse the BBB more effectively than conventional drugs, which are often excluded by this protective barrier.

4. Reduced Side Effects: Nanoformulations are designed to minimize exposure of healthy brain tissue to potentially harmful therapeutic compounds. This precision delivery not only enhances the efficacy of the treatment but also reduces the risk of side effects that can result from the exposure of healthy tissue to potent drugs.

5. Targeted Therapies: Functionalizing the surface of these nanoparticles allows scientists to ensure they bind specifically to diseased cells or regions within the brain. This precision minimizes collateral damage to healthy tissue and enhances the therapeutic effect. For example, in the case of brain tumors, nanoformulations can be engineered to seek out and destroy cancerous cells while leaving surrounding brain tissue unharmed.

6. Sustained Drug Release: Nanoformulations can be engineered for sustained drug release. They release therapeutic agents gradually, ensuring that the brain receives a consistent supply of medication over an extended

period. This approach is particularly promising for the treatment of progressive conditions like neurodegenerative diseases, where continuous therapy is needed to slow disease progression.

ENHANCING DRUG DELIVERY TO THE CNS⁽³⁾:

The treatment of Central Nervous System (CNS) disorders presents a unique set of hurdles, primarily centered around the need to get therapeutic medications to their intended destinations within the brain and spinal cord effectively. The human body has evolved a remarkable defense mechanism known as the blood-brain barrier (BBB) to shield the CNS from potential harm. While this natural barrier is essential for our well-being, it can pose significant challenges when it comes to administering medication for neurological conditions.

Enter nanoformulations, the tiny heroes of modern medicine. These minuscule particles are engineered to revolutionize the way we deliver drugs to the CNS. They measure between 1 to 100 nanometers in size, which is incredibly small by human standards but immensely significant in the world of medical science

1. Precision Delivery: Imagine you're trying to send a package to a specific address within a vast city. Traditional drug delivery methods are like sending a large shipment that gets distributed all over the city. It might eventually reach the right address, but it's also affecting areas where it's not needed. Now, nanoformulations are like sending a courier on a bike with GPS navigation.

They carry a payload of therapeutic agents and are meticulously designed to find their way directly to the right destination within the CNS. This precision delivery is like hitting the bullseye, ensuring that the medications reach the exact spots where they are needed most.

2. BBB Bypass: The BBB is like a security checkpoint at the entrance to an exclusive club. It lets in only a select few while keeping the rest out. Traditional drugs often find it challenging to get past this bouncer, leading to insufficient drug delivery to the CNS. Nanoformulations, however, are the VIP passes. Their tiny size and unique properties allow them to slip through this barrier with finesse. This means that therapeutic agents that would otherwise struggle to enter the CNS can now do so effectively.

3. Reduced Collateral Damage: Picture a surgical strike compared to carpet bombing. Traditional drug delivery might affect not just the target but also neighboring areas within the brain, potentially causing side effects. Nanoformulations are more like the precision strike. They minimize exposure of healthy brain tissue to potent medications, reducing the risk of side effects. This approach not only makes the treatment more effective but also gentler on the patient.

4. Enhanced Drug Efficacy: Think of nanoformulations as vehicles designed for a cross-country race, while traditional drugs are stuck in heavy traffic. Nanoformulations are built to transport therapeutic agents directly to the

intended locations within the CNS, ensuring that the drugs can perform their healing functions where they are needed most. This focused delivery significantly enhances the overall effectiveness of the treatment.

In essence, nanoformulations are like the superheroes of drug delivery in the world of CNS disorders. They are the precise messengers, the brain's VIP passes, and the guardians of healthy brain tissue. They hold the promise of not only making treatments more effective but also improving the quality of life for individuals grappling with neurological conditions. As we continue to unlock their potential through ongoing research, nanoformulations shine as a beacon of hope for patients and a testament to the incredible advancements in medical science.

TARGETED THERAPIES: PRECISION MEDICINE FOR THE BRAIN ⁽⁴⁾:

Nanoformulations bring a level of precision to the treatment of Central Nervous System (CNS) disorders that was once the stuff of science fiction. Think of them as highly skilled detectives in the intricate landscape of the brain, able to pinpoint their targets with unparalleled accuracy.

WORKING:

1. The Smart Surface: Imagine a nanoparticle as a mini-vehicle navigating the intricate roads of the brain. But what makes them truly remarkable is their smart surface. Scientists have found ingenious ways to modify the outer layer of these nanoparticles. It's like giving our detective a special set of glasses that

helps them identify their suspect in a crowded room. By functionalizing the surface of these nanoparticles, they can be programmed to recognize and bind specifically to diseased cells or regions within the brain.

2. The Precision Strike: Now, picture this nanoparticle, armed with its smart surface, homing in on a brain tumor. This is where nanoformulations show their true magic. They don't just go after any cell; they precisely target the ones causing the trouble. It's akin to our detective effortlessly identifying and apprehending the criminal in that crowded room while sparing the innocent bystanders.

3. Minimizing Collateral Damage: The real beauty of this precision is in its ability to spare healthy brain tissue. When battling something as delicate as a brain tumor, it's crucial to avoid harming the surrounding brain matter. Nanoformulations excel at this task. They seek out and destroy the cancerous cells with surgical precision while leaving neighboring brain tissue unharmed. This means fewer side effects and less damage to the vital functions controlled by the brain.

4. Enhancing Therapeutic Effect: Just as our detective's keen eye ensures the right criminal is apprehended, nanoformulations ensure that the right cells are targeted. This not only makes the treatment more effective but also reduces the chances of the condition returning. It's like getting to the root of the problem and dealing with it directly, rather than using a scattergun approach.

In the context of brain tumors, nanoformulations are akin to the world's most skilled brain surgeons, capable of removing the cancerous cells while preserving the healthy tissue that defines who we are. They're the epitome of precision in medicine, and they hold immense promise for improving the lives of those facing CNS disorders. As scientists continue to refine these techniques, we can look forward to even more remarkable breakthroughs in the field, offering hope to patients and their families.

NEURODEGENERATIVE DISEASES: A PROMISING FRONTIER ⁽⁵⁾:

Advancing the field of neurodegenerative diseases such as Alzheimer's and Parkinson's is a journey filled with unique challenges. These conditions are often chronic, progressive over time, and require long-term treatment that can be physically and mentally draining. However, in this challenging environment, nanoformulation offers a ray of hope through long-term drug release.

WORKING:

1. Neurodegenerative Diseases: Diseases such as Alzheimer's and Parkinson's are particularly challenging because they do not show cure. They need regular control and maintenance. Most patients need medications to slow the progression of these diseases, but over time, conventional treatments do not work.

2. Benefits of Nanopreparations: This is where nanopreparations come into play. Think of these as hard-working, time-release capsules. These tiny

nanoparticles can be designed to slowly release antibiotics. It's like having a trusted friend who never forgets to give you the support you need. Slow release ensures that the brain receives the drug continuously.

3. Slowing the Progression: The main goal in the treatment of neurodegenerative diseases is to slow the progression of the disease. Nanoformulation is effective in this task. They can maintain a stable therapeutic level in the brain by continuous administration of the drug. This helps stop or at least slow the progression of the disease.

4. Improve quality of life: Quality of life is important for patients and their families. Neurodegenerative diseases can be emotionally taxing, and the uncertainty of symptoms only adds to the stress. The nanoformulation is designed to provide a sense of predictability and stability by ensuring the brain continues to receive the medication it needs.

The important thing is that nanomedicines are a constant support for humans against neurodegenerative diseases. They promise not to change their commitment, providing regular medication to maintain a sense of control in the face of uncertainty. Although these conditions remain challenging, nanoagents provide a glimmer of hope for better treatment and quality of life for patients and their loved ones. This road will be long, but with the help of nanostructures, patients can face this situation more safely.

FUTURE PROSPECTS AND CHALLENGES⁽⁶⁻⁸⁾:

The future of nanoformulations for Central Nervous System (CNS) disorders holds immense promise and equally significant challenges. On one hand, the development of nanoscale drug delivery systems offers the potential to revolutionize the treatment of CNS disorders, such as Alzheimer's disease, Parkinson's disease, and brain tumors. Nanoformulations can improve drug solubility, enhance drug penetration across the blood-brain barrier, and provide sustained release, thereby optimizing therapeutic outcomes while minimizing side effects. Furthermore, they enable targeted delivery, reducing systemic toxicity and improving patient compliance. However, the field faces notable challenges. Designing safe and biocompatible nanocarriers is crucial to avoid potential toxicity concerns. Additionally, regulatory approvals and standardization of manufacturing processes remain formidable hurdles. As we navigate these challenges, the continued research and innovation in nanoformulations hold great promise for transforming the landscape of CNS disorder treatments, offering hope for improved patient outcomes and quality of life.

CONCLUSION ⁽⁹⁾:

The application of nanoformulations in CNS disorders is a testament to the power of innovation in medicine. These tiny particles are breaking down barriers, both physical and scientific, to improve the treatment of conditions that have long been intractable. As research continues and nanomedicine

evolves, we can look forward to a future where CNS disorders are managed more effectively, offering better outcomes and improved quality of life for patients. Nanoformulations are indeed unlocking the potential of nanomedicine for the brain.

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CHAPTER-4

NEWER TRENDS IN PHARMACEUTICAL COATING TECHNIQUES

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ABSTRACT:

In the rapidly evolving field of pharmaceuticals, advanced coating techniques have emerged as transformative tools, revolutionizing drug delivery systems and patient outcomes. These techniques address critical challenges related to drug stability, solubility, bioavailability, and controlled release. Among these advancements, nanocoatings have taken center stage, allowing for precise control over coating attributes. These nano-thin films not only shield drugs from degradation but also enable targeted release, ensuring maximum therapeutic efficacy. In this article, we explore the essential elements involved in drug coating, from drug properties to the coating process and control. We

delve into the equipment required for these processes, highlighting key tools like perforated coating pans, standard coating pans, spraying guns, exhaust and heating pipes, and fluidized bed coaters. Additionally, we discuss both conventional and modern coating techniques, with a focus on the latest innovations such as Magnetic Assisted Impaction Coating, Layer by Layer Coating, Solventless Coating, Wurster Coating, Electrostatic Dry Coating, Aqueous Film Coating, Plasma Enhanced CVD, and Supercell Coating. These advanced techniques hold promise for personalized medicine, reduced side effects, and improved treatment regimens, ushering in a new era of pharmaceutical excellence.

Keywords:- Pharmaceuticals, Advanced coating techniques, Drug delivery systems, Nanocoatings, Drug stability, Controlled release, Equipment for drug coating, Modern coating innovations.

INTRODUCTION⁽¹⁾:

Advanced coating techniques play a pivotal role in modern pharmaceuticals, revolutionizing drug delivery systems and enhancing patient outcomes. These techniques are crucial for overcoming challenges related to drug stability, solubility, bioavailability, and controlled release. One of the most prominent advancements in this field is the development of nanocoatings.

Nanotechnology has enabled the creation of nano-thin films with precise control over thickness, composition, and porosity. These coatings not only protect drugs from degradation but also allow for targeted release, ensuring that the therapeutic agent reaches its intended site of action with maximum efficacy.

In the realm of pharmaceuticals, the evolution of advanced coating techniques has revolutionized drug delivery and therapeutic efficacy. Coatings play a pivotal role in pharmaceutical formulations by enhancing drug stability, controlling release profiles, and improving patient compliance. This introduction to advanced coating techniques delves into innovative methodologies that have transcended traditional approaches.

In this era of pharmaceutical innovation, advanced coating techniques provide unprecedented control over drug behavior within the body. As researchers continue to explore these methods, the potential for personalized medicine, reduced side effects, and improved treatment regimens becomes increasingly tangible, ushering in a new era of pharmaceutical excellence.

ELEMENTS INVOLVED IN DRUG COATING⁽²⁻³⁾:

- Drug properties
- Design

- Coating process
- Control

EQUIPMENTS REQUIRED FOR COATING PROCESS ⁽⁴⁻⁸⁾:

The equipment involved in a coating process can vary depending on the specific depending on the specific type of coating and application, but here are some common equipment components.

i. Perforated coating pan:

It is used for the efficient and uniform coating of various product used in food and pharmaceutical industries. This specialized pan is designed with precision-engineered perforations that allow for efficient and uniform coating of various products, such as candies, chocolates, pills, or tablets. The perforations on the pan's surface facilitate an even distribution of coatings, such as flavors, colors, or protective layers, ensuring that each item receives a consistent and high-quality finish. The pan's rotation mechanism ensures thorough coverage, while excess coating material is efficiently separated through the perforations, resulting in minimal waste and enhanced productivity. Its versatile design makes it an indispensable tool in achieving superior product quality and visual appeal, making it a cornerstone in the manufacturing processes of a diverse range of consumer goods.

Working principle:

The working principle of a perforated coating pan is rooted in its ingenious design, aimed at achieving efficient and uniform coating of various objects. As the pan rotates, the products to be coated, such as candies, tablets, or confectioneries, are placed inside. The rotation causes these items to tumble and cascade within the pan. Simultaneously, a liquid or powdered coating material is introduced onto the products. The perforations on the pan's surface allow the coating material to disperse evenly, adhering to the products as they move. This controlled movement ensures a consistent coating layer on each item. Furthermore, the excess coating material, whether it's excess liquid or powder, is separated from the products as they tumble and passes through the perforations, preventing overcoating and minimizing wastage. The combination of rotation and the precise perforated surface thus creates a dynamic and effective process for achieving uniformly coated products, vital for industries requiring impeccable visual appeal and product quality.

i. Standard coating pan:

A standard coating pan is a versatile and essential piece of equipment used in various industries, particularly in pharmaceutical, food, and confectionery manufacturing. This specialized pan is designed to evenly coat solid products, such as tablets, candies, or nuts, with a thin layer of liquid or powdered

material, enhancing their appearance, taste, and texture. The coating process involves the controlled rotation of the pan, which facilitates uniform distribution of the coating material, creating a smooth and consistent outer layer on the products. These pans come in different sizes and materials, often featuring a tilted or perforated design to aid in the efficient application of coatings and the removal of excess material. Whether it's adding a protective layer to pharmaceutical tablets or creating a delectable shell on confectionery items, the standard coating pan plays a crucial role in achieving the desired end product quality.

Working principle:

The working principle of a standard coating pan revolves around a harmonious combination of motion, material, and control. This essential equipment is designed to facilitate the uniform coating of various items, such as confectioneries or pharmaceuticals. The process begins as the pan rotates on its axis, creating a dynamic environment for the products within. A controlled spray or drizzle of the desired coating material is introduced, gradually enveloping the items as they tumble and interact. The constant rotation ensures an even distribution of the coating, while the unique angle of the pan's perforations allows excess material, such as excess chocolate or sugar solution, to escape, preventing over-coating and ensuring consistent quality. The

combination of controlled motion and efficient separation of surplus material results in a flawless, uniform coating on each item. This working principle highlights the intricate balance between mechanical movement and material dispersion, culminating in a meticulously finished product that meets the highest standards of quality and appearance.

ii. Spraying guns:

Spraying guns play a pivotal role in coating equipment, serving as the precise and versatile tools that transform liquid coatings into smooth, even layers on various surfaces. These guns are meticulously designed to deliver a controlled spray pattern, ensuring efficient coverage while minimizing overspray and waste. By atomizing the coating material into fine droplets, spraying guns facilitate uniform application, whether in industrial settings for large-scale projects or in intricate tasks requiring intricate detailing. With adjustable nozzle sizes, airflow, and pressure settings, operators can customize the spray to match specific coating requirements, achieving desired thickness and finish. The evolution of spraying gun technology has not only enhanced coating efficiency and consistency but has also contributed to environmental sustainability by reducing excess material usage and promoting a greener application process.

Working principle:

Spraying guns in coating equipment operate on a fundamental principle of atomization and controlled deposition. These sophisticated devices transform liquid coatings into a fine mist of droplets, optimizing their distribution over a surface. The process begins by pressurizing the coating material, forcing it through a nozzle orifice that narrows the stream. As the pressurized liquid exits the nozzle, it encounters a high-velocity stream of air, causing the material to break into tiny droplets. The interplay of pressure, velocity, and airflow ensures uniform atomization, creating a mist with precise droplet sizes. This mist is directed toward the target surface, where the droplets adhere and form a consistent and even coating. The efficiency and quality of the spraying gun's performance are influenced by factors such as nozzle design, air pressure, coating viscosity, and operator technique. Advanced spraying gun technologies now incorporate features like adjustable nozzle patterns and digital controls, allowing for greater precision and versatility in achieving desired coating thicknesses and finishes across various industrial applications.

iii. Exhaust and heating pipes:

Top of FormIn the pharmaceutical industry, the design and maintenance of exhaust and heating pipes play a critical role in ensuring the safety, quality, and efficiency of production processes. Exhaust pipes are essential for removing

potentially hazardous fumes, gases, and particles generated during various pharmaceutical manufacturing processes. These pipes are carefully engineered to direct pollutants away from the working environment and effectively filter and treat any harmful emissions. Simultaneously, heating pipes are integral for maintaining optimal temperature conditions within pharmaceutical facilities. Precise temperature control is vital for processes such as crystallization, fermentation, and drug synthesis, where even minor temperature deviations could impact product quality and yield. By employing advanced exhaust and heating pipe systems, pharmaceutical companies can uphold strict regulatory standards, safeguard employee well-being, and consistently produce pharmaceutical products of the highest caliber.

Working principle:

In the pharmaceutical industry, exhaust and heating pipes play a crucial role in maintaining optimal operational conditions and ensuring the quality and safety of the production process. Exhaust pipes are designed to effectively remove harmful fumes, gases, and particulates generated during various pharmaceutical manufacturing processes. These pipes are strategically placed and equipped with ventilation systems to prevent the accumulation of hazardous substances, thereby safeguarding the health of workers and maintaining the purity of the pharmaceutical products.

On the other hand, heating pipes contribute to the precise control of temperature-sensitive processes within pharmaceutical facilities. These pipes are engineered to distribute and regulate heat evenly throughout equipment such as reactors, dryers, and sterilization chambers. Consistent and accurate temperature control is essential to achieving reproducible and high-quality pharmaceutical products, as certain reactions and processes are highly dependent on specific temperature ranges. Through the proper design and implementation of exhaust and heating pipes, pharmaceutical manufacturers ensure a controlled and safe working environment while adhering to stringent quality standards and regulatory requirement.

iv. **Fluidized bed coater:**

A fluidized bed coater is an innovative and versatile industrial process widely utilized in various applications, ranging from pharmaceuticals and food processing to chemical manufacturing and materials development. The process involves suspending solid particles within a gas or liquid medium, creating a dynamic "fluidized" state where the particles exhibit fluid-like behavior. This unique environment allows for precise and uniform coating of the particles with a desired material, such as a protective layer or a functional coating. The fluidized bed coater offers several advantages, including efficient heat and mass transfer, excellent mixing, and consistent coating thickness, resulting in

enhanced product quality and performance. Its adaptability and efficiency make it a vital tool for industries seeking to optimize production processes and achieve superior product characteristics.

Working principle:

The working principle of a fluidized bed coater revolves around the concept of fluidization, a process where solid particles are suspended and behave like a fluid when subjected to a controlled flow of gas or liquid. In the context of a fluidized bed coater, fine particles or granules of a material to be coated are placed in a chamber. A stream of air or other gas is then introduced from below, causing the particles to become suspended and form a fluidized bed. As the bed becomes fluid-like, the material particles start to move freely, creating a dynamic environment conducive to efficient coating. A coating solution or suspension is introduced onto the fluidized bed, and due to the particles' motion, a uniform and consistent coating is achieved as the liquid adheres to the surface of the particles. The fluidized bed coater's working principle ensures that each particle is evenly coated, enhancing the quality and performance of the coated product, whether it's pharmaceuticals, food particles, or industrial materials. This technology finds application in various industries where precise and uniform coating is essential for product functionality and quality.

CONVENTIONAL COATING TECHNIQUES ⁽²⁾:

- Direct coating.
- Immersion coating.
- Direct roll coating.
- Transfer coating.
- Heat lamination.
- Adhesive lamination
- Sugar coating
- Film coating
- Enteric coating

MODERN OR ADVANCED COATING TECHNIQUES⁽⁹⁻¹⁶⁾:**I. Magnetic Assisted Impaction Coating⁽⁹⁾:**

Magnet-assisted impaction coating is an innovative technique used in the field of surface engineering and coating applications. This process harnesses the power of magnetic fields to guide and control the deposition of particles onto a substrate surface. It involves suspending coating particles within a carrier fluid

and then subjecting them to a magnetic field, which influences their trajectory and aids in precise, directional deposition. This technology allows for the creation of uniform and adherent coatings with enhanced properties, such as improved wear resistance, corrosion protection, and surface finish. Magnet-assisted impaction coating has found applications in various industries, including aerospace, automotive, and electronics, where the need for precise and controlled coatings is critical for enhancing product performance and durability.

II. Layer by Layer coating⁽¹⁰⁾:

Layer-by-layer (LbL) coating has emerged as a highly versatile and precise technique in the field of pharmaceuticals. This innovative coating method involves the sequential deposition of nanoscale layers onto pharmaceutical particles or substrates, typically using oppositely charged materials. LbL coating offers unparalleled control over the composition, thickness, and properties of the coatings, making it invaluable for pharmaceutical applications. By carefully tailoring the layers, LbL coating can achieve various objectives, including controlled drug release, enhanced bioavailability, and taste masking. Its adaptability and ability to encapsulate a wide range of active pharmaceutical ingredients make it a promising approach for the development

of advanced drug delivery systems that meet the stringent requirements of modern pharmaceutical formulations.

III. Solventless coating⁽¹¹⁾:

Solventless coating, a pioneering approach in various industries including pharmaceuticals, represents a sustainable and eco-friendly alternative to traditional coating methods that rely on volatile organic solvents. This innovative technique eliminates the need for solvents, mitigating environmental and safety concerns while reducing production costs associated with solvent disposal and recovery. Solventless coating achieves this by utilizing various technologies such as hot melt, UV-curing, or powder coatings. In pharmaceuticals, this method finds particular significance due to its capacity to coat drug formulations efficiently and cleanly, ensuring the absence of residual solvents that could compromise product quality and safety. Moreover, solventless coating enables precise control over coating thickness, thereby improving dosage uniformity and enhancing the overall performance of pharmaceutical products. As the pharmaceutical industry continues to prioritize sustainability and product quality, solventless coating emerges as a pivotal solution, aligning with the industry's commitment to environmentally responsible and high-quality drug manufacturing.

IV. Wurster coating⁽¹²⁾:

Wurster coating, named after its inventor Dale E. Wurster, is a widely utilized technique in pharmaceutical and chemical industries for the controlled and uniform coating of particles, typically in fluidized bed equipment. This method involves suspending solid particles in a stream of air or gas within a fluidized bed chamber. A specialized spray nozzle system is used to deposit a coating material onto these particles as they circulate in the chamber. What sets Wurster coating apart is its ability to provide precise control over coating thickness and uniformity. This makes it a valuable choice for pharmaceutical applications, as it allows for the encapsulation of active pharmaceutical ingredients, thereby controlling drug release rates and enhancing stability. Moreover, Wurster coating is well-suited for taste masking, texture modification, and the development of modified-release dosage forms, contributing significantly to the advancement of pharmaceutical formulations.

Coating Technique	Description	Application
Magnetic Assisted Impaction	Involves the use of magnetic forces to guide particles onto the	Used to coat pharmaceutical particles for controlled drug release

Coating substrate surface. release.

Layer by Layer Alternating layers of Utilized for controlled drug
Coating oppositely charged release, taste masking, and
materials are deposited on stability enhancement.
a substrate.

Solventless Coating process without Commonly used for tablet
Coating the use of solvents, often coating and oral film
employing heat or preparation.
pressure.

Wurster Coating A fluidized bed coating Used for controlled release,
method where particles taste masking, and
are suspended in air and improving drug stability.
coated.

Electrostatic Film Electrostatic forces are Applied for controlled drug

Coating used to deposit a charged release and taste masking of polymer onto a substrate. tablets.

Aqueous Film Water-based coating Frequently used for tablet Coating technique where a coating to improve drug polymer film is applied to appearance and stability. a substrate.

Plasma Enhanced Chemical vapor deposition Used to modify the surface CVD enhanced by plasma to properties of create thin films. pharmaceutical materials.

Supercell Coating Utilizes a rotating drum to Suitable for coating various apply a coating to particles pharmaceutical particles for using centrifugal force. drug delivery.

V. Electrostatic Dry Coating⁽¹³⁾:

Electrostatic dry coating is an innovative and environmentally friendly method used in pharmaceutical manufacturing to apply a uniform and precise coating onto solid dosage forms without the need for solvents or aqueous solutions. In this technique, pharmaceutical particles are charged electrostatically, creating a static charge on their surface. Then, a coating material of opposite charge is introduced into the coating chamber. The charged pharmaceutical particles attract the coating material, resulting in the formation of a thin, even layer on the particle's surface. Electrostatic dry coating offers several advantages, including reduced production time, cost-effectiveness, and the ability to coat temperature-sensitive or moisture-sensitive drugs effectively. This technique is particularly well-suited for taste masking, modified-release formulations, and the production of tablets with a controlled release profile, making it a valuable addition to the arsenal of pharmaceutical coating methods.

VI. Aqueous Film coating⁽¹⁴⁾:

Aqueous film coating is a widely used pharmaceutical coating technique known for its efficacy and safety in the pharmaceutical industry. It involves the application of a thin, uniform, and water-based film onto solid dosage forms such as tablets, capsules, or pellets. Unlike traditional solvent-based coating methods, aqueous film coating is environmentally friendly, reducing the risk of solvent-related impurities in the final product. It offers several advantages,

including improved tablet appearance, taste masking, protection against moisture, and enhanced stability of active pharmaceutical ingredients. Aqueous film coatings are also customizable, allowing pharmaceutical manufacturers to achieve various finishes, colors, and functionalities. With its compatibility with a wide range of pharmaceutical formulations and its compliance with stringent regulatory standards, aqueous film coating continues to be a preferred choice for enhancing the quality and performance of pharmaceutical products.

VII. Plasma enhanced CVD⁽¹⁵⁾:

Plasma-enhanced chemical vapor deposition (PECVD) is a cutting-edge thin film deposition technique that has found widespread application in various industries, including semiconductor manufacturing, optics, and microelectronics. Unlike conventional chemical vapor deposition (CVD), PECVD relies on the use of a low-pressure plasma to enhance the deposition process. In PECVD, a precursor gas is introduced into a vacuum chamber, where it is exposed to a plasma discharge created by radiofrequency (RF) or microwave energy. This plasma energizes the gas molecules, leading to chemical reactions and the formation of a thin film on the substrate surface. PECVD offers several advantages, including precise control over film thickness, composition, and properties, making it ideal for creating complex multilayer

structures, semiconductors, optical coatings, and advanced materials with tailored characteristics. Its versatility and ability to deposit high-quality films at relatively low temperatures make PECVD an indispensable technology in the development of next-generation electronic devices and advanced functional coatings.

VIII. Supercell Coating⁽¹⁶⁾:

Supercell coating is an emerging and highly promising technique within the realm of pharmaceuticals. This innovative coating method involves the use of supercritical fluid technology to precisely apply a thin, uniform layer of pharmaceutical coating onto particles or substrates. Supercell coating offers several advantages, including the ability to coat sensitive or heat-labile drugs without the need for high temperatures or organic solvents, thus reducing the risk of drug degradation. Additionally, supercritical fluids can be easily removed from the final product, leaving behind a clean and well-defined coating. This technique holds great potential for improving drug solubility, bioavailability, and controlled release, addressing some of the key challenges in pharmaceutical formulation. As research and development in supercell coating continue to advance, it is likely to play a pivotal role in the development of next-generation pharmaceutical products with enhanced therapeutic efficacy and reduced side effects.

CONCLUSION⁽²⁾:

Advanced coating techniques represent a transformative frontier in materials science and engineering. These cutting-edge methods have ushered in a new era of innovation, offering remarkable enhancements in a wide array of industries, from aerospace and automotive to electronics and healthcare. Through precise control of thin film deposition, nanomaterial integration, and surface modification, these techniques empower us to develop materials with unprecedented properties, such as enhanced durability, tailored functionalities, and improved environmental sustainability. As technology continues to evolve, advanced coatings will undoubtedly play a pivotal role in shaping the future of materials and ushering in breakthroughs that will benefit society in myriad ways, from energy efficiency and corrosion resistance to medical device advancements and beyond.

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CHAPTER-5

A BRIEF INTRODUCTION ON MACROALGAE AS A FEEDSTOCK FOR BIOETHANOL AND SOME SELECTED HYDROLYSIS METHODS EFFECTS ON BIOETHANOL PRODUCTION

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Abstract

The present concerns of fossil fuel resource depletion and environmental changes have intensified concern for the search for sustainable renewable energy for future generations. Biofuels have emerged as a promising feasible replacement for conventional fossil fuels. Bioethanol, a potential gasoline substitute, faces challenges in finding suitable feedstock, eco-friendly strategy, and economically viable manufacturing methods. Because of food security issues and inflated manufacturing procedures, first-generation and second-generation bioethanol are unsustainable, prompting a search for third-generation bioethanol feedstock from marine Macro algae. In terms of food security and environmental effects, the incorporation of algae (macroalgae) as a sustainable feedstock for bioethanol has attracted international interest. In recent years, there has been a spike in research on algal utilization in

bioethanol, which is expected to become one of the key driving factors in the bioethanol sector. As a result, this research focuses on the possibilities and prospects of third-generation bioethanol feedstock. This review can be useful in generating suggestions for future research that can be used to commercialize bioethanol from third-generation feedstock.

Introduction

Fast industrialization and fast population expansion are two main contributors to the global energy dilemma. The man was so reliant on non-renewable feedstock, such as fossil fuels, for his daily requirements. Unfortunately, the widespread use of fossil fuels has resulted in issues such as depletion of reserves, price fluctuations, severe environmental consequences, and climate change. The fact that the bulk of energy is produced from fossil fuel reserves, while only around 10% is produced from renewable energy sources, confirms the worrying pace of reliance on fossil fuel reserves. As a result, the primary task for the modern world is to identify new renewable energy supplies that can alleviate these challenges for future energy growth. Because of the significant drop in fossil fuel supply over the last several decades, biofuels have emerged as a possible alternative to alleviate the energy problem to a larger extent. The main advantages of biofuels over fossil fuels are their ability to reduce greenhouse gas (GHG) emissions, continuous supply of feedstock throughout the year, ease of cultivation, harvesting, and transportation, and

unique properties that contribute to improved engine efficiency. Liquid biofuels, such as bioethanol, are expected to be at the top of the 'biofuel ladder' by 2050 due to their efficacy in replacing gasoline in the transportation sector. In other words, bioethanol is a prospective worldwide fuel alternative due to its readily biodegradable nature, which paves the way for addressing existing environmental challenges. The ease of availability of feedstock in terms of geographical dispersion is critical in the development and commercialization of bioethanol. The biofuels business, particularly bioethanol, is predicted to create numerous chances for socioeconomic growth across a wide range of industries. After the introduction of the internal combustion engine in the early 1800s, the industrial potential of ethanol was examined. According to Morris, during the end of the 1800s, the sale of ethanol in the United States topped 25 million gallons per year because it was used as lamp fuel. However, the onset of the Civil War compelled the government to levy a tax on ethanol in order to support the war, which nearly destroyed the ethanol business. Concerns about the restricted usage of ethanol persisted until the 1970s oil crisis, when the use of ethanol as a fuel was resurrected in 1970S. Bioethanol provided about 85% of the global output of biofuels between 2000 and 2007. For bioethanol synthesis, a wide range of possible feedstock from across the world can be used . However, the quest for a suitable feedstock for bioethanol has resulted in the creation of three generations thus far, namely the first

generation generated from edible crops, the second generation from non-edible crops, and the third generation from algal feedstock. Because of its ease of availability and enormous commercialization potential, third-generation feedstock is now the focus of biofuels research. Until recently, the majority of published evaluations have mostly focused on the sustainability of microalgae as a biofuel feedstock. At some point, the distinctiveness of macroalgae properties contains enormous potential to be emphasized further. As a result, the review's uniqueness is to provide a full utilisation of both micro- and macroalgae in biofuels applications, especially third generation bioethanol production. This study emphasises the significance of third generation bioethanol, covering its feedstock, geographical distribution, conversion methods, economic and financial issues, and commercial feasibility. Technically, this review seeks to recommend some strategies for better commercialization of third generation bioethanol in Asia. A strong understanding of the relevance of bioethanol production prepares the path for its application as a flexible, high performance transportable fuel .

Biofuels

When compared to fossil fuels, biomass-based bioethanol production is more sustainable and broadly disseminated.

There are now three generations of bioethanol that have thrived depending on

distinct feedstock. First-generation bioethanol is produced by fermenting glucose found in starch and sugar crops. However, because the feedstock is generated from food sources, the primary disadvantage of first-generation bioethanol is the concern of food supply constraint, which may influence the human global population. Millions of people worldwide are now suffering from hunger and malnutrition, and the use of food resources for fuel may cause food prices to rise. According to Ritslaid et al., first generation bioethanol is commercially unviable since the carbon contents of the plants are mainly lost during the conversion process. Given this constraint, the researchers devised a more technologically efficient and adaptable solution, second generation bioethanol. The second-generation bioethanol' developed as a boon to overcome the 'food vs fuel' dispute that plagued first generation bioethanol. Second generation bioethanol, often known as "advanced biofuels," is generated by new procedures that primarily use lignocellulosic feedstock and agricultural forest leftovers. The benefits of these feedstocks include their ease of availability, the fact that they do not compete with food, and hence have a far lower environmental effect. However, the greatest barrier to commercial scale-up of second-generation bioethanol was owing to technical problems. Because of its lignin composition, bioethanol has a high cost and a mediocre yield. Another major issue with second generation bioethanol production is the need for advanced technology and infrastructure to help in the conversion

process. Furthermore, logging and forest clearing are required for the gathering of feedstock such as woody biomass, which can devastate the environment. As a result, developing bioethanol from maritime plants is a difficult task since they have a tremendous potential for producing enormous volumes of biomass. Third generation bioethanol offers greater advantages than first- and second-generation bioethanol. The utilisation of marine organisms such as algae is crucial to third generation bioethanol. can decrease agricultural plant feedstock competition. Because of its high lipid and carbohydrate content, high proton conversion, ease of culture in a wide range of water environments, relatively low land utilisation, and high carbon dioxide (CO₂) absorption, algae is a viable alternative feedstock. According to Schenk et al. , the highest theoretical output for algal biomass generation has been predicted to be 365 tonnes of dry biomass per hectare per year. Above algae have a low lignin and hemicellulose content, making it suitable for use in bioethanol synthesis. Although research on the use of algal feedstock in bioethanol is still in its early stages, it has enormous potential as a suitable feedstock for commercial bioethanol production in the future.

Third generation bioethanol feedstock

Because algae may be converted directly into energy, it is being explored as a viable feedstock for the production of third generation bioethanol. In general, the use of this feedstock for bioethanol production is influenced by variables

such as technology and the marine environment. Macroalgae, often known as seaweeds, are common and have been utilised as a marine vegetable in Asian nations such as China, Japan, and Korea for millennia. Despite the fact that seaweeds contain high levels of proteins, vitamins, amino acids, growth hormones, and minerals and are regarded adequate for a meal, consumers do not use them as a primary source of energy in their daily lives. Seaweeds were widely used in the food business, including the manufacturing of agar, alginate, carrageenan, and as a gelling agent. Because seaweeds are available all year, it is one of the most significant cultivated marine biomasses. In addition, seaweeds provide sustenance and shelter for other marine living species. Because seaweeds are available all year, it is one of the most significant cultivated marine biomasses. In addition, seaweeds provide sustenance and shelter for other marine living species.

Brown (Phaeophyceae), red (Rhodophyceae), and green (Chlorophyceae) seaweeds are divided into three families. Seaweeds are classified into three major compositions: carbohydrates, proteins, and lipids, with the quantity of each component varying substantially. The structural cell wall of seaweeds is often composed of a matrix of linear sulphated galactan polymers. Several studies recommended seaweeds as one of the most promising feedstocks for readily converting to bioethanol, owing to their low or free lignin composition. Brown seaweeds include carbohydrates such as laminaran, mannitol, fucoidan,

cellulose, and alginates. The cell wall of red seaweed is composed of polysaccharides such as agar, cellulose, xylene, mannan, and carrageenan, whereas the cell wall of green seaweed is composed of cellulose, mannose, and xylene. In comparison, red seaweed has the greatest carbohydrate composition among the three varieties of seaweeds.

Numerous researches on seaweeds have recently been undertaken, particularly on the possibilities of its composition. Carbohydrates have a high ratio presence in seaweeds, therefore converting this component into bioethanol is critical throughout the manufacturing phase.

Hydrolysis, fermentation and purification of TGB feedstock

Because of their ease of cultivation and availability, algae are now used to produce bioethanol all over the world. Algal feedstock has the potential to be transformed into bioethanol using extraction methods such as thermo-chemical or biological. The process of producing bioethanol is lengthy and varies depending on the type of feedstock utilised. In general, the first stage in handling fresh algae gathered from the sea is drying, which is necessary to maintain the crude extract and prevent the algae from gelling. The feedstock must be reduced in size to enhance surface area for further analysis. Algae powder and slurry are often utilised for the following phase in the process, which comprises hydrolysis followed by fermentation.

Hydrolysis

Hydrolysis of algal internal components is crucial for bioethanol synthesis, with cell walls depolymerizing primary structures to extract polysaccharide contents like alginates, fucans, laminaran, agarans, carrageenans, and ulvans. The polysaccharide will undergo degradation into free monomer molecules, which can be easily fermented into bioethanol. Enzymatic hydrolysis is a recent method that has gained global attention from researchers.

Acid hydrolysis

sulfuric acid (H_2SO_4), can significantly enhance the release of simple sugars from polysaccharides, a process that has been extensively utilized in hydrolysis. Polysaccharides from brown, red, and green macroalgae classes can be successfully hydrolyzed to monosaccharides by dilute H_2SO_4 treatment at high temperatures. The acid's function in hydrolysis may be observed in its ability to disrupt the bonds that link the lengthy chains of polysaccharides.

Binod et al. discussed this in the first phase. There are elements that alter the outcomes of other metabolic stages that are not rate limiting. Fermentation is frequently performed using microorganisms such as bacteria, yeast, and fungus. Because of its properties such as excellent selectivity, minimal buildup of by-products, high ethanol production, and rapid pace of fermentation, *Saccharomyces cerevisiae* (yeast) is the most often used strain in bioethanol fermentation. Enzymatic hydrolysis is a technique used to convert complex sugars into their simple form, aiming to reduce environmental negative

impacts. Cellulases are the enzymes most commonly used in enzymatic hydrolysis to digest polysaccharides, and they are classified into three types: endo-glucanases, exo-glucanases, and -glucosidase. Endoglucanases have the capacity to hydrolyze the complex sugars of the feedstock by targeting the internal sections of the amorphous area of cellulose, according to Carere et al. Exo-glucanases breakdown cellulose by cleaving cellobiose units off the non-reducing end of a cellulose fibre to allow the enzyme to attack. The cellobiose residues were ultimately broken into two units of glucose by the joint efforts of -glucosidase. The physical structure of the feedstock or substrate, as well as its interaction with the enzymes, are some of the elements that must be adequately handled during the process. Enzyme adsorption and the formation of enzyme-substrate complexes are regarded as essential processes in enzymatic hydrolysis.

The enzymes will break down the algae's cell wall to liberate additional monosaccharide from the feedstock. The binding of the enzymes to the algal feed stock in the process will break the polysaccharide bonds. As a result, enzyme concentration falls and conversion into bioethanol occurs during the fermenting process. According to Meng and Ragauskas, the accessibility of a reactive cellulose surface is the primary obstacle to successful enzymatic hydrolysis. However, algal-based feedstock has superior properties in terms of porosity, which can improve enzyme interaction during hydrolysis. It has

been demonstrated that the accessibility of enzyme into the substrate during hydrolysis is via cell wall pores, which is a key contribution to the effective hydrolysis process. The comparison of acid and enzymatic hydrolysis procedures is shown in Table 1.

Fermentation

With the aid of a few microbes, the simple sugars generated during the hydrolysis stage may be quickly transformed to bioethanol. Bioethanol, along with a few byproducts such as CO₂ and water, is the primary result of fermentation. The expression of microorganisms utilised in fermentation is one of the key elements influencing the outcomes of subsequent metabolic stages that are not rate limiting. Bacteria, yeast, and fungus are all examples of microorganisms.

Because of its great selectivity, minimal buildup of by-products, high ethanol production, and rapid pace of fermentation, *Saccharomyces cerevisiae* (yeast) is the most often used strain in bioethanol fermentation. Park et al. discovered that *Brettanomyces custersii* can ferment galactose in mixed sugars, highlighting the increasing use of innovative fermentation technology in advanced bioethanol production, including separated hydrolysis and simultaneous saccharification and fermentation.

Separated hydrolysis and fermentation (SHF)

SHF's fundamental mechanism is based on the separation of hydrolysis and

fermentation into two different processes. As in the standard bioethanol manufacturing method, hydrolysis will be carried out first to breakdown the feedstock into monomer sugars using enzyme. This is followed by the fermentation reaction, which uses the sugars generated during the hydrolysis stage. However, one significant issue with the SHF method is end product suppression by sugars generated during hydrolysis.

Simultaneous saccharification and fermentation (SSF)

In SSF, the hydrolysis and fermentation processes are carried out concurrently in a single phase involving a single reactor.

During the process, the feedstock, enzyme, and yeast are mixed in an ordered fashion, allowing the sugars released to be quickly transformed into bioethanol. By eliminating the remaining sugar, SSF can minimise end-product inhibition. If the SSF reaction conditions are optimal, a higher bioethanol yield can be produced.

Table -1

Comparison of acid and enzymatic hydrolysis [63]

Parameters	Acid	Enzymatic
Time	Short	Long
Cost	Low	High
Temperature	High	Mild

Product inhibition	No	Yes
Sugar yield	Low	High
Equipment corrosion	Yes	No
Undesirable by-products	Yes	NO

Table -2

Acid hydrolysis and macroalgal fermentation under different conditions for bioethanol production

MacroAlgal feedstock	Hydrolysis parameters	Fermenting microorganism	Parameters for fermentation	Bioethanol yield (g/g)	Reference
Eucheuma cottonii	5% (w/v) H ₂ SO ₄ , 100 °C, 30–120 min, pH 5.0	S.cerevisiae	10% (v/v) Saccharomyces cerevisiae, 28–30 °C, 36–168 h.	0.046	64
Kappaphycus alvarezii	5% (w/v) H ₂ SO ₄ ,	Saccharomyces cerevisiae	5% (v/v) Saccharomyc	0.0390	65

100 °C, 60 (NCIM 3523) es cerevisiae,
 min, pH 30 °C, 150
 5.5 rpm, 48 h, pH
 6.4–6.8

Table-3

Bioethanol generation using enzymatic hydrolysis and algal fermentation under various circumstances

MacroAlgal feedstock	Hydrolysis parameter	Fermenting microorganism	Parameters For fermentation	Bioethanol yield (g/g)	Reference
Gracilaria salicornia	amount of enzyme (0.5% (w/v) cellulase), 40 °C, 26 h, pH 5.0	Escherichia coli (KO11)	30 °C, 50 h	0.079	131

- Conclusion : both acid hydrolysis and enzymatic hydrolysis are important methods to improve bioethanol yield and using macroalgae for bioethanol production will not cause food security problems for human beings and macroalgal biofuels will cease the environmental hazards.

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CHAPTER-6

A STUDY ON SPIRAL OPTIMIZATION TECHNIQUES AND ITS SALIENT FEATURES

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Abstract

All objects in the universe must be optimized using distance and time, but optimization of spherical objects appears to be challenging, the field of spiral optimization algorithms (SOA) has emerged. This study focuses on the Spiral Optimization Algorithm and its variants, in particular when it comes to spherical framework objects that need to be optimized over time or distance.

KEYWORDS: Spiral Optimization Algorithm, Spiral Model, Spherical Structure, Spinning Mills, Communication gap, Industries.

1.1 INTRODUCTION

Optimization is a powerful tool that can aid in what-if analysis and reveal where improvements can be made or where trade-offs may need to be made in engineering problems. Optimization is divided into different categories, including statistical techniques and probabilistic methods. A mathematical algorithm is used to evaluate a set of data models and choose the best solution. The problem domain is specified by constraints, such as the range of possible values for a function. A function evaluation must be performed to find the optimum solution. Optimal solutions will have a minimal error, so the minimum error is zero. Optimization plays an important role in our day-to-day life. There are number of techniques of optimizations are available to find the solution in various field like engineering as well as non-engineering areas.

1.2 OPTIMIZATION TECHNIQUES

Optimization, also known as mathematical programming, is a collection of mathematical principles and methods used for solving quantitative problems in many disciplines, including physics, biology, engineering, economics, and business. The subject grew from a realization that quantitative problems in manifestly different disciplines have important mathematical elements in common. Convex optimization problems arise frequently in many different fields, and recognizing them and finding the most appropriate

technique for solving them is crucial. There are various optimization techniques, including particle swarm optimization, genetic algorithms, and topology optimization, that can be used to solve different types of problems. Optimization on Riemannian manifolds is a modern framework that spans many areas of science and engineering, including machine learning, computer vision, signal processing, dynamical systems, and scientific computing.

Optimization problems typically have three fundamental elements. The first is a single numerical quantity, or objective function, that is to be maximized or minimized. The objective may be the expected return on a stock portfolio, a company's production costs or profits, the time of arrival of a vehicle at a specified destination, or the vote share of a political candidate. The second element is a collection of variables, which are quantities whose values can be manipulated in order to optimize the objective. Examples include the quantities of stock to be bought or sold, the amounts of various resources to be allocated to different production activities, the route to be followed by a vehicle through a traffic network, or the policies to be advocated by a candidate. The third element of an optimization problem is a set of constraints, which are restrictions on the values that the variables can take[6]. For instance, a manufacturing process cannot require more resources than are available, nor can it employ less than zero resources. Within this broad framework,

optimization problems can have different mathematical properties. Problems in which the variables are continuous quantities (as in the resource allocation example) require a different approach from problems in which the variables are discrete or combinatorial quantities (as in the selection of a vehicle route from among a predefined set of possibilities).

1.3 CLASSIFICATION OF OPTIMIZATION TECHNIQUES

Optimization techniques are used to find the optimal value of a function given certain constraints. There are three main elements to solve an optimization problem: an objective, variables, and constraints. The objective is the desired result or goal of the problem, while the variables can have different values, and the constraints limit the possible values of the variables. There are many different optimization techniques that can be used, depending on the specific problem and constraints. Overall, optimization techniques are an important tool for finding the optimal value of a function given certain constraints, and there are many different techniques that can be used depending on the specific problem and constraints.

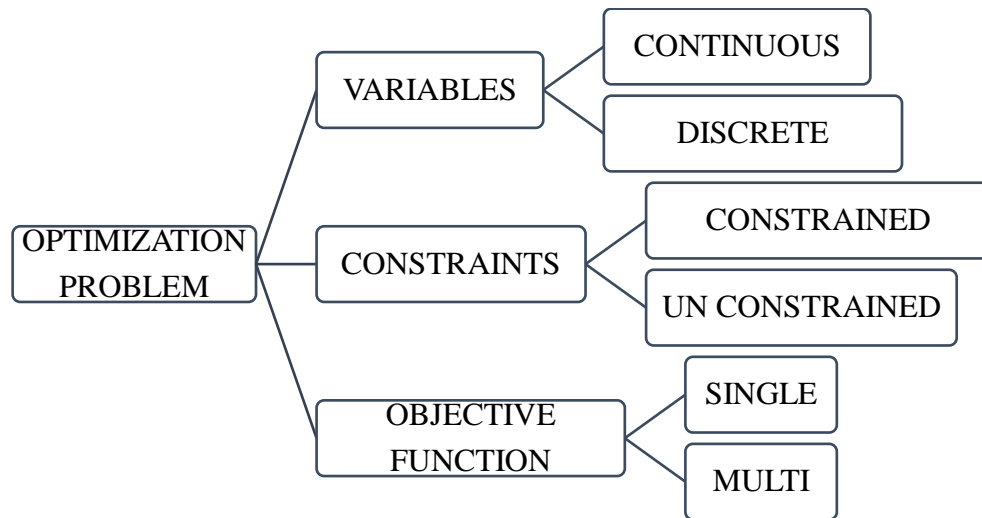


Figure 1- Classification of Optimization

There are different types of optimization problems. A few simple ones do not require formal optimization, such as problems with apparent answers or with no decision variables. But in most cases, a mathematical solution is necessary, and the goal is to achieve optimal results. Most problems require some form of optimization. The objective is to reduce a problem's cost and minimize the risk.

1.3.1 Genetic Algorithm:

A genetic algorithm (GA) is a method for solving both constrained and unconstrained optimization problems based on a natural selection process that mimics biological evolution. The algorithm repeatedly modifies a population of individual solutions.

1.3.2 Quadratic Algorithm:

The process of finding the maximum or minimum value of functions is

called optimisation. For the quadratic function $y = ax^2 + bx + c$ $y = a x^2 + b x + c$, we have already seen that the vertex has x -coordinate $-\frac{b}{2a}$. We need to identify a situation's maximum or minimum value in many cases.

1.3.3 Linear Programming:

Linear programming is an optimization method to maximize (or minimize) an objective function in a given mathematical model with a set of requirements represented as linear relationships

1.3.4 Ant colony optimization:

Ant colony optimization (ACO) is an optimization algorithm which employs the probabilistic technique and is used for solving computational problems and finding the optimal path with the help of graphs. From: Applications of Big Data in Healthcare, 2021.

1.3.5 Particle Swarm Optimization:

PSO is a stochastic optimization technique based on the movement and intelligence of swarms. In PSO, the concept of social interaction is used for solving a problem. It uses a number of particles (agents) that constitute a swarm moving around in the search space, looking for the best solution.

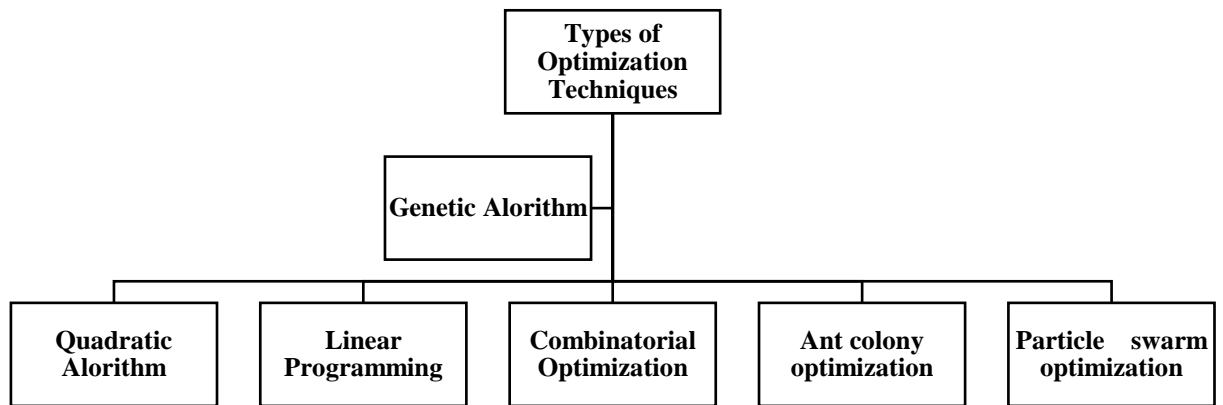


Figure 2 - Types of Optimization Techniques

1.3.6 SPIRAL OPTIMIZATION ALGORITHM

In Mathematics, the spiral optimization (SPO) algorithm is a metaheuristic inspired by spiral phenomena in nature. Spiral optimization algorithm was first proposed for 2-D unconstrained optimization. It was extended for n-D spiral models.

Spiral Optimization Algorithm (SOA) is an optimization technique developed recently. SOA is proposed to solve Combined Economic and Emission Dispatch. Numerical results on three test systems are presented and compared.

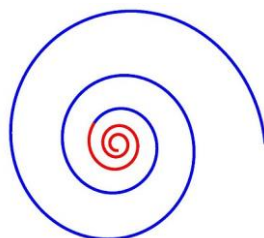


Figure 3- Spherical Structure

The Spiral Optimization Algorithm (SOA) is a metaheuristic inspired by spiral phenomena in nature. The algorithm was first proposed for two-dimensional unconstrained optimization based on two-dimensional spiral models. It was later extended to n-dimensional problems by generalizing the two-dimensional spiral model to an n-dimensional spiral model. The SOA algorithm searches continuous space using no gradient and only spiral trajectories composed of spiral vectors generated by deterministic spiral models. There are effective settings for the SOA algorithm, including the periodic descent direction setting and the convergence setting. The conditions relating to the sizes and directions of the spiral vectors and the initial search points are based on direct search theory and recent SOA algorithm theories. The presented convergence was numerically verified using test functions with different properties. Preliminary studies have shown the effectiveness of the SPO algorithm compared to other metaheuristics such as Particle Swarm Optimization (PSO). The algorithm has been applied to various optimization problems, including constrained mean-variance portfolio optimization problems, optimal sizing strategies for hybrid electric air-ground vehicles, and microelectronic thermal management problems [7,9].

1.4 SPIRAL MODEL

- It is the combination of waterfall model and iterative model.

- Each phase in spiral model begins with design goal and ends with client reviewing.
- Software is developed in a series of increment releases.

BENEFITS OF THE SPIRAL MODEL

As mentioned before, the spiral model is a great option for large, complex projects. The progressive nature of the model allows developers to break a big project into smaller pieces and tackle one feature at a time, ensuring nothing is missed. Furthermore, since the prototype building is done progressively, the cost estimation of the whole project can sometimes be easier.

LIMITATIONS OF THE SPIRAL MODEL

Limitations of the spiral model include:

- **High cost** - The spiral model is expensive and, therefore, is not suitable for small projects.
- **Dependence on risk analysis** - Since successful completion of the project depends on effective risk handling, then it is necessary for involved personnel to have expertise in risk assessment.
- **Complexity** - The spiral model is more complex than other SDLC options. For it to operate efficiently, protocols must be followed closely. Furthermore, there is increased documentation since the model involves intermediate phases.

- **Hard to manage time** - Going into the project, the number of required phases is often unknown, making time management almost impossible. Therefore, there is always a risk for falling behind schedule or going over budget.

PRELIMINARIES

(a) SOA Definition:

In Mathematics, the **Spiral Optimization (SOA) Algorithm** is a metaheuristic inspired by spiral phenomena in nature.

$$x_{k+1} = rR^{(n)}(\theta)x_k - (rR^{(n)}(\theta) - I)x^*$$

where r is the spiral radius;

$R^{(n)}(\theta)$ is the rotational matrix of order $n \times n$, θ is the spiral rotation angle, I is the identity matrix of order $n \times n$, x^* is the spiral center, $x^{(k)}$ and $x^{(k+1)}$ are the search point positions at iterations k and $k+1$, respectively. The rotational matrix $R^{(n)}(\theta)$ for an n -dimensional case on an arbitrary $x_i x_j$ - plane is given as

$$R^{(n)}(\theta) = \begin{bmatrix} 1 & 0 & 0 & \dots & 0 & 0 & 0 \\ 0 & 1 & 0 & \dots & 0 & 0 & 0 \\ 0 & 0 & \cos(\theta_{i,j}) & \dots & -\sin(\theta_{i,j}) & 0 & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots & \vdots & \vdots \\ 0 & 0 & \sin(\theta_{i,j}) & \dots & \cos(\theta_{i,j}) & 0 & 0 \\ 0 & 0 & 0 & \dots & 0 & 1 & 0 \\ 0 & 0 & 0 & \dots & 0 & 0 & 1 \end{bmatrix}$$

It is to be noted that the model generated the spiral trajectories around the

center x^* and these trajectories are classified into two types:

- If $r > 1$ and $\theta \in (-\pi/2, \pi/2)$, the trajectory is a conventional spiral;
- If $r < 1$ and $\theta \in (-\pi/2, \pi/2)$, the trajectory is a hypotrochoid spiral.

From the above classification, the spiral's direction of rotation based on the value of θ is classified as follows:

- If $\theta \in (-\pi/2, 0)$, the rotation of trajectory is clockwise;
- If $\theta \in (0, \pi/2)$, the rotation of trajectory is anticlockwise.

The spiral trajectories for a two-dimensional system for various values of $r \in [-1, 1]$ and $\theta = \pi/8$. Similarly, the trajectories for various values of $\theta \in [-\pi/2, \pi/2]$ and $r = 0.85$ for conventional spiral and $r = -0.85$ for hypotrochoid spiral. Further, the conventional and hypotrochoid spiral trajectories for both positive and negative values of θ .

(b) METHODOLOGY

1. Set the number of search points $m \geq 2$ and the maximum iteration number k_{\max} .
2. Place the initial search points $x_i(0) \in R^{(n)}$ ($i=1, 2, 3, \dots, m$) and determine the center $x^*(\theta) = x_{ib}(0)$, $i_b = \operatorname{argmin}\{f(x_i(0))\}$, and then set $k = 0$.
3. Decide the step rate $r(k)$ by a rule.
4. Update the search points: $x_i(k+1) = x^*(k) + r(k) \cdot R(\theta) (x_i(k) - x^*(k))$ ($i=1, 2, 3, \dots, m$).

5. Update the center :

$$x^*(k+1) = \begin{cases} x_{ib}(k+1) & (\text{If } f(x_{ib}(k+1)) < f(x^*(k))) \\ x^*(k) & (\text{otherwise}) \end{cases} \quad \text{where } i_b =$$

$$\operatorname{argmin}\{f(x_i(k+1))\}, i = 1, \dots, m$$

6. Set $k = k+1$. If $k = k_{\max}$ is satisfied then terminate and output $x^*(k)$. Otherwise, return to step 3.

1.5 TYPES OF SPIRAL OPTIMIZATION ALGORITHM

1. Logarithmic Spiral:

This spiral is related to Fibonacci numbers, the golden ratio, and the golden rectangle, and is sometimes called the golden spiral. The logarithmic spiral can be constructed from equally spaced rays by starting at a point along one ray, and drawing the perpendicular to a neighboring ray.

2. Archimedean Spiral:

If a line rotates in a plane about one of its ends and, at the same time, if a point moves along the line in one direction, then the curve traced out by the moving point is called a spiral. If the point is moving with a constant speed along the line that rotates with constant angular velocity, then the spiral traced by the point is called Archimedean Spiral. The point about which the line

Archimedean Spiral

(with three convolutions)

Equation of the spiral: $\rho = b\theta$ Number of convolutions: $n = \frac{\theta}{2\pi}$

The diagram illustrates an Archimedean spiral on a Cartesian coordinate system. The spiral starts at the origin (0,0) and winds outwards counter-clockwise. The x-axis is labeled with values: -5πb, -3πb, -πb, 0, πb, 2πb, 3πb. The y-axis is labeled with values: 2.25πb, 1.25πb, 0.75πb, 0.25πb, -0.25πb, -0.75πb, -1.25πb, -1.75πb, -2.25πb. The spiral is divided into three full convolutions (n=1, 2, 3) by radial lines. The radial distance from the origin to the spiral at any angle θ is given by the equation ρ = bθ. The number of convolutions n is given by n = θ / (2π).

3. Moth Flame Optimization:

4. Whale Optimization Algorithm:

5. Seagul Optimization Algorithm:

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algorithm in 2020 to mimic the sparrow's behaviors during group wisdom, antipredation, and foraging [93]. In this algorithm, the sparrows' population is divided into two groups of 20:80 as discovers and followers. It has a broad search space to search for the food and guide the followers to move towards the food source.

1.6 CONCLUSION

We have a wide variety of Optimization Techniques in Operations Research. Here, we optimized time and distance using the Spiral Optimization Algorithm for spherical objects. The future trends of Spiral Optimization Algorithm can be extended to the vast areas of spherical structured problems or concerns which deal with spherically optimized cases. The frameworks which are spherical may include centric oriented Multi-National Companies, manufacturing of wheels and wheel-oriented objects such as Pottery making, grinding machines, etc., also, for n seeming to be large, software related Computation is suggested.

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CHAPTER-7

Determination of proximate and some antinutritional compositions of leaves and seeds of tropical almond (*Terminalia catappa*) collected from Sokoto city, Nigeria

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Abstract

Terminalia catappa is a common tree found in Nigeria, but it is mostly underutilized and its constituents were underreported. The objective of this work was to expunge the proximate and antinutrients of leaves and seeds present in *Terminalia catappa* obtained from Sokoto, Nigeria. The proximate composition of the seed and leaves of the two varieties were determined using standard methods and in turn revealed that, the seeds had a moisture content

of 10.34%; crude fat, 5.64%; protein, 20.30%; ash, 5.19%; carbohydrate, 45.71% and crude fibre, 12.76%. The Leaves contain 8.93% moisture; 2.67% crude fat; 2.92% protein; 4.79% ash; 75.59% carbohydrates and 5.10% crude fibre. The anti-nutritional components of tropical almond such as oxalate, phytate, cyanide, and nitrate show that, leaves possessed (in mg/100gDW) oxalate (8.197 ± 0.25), phytate (6.34 ± 0.39), nitrate (18.64 ± 1.06), and cyanide (111.9 ± 2.64). While seed contains, oxalate (10.70 ± 0.47), phytate (9.70 ± 0.69), nitrate (20.07 ± 1.11), and cyanide (106 ± 2.58) respectively ($p < 0.05$). The concentration of some anti-nutrient in leaves was relatively higher than that of seeds. The fruits should be subjected to methods for neutralization of antinutrients when taken for their nutritional benefits.

Keywords: *Terminalia catappa*, carbohydrates, ash, cyanide, oxalate, nutrients, malnutrition, medicine

Introduction

Plants continuously help the humans on earth in a number of diverse ways. Every part of plants such as seeds, and leaves has been utilized in industrial, domestic, traditional etc. applications for the benefits of man and other organisms living in the biosphere (Salawu et al., 2018; Gada & Samaila, 2021; Guerra-Teixeira et al., 2022). Parable, almond tree is of great value in many parts of the world (Akpabio, 2012). A typical almond tree (*Terminalia catappa*) usually reaches 3-8m in height, possesses an ellipsoid fruit that is blunt at the

peak. The fruit is also circa 7.51 cm in length, and 5.0cm in width; therewith, when its ripening transmogrifies the green color to purple-yellow and have a thick shell for the preservation of the seed. The seed is a good source of oil. A ripen monocarp is mostly edible to many people, including children in many countries such as Spain, Italy, Greece, Iran, Morocco, France, and Nigeria. Many places in Asia, Australia, and Africa utilizes the almond for many purposes (Akpabio, 2012; Packirisamy & Kirishnamorthi, 2012; Offor et al., 2015).

Likewise, the leaves of the plant *Terminalia catappa* are widely applied in native and traditional approaches, a role that was due to the presence of phytochemicals of the plant. Previous works ascertain the occurrence of bioactive compounds in almond and in turn its antioxidant, antifungal, antimicrobial, antidiabetic, and anthelmintic effects (Packirisamy & Kirishnamorthi, 2012; Offor et al., 2015).

Meanwhile, it was equally related that, the almond has possessed other diversely useful components that can immensely contribute in human or organisms diet for the supply of nutrients required by the biological system (Offor et al., 2015). For example, leaves of almond contain vitamins, A, B, C, D, and macroconstituents such as ash, moisture, fibre, fat, carbohydrate, and quasi (Offor et al., 2015). Similarly, a surf of past studies shows that a handful of works were conducted on the proximate and antinutrients of the almond. Parable, Christian & Ukhun (2006) study has shown that the *T. catappa*

contains phosphorus, carbohydrates, fat, and useful nutrients such as vitamin A, vitamin C, Na, K, Mn, Zn, Fe, and Ca. Ekop & Eddy (2005) show little levels of antinutrients tannin, cyanide, and oxalate in *T. catappa*. Therewith, Mustapha (2001) indicates elevated levels of tannins in different parts (seed, leaves, wood, fruit, and bark) of *T. catappa*. However, despite the fact that the *T. catappa* is a renowned fruit consumed in Sokoto in raw form there are scanty published works about the plant in the state or relations. Indeed, there are bedeviling issues in the state such as food insecurity, malnutrition, poor healthcare in rural areas, and poverty that spur the intensive need to give out data that will help in using local plants for proper nutrition and alternative medicine, and taking caveat in reducing the effects of antinutrients. Similarly, the distinguishing nature of the environment, soil, pollution, and genetics could affect the concentration of the constituents of plants; there is need for proximate and antinutrients data from localities (Hassan et al., n.d.; Umar et al., 2021; Gada & Samaila, 2021; Garba et al., 2022). Thus, the objective of this work was to expunge the proximate and antinutrients of leaves and seeds present in *Terminalia catappa* obtained from Sokoto, Nigeria.

Materials and methods

Study area

The study was carried out in Sokoto, Nigeria. It was shown in the figure 1.

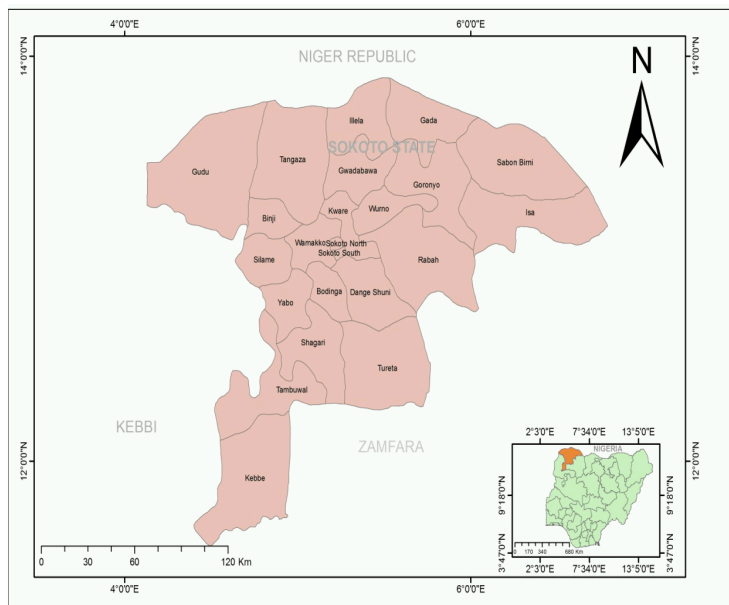


Figure 1. Map of the study location; Source: Hamza et al (2023).

Plant collection and identification

The plant samples of *Terminalia catappa* (tropical almond) leaves and seed were collected from Arkilla Area Sokoto on 15 Feb 2022 and identified by a competent botanist from Sokoto State University Sokoto, Nigeria.

Preparation of the samples

The leaves and seed of plant species were cleaned using clean water until soil

and other materials on them were removed. Thereafter, they were then air dried under shade for a week. The plants materials were then ground into fine powder using local grinding machine then wrapped in air-tight containers and placed in the laboratory at room temperature to further analysis.

Proximate analysis

The determination of crude fat, crude protein, crude fibre, moisture, ash, and carbohydrate was conducted according to standard methods and procedures as reported in (Hassan & Umar, 2004). All reagents and apparatus are of analytical grade.

Antinutrients determination

The antinutrients including, oxalate, phytate, nitrate, and cyanide were determined according to standard procedures reported in (Effor et al., 2015; Salawu et al., 2018).

Statistical analysis

All the performed determinations were in triplicate, and results were expressed as mean standard deviation, and X^2 test was conducted at $p < 0.05$ confidence limit.

Results and discussion

The results for this work were shown in tables 1 and 2.

Table 1. Proximate composition of leaves and seeds of *Terminalia catappa* collected from Sokoto city, Nigeria

<u>PARAMETERS</u>	<u>SEED (%DW)</u>	<u>LEAVES</u>
<u>(%DW)</u>		
Crude Lipid	5.64 ± 0.61	2.67 ± 0.29
Crude protein	20.30 ± 0.59	2.92 ± 0.07
Crude fibre	12.76 ± 4.34	5.10 ± 0.53
Total ash	5.19 ± 0.08	4.79 ± 0.17
Carbohydrate	45.71 ± 6.52	75.59 ± 0.23

Moisture	10.34 ± 1.03	8.93 ± 0.75
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Values are mean \pm standard deviation of triplicate determination.

Table 2: Antinutritional parameters of Tropical Almond leaves and seed collected from Sokoto, Nigeria

ANTI-NUTRIENT	CONCENTRATION (mg/100g)	
	LEAVES	SEED
Oxalate	8.19 ± 0.25	10.70 ± 0.47
Phytate	6.34 ± 0.39	9.70 ± 0.69
Nitrate	18.64 ± 1.06	20.07 ± 1.11
Cyanide	111.90 ± 2.64	106 ± 2.58

Values are expressed as mean \pm standard mean.

Table 1 shows the amounts of proximate nutritional constituents in seed and leaves of *T. catappa* collected from Sokoto, Nigeria. Therein, the table 1 shows that there exists more lipid, protein, fibre, ash, and moisture in the seeds than the leaves; and carbohydrates are more elevated in leaves than the seeds

observed. Seeds are seeming to be more likely to contain much protein than the leaves may be because the leaves are not edible or the seed has to be contain enough proteins for reproduction and development purposes; whereas, the leaves are basically and biochemical energy activities. The presence of carbohydrates in leaves more than the seeds can be attributed to the role of the leaves in photosynthesis that results in the making of carbohydrates (Edelman & Colt, 2016). In this study, seeds and leaves (in table 1) contain lower levels of lipid, protein, carbohydrates, and moisture than the values obtained by Akpabio (2012) from Uyo, southern part of Nigeria. Likewise, determination of proximate compositions from the leaves of *T. catappa* from Indian study had reported higher values compared to the ones reported in this work (as in table 1) (Packirisamy & Krishnamorthi, 2012).

The results in table 2 (at $p < 0.05$) indicated the presence of varied amounts of oxalate, phytate, nitrate, and cyanide in leaves and seeds of *T. catappa* collected in Sokoto, Nigeria; therewith, leaves had shown more antinutrients than the seeds. The oxalate found in table 2 is lower than the one reported in a Southern Nigeria study by Akpabio (2012) and the cyanide was extremely higher than the one reported by Akpabio (2012) as well.

The determination of proximate contents shown in table 1 shows the significant values ($p < 0.05$) of lipid, protein, fibre, ash, and carbohydrate. Lipids found are a good source for consumers because it has hypolipemic effect to

ameliorate hyperlipidemia outcome such as hypertension, coronary heart disease, and myocardial infarction (Okezie et al., 2017; Abd-Elbaky & Gharib, 2021). Proteins obtained are useful building blocks of life in cells for repair of worn-out tissues and synthesis of new ones. In other ways, catalytic activities, signal transduction, transporters are done by proteins (Okezie et al., 2017; Aletan & Kwazo, 2019). The significant amount of fibre (12.76 ± 4.34 and 5.10 ± 0.53) obtained in *T. catappa* refers to the roughages (forms of non-hydrolysable polysaccharides) that are needed for purposes by the body. Fibers join proteins, sugars, and cholesterol for the benefit of the human body and are useful in reducing colon cancer risk, maintenance of bowel, and absorption of trace elements (Okezie et al., 2017). And ash level determined indicates that there are mineral elements in the plant parts examined; therewith, the presence of carbohydrates (45.71 ± 6.52 and 75.59 ± 0.23) can be of benefits for human intake by providing ATP. Deficiency of carbohydrate is observed with symptoms such as fatigue, poor mental development, and poor body stamina (Okezie et al., 2017).

Additionally, values of significant ($p < 0.05$) content of oxalate, phytate, nitrate, and cyanide were found in the plant (*T. catappa*). However, oxalate and phytate are substances that are not suitable for human consumption (at certain levels), because they form complex with divalent and trivalent useful ions (such as

magnesium, zinc, iron) to impede absorption. Likewise, oxalate acts as an inhibitor of iodine function and thereby raising iodine deficiency risk (Ayuba et al., 2020; Sarkingobir et al., 2022). Meanwhile, exposure to cyanide through unprocessed food can affect iodine metabolism, and can travel to harm the brain. Cyanide forms hydrogen cyanide that inhibits enzymes such as mutase, cytochrome oxidase, and succinic dehydrogenase; above all it is hepatotoxic and neurotoxic (Thomas & Jaiswal, 2021). In often times cyanide is converted to nitric oxide, N-nitroso, and nitrite compounds and pose health impacts in humans such as impairment of hemoglobin by making methemoglobin, hyperplasia of the zona glomerulosa in the gastric neoplasia, and adrenal cortex (Grout et al., 2023).

Conclusion

The seeds and leaves of *Terminalia catappa* collected in Sokoto show significant amount of proximate parameters (fat, protein, fibre, carbohydrate). The concentration of some anti-nutrients in leaves was relatively higher than that obtained in seeds. The fruits and leaves of the plant should be subjected to methods for neutralization of antinutrients when taken for their nutritional benefits.

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CHAPTER-8

Evaluation of Antimitotic activity of Zinc oxide nanoparticles of *Syzigium cumini* seed extract on *Allium cepa* roots

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ABSTRACT

Nanotechnology represents a vast variety of disciplines ranging from basic material science to personal care applications. Recently, there is an increased

interest in the development of nanoparticles for the delivery of therapeutic agents in the medical field. Cancer is one of the most fatal diseases affecting human population and the major cause of death worldwide. Hence, it is important to discover chemotherapeutic drugs which are cost effective and no side effects. *Syzigium cumini* seeds are also known as black jamun having many pharmacological potential which are used as traditional medicine from the time immemorial. The present study aims to evaluate the antimitotic activity of Zinc oxide nanoparticles of *S.cumini* seed extract on *Allium cepa* root cap cells. Five different concentration of extract 0.5, 1.0, 1.5, 2.0, 2.5 mg/ml and water as control were taken. After 48 hrs the grown roots cells are treated with extract. After the treatment (at 72hr) the onion bulbs were taken from the test tube, roots were removed and observed under microscope. A dose dependent activity was noted in extract treated groups compared to control. The total number of cells gradually decreased from the lowest to highest concentration which indicates that Zinc oxide nanoparticles *S.cumini* seed extract possess anti mitotic activity.

Key words Nanotechnology, *Syzigium cumini*, Cancer, Chemotherapy

INTRODUCTION

Cancer is a deadly disease, which involves the abnormal proliferation of cells along with malignancy and metastatic behavior. The current drugs in cancer chemotherapy mainly target the highly dividing cells. These drugs are

cytotoxic and cause mitotic arrest. Antimitotic agents are widely used in chemotherapy, target exclusively proliferative cells and commonly induce a prolonged mitotic arrest followed by cell death via apoptosis. Recently, there has been an increased interest in the study of plantbased materials as an anticancer compound [1]. Medicinal plants are an important source for isolation of anticancer drugs and are being studied extensively worldwide to develop more effective anticancer treatment. A number of plant-derived compounds such as combretastatin, paclitaxel and vincristine are identified and used as antimitotic agents of cytotoxic drugs. Most of these drugs are the secondary plant metabolites including phenolics and flavonoids [2,3,4,5].

In the last decade, biosynthesis of metal oxide nanoparticles has received increasing attention due to their potential properties such as optical, electronic, mechanical, magnetic, and chemical properties and hence has incredible applications in the field of physics, chemistry, medicine, biology, agriculture, food processing, and so forth [6]. Wide varieties of methods have been reported for synthesis of Zinc oxide including thermal decomposition method, hydrothermal technique and electrochemical methods. However, these methods are energy consuming, therefore the rising needs to develop eco-friendly green method for nanoparticle preparation. Recently plant mediated green synthesis of different nanoparticles from various plants such as *Cassia alata* [7], *Camellia sinensis* [8], *Mangifera indica* [9], *Azadirachta indica*

[9], *Syzygium cumini*^[10] and *Ocimum basilicum*^[11] has been reported.

Syzygium cumini belongs to the Family Myrtaceae commonly known as java plum or black plum. *Syzygium cumini* possess a huge number of pharmacological properties including antioxidant, anti-inflammatory, neuropsychopharmacological, anti-microbial, anti-bacterial, anti-HIV, antileishmanial and antifungal, nitric oxide scavenging, free radical scavenging, anti-diarrheal, antifertility, anorexigenic, gastroprotective and anti-ulcerogenic and radioprotective activities which has been reported earlier [12]. Hence an attempt was made to analyze the antimutagenic activity of Zinc oxide nanoparticles of *Syzygium cumini* seed extract.

MATERIALS AND METHODS

Collection and preparation of *Syzygium cumini* seed extract

Syzygium cumini fruits were collected from local market and the seeds were manually removed, washed several times and are sun dried for a week. After complete drying, seeds were ground and made into a moderate coarse powder and stored in an airtight container. 100 g powder was extracted with ethanol in a Soxhlet apparatus and cooled in room temperature, concentrated in a rotary evaporator to get residue which was used for further study [13].

Preparation of crude extract for synthesis of Zinc Oxide nanoparticles

5 g of *Syzigium cumini* seed extract powder was taken in a sterile conical flask. 50 ml of distilled water was added to it. Then the mixer was kept in incubator for 48 hours in room temperature. After incubation, the solution is subjected to centrifuge at 6000 rpm for 10 min to obtain the pellet. Then the supernatant was collected from the tube and it was kept for evaporation (to sediment the particles) until it get fully evaporated ^[14].

Synthesis of Zinc Oxide nanoparticles

0.1M aqueous solution of zinc acetate was used as the precursor. The composition of precursor (Zn solution) and the *Syzigium cumini* seed extract in volume ratio were prepared by adding the extract drop by drop to zinc acetate solution, with constant stirring at 70-80°C, As the solution started evaporating at the end of the process, the obtained viscous gel was loaded into the oven (at 90°C) to produce a black colour powder. Then. it was calcined in alumina crucible and heated at 600°C in different times (1, 2 and 3hr). The obtained brown precipitates were characterized with different methods ^[14].

Antimitotic activity

***Allium cepa* Root Cap Cells Preparation**

Onion bulbs were collected from a local market. Outer scales of Onion were removed without destroying the root primordia by the dry bottom plates of the bulbs. Bulbs were placed in distilled water for 48 hr to germinate for each

separate extract with certain concentration and placed in a room at room temperature. Newly grown roots were 1–2 cm in length, then the onion roots were treated with the zinc oxide nano extracts of *Syzigium cumini* seed before 24 hr for the recovery. Sodium Benzoate was considered as the positive control whereas negative control was considered as distilled water this makes exposure of root tips. After exposure to negative control when root tips are put in the extracts treated for 24 hr and recovery is when after this treatment, the root tips are put back into distilled water for another 24 hr. 5 root tips were cut from each bulb, after 24 hr under each exposure, (5 bulbs for each treatment method). The root tips were fixed in 3:1 (v/v) ethanol: glacial acetic acid and stored overnight at 4°C. They were placed in 70% (v/v) aqueous alcohol the next day and refrigerated until used. Five slides on average were made for each bulb for each treatment using root tips that were hydrolyzed in 1N HCl for 3 min. Stained root tips were squashed in aceto-carmin stain. Each slide was observed under electron microscope for further study ^[15].

$$\text{Mitotic Index} = \frac{\text{Number of dividing cells}}{\text{Total number of cells}} \times 100$$

Statistical analysis

Statistical data were analyzed using oneway ANOVA and the P value obtained for this activity is found to be 0.315.

RESULTS AND DISCUSSION

The effect of Zinc oxide nanoparticles extract of *Syzigium cumini* on mitotic index was presented in Table 1, figure 1 and plate 1.1 to 1.7. A dose dependent activity was observed in the extract of *Syzigium cumini* on mitotic index. Less number of viable cells was observed in subsequent concentrations as compared to control at 24 hrs and 72 hours. The total number of cells gradually decreased from the lowest to highest concentration. In prophase, the first phase in mitosis it was noted as 12,11,04,02,01 for the concentrations 0.5, 1.0, 1.5, 2.0, 2.5 mg/ml which was more or less equal to the control at 24 hours. It was observed that in all concentrations, the cells in prophase are significantly more in number than other phases. It was observed that a vast change occur in metaphase of mitotic division in the extract treated experimental samples when compared to the control at 72 hours. A notable decrease in the number of cells in metaphase (43) was observed in control sample at 24 hrs. The number cells in metaphase for the various concentrations of extract treated samples 0.5, 1.0, 1.5, 2.0, 2.5 mg/ml were found to be 13,09,13,02,01 respectively. It was much less than the control at 72 hours. In the third phase of mitotic cell division, anaphase no cell division occurred or reached in the control sample at 24 hrs. A reduction was observed in control sample (24) at 72 hrs. The number cells in anaphase for the various concentrations of extract treated sample 0.5, 1.0, and 2.5 mg/ml were found to be 19,5 and 1

respectively. It was noted that in 1.5 and 2.0mg/ml concentration of extract treated sample no anaphase was seen and it showed that the extract controlled the proliferation or division in third phase of mitosis. A remarkable change was observed in telophase, the fourth phase of mitosis. It was noted that no division occur in control sample at 24 hrs and in extract treated experimental sample with concentrations of 1.0, 1.5 and 2.5mg/ml when compared to the control at 72 hours in which showed 22 number of cells in telophase was observed. In extract treated sample with 0.5 and 1.0 mg/ml concentrations, observed a 09 and 01 number of cells in telophase stage. Previous studies were examined and in many numbers different of species this study has been carried out and similar results were observed.

In *Allium cepa* root meristem model, commonly known as *Allium* assay, root meristematic cells are used for screening of drugs with anti-mitotic activity. In meristematic region, the cell division is similar to cancer cell division in humans. Therefore, these meristematic cells can be evaluated for screening of drugs with potential anti-mitotic activity. The general principle of the mechanisms of mitosis is best and most easily studied in the actively growing region of plants such as a shoot or root apex. Among the plant species, *Allium cepa* has been used to evaluate DNA damages, such as chromosome aberrations and disturbances in the mitotic cycle. *Allium* assay is considered a rapid, highly sensitive and reproducible bioassay for detecting cytotoxicity and

genotoxicity. In *Allium cepa* assay, OIHE was found to exhibit dose dependent antimitotic action on *A. cepa* root meristematic cells as indicated by inhibition of root growth (reduced root number and length) and decreased mitotic index after 72 h of treatment. The maximum inhibition of root growth was observed at 6mg/ml affecting the rootlet morphology [shrinking of the rootlets and dark brown color].

Table 1 showing the effect of Zinc Oxide nanoparticles treated extract of *Syzygium cumini* seeds on mitotic index

Concentration (mg/ml)	Total No. of Cells	Non- Dividing Cells	Prophase	Metaphase	Anaphase	Telophase	Total Cells
Control (24 hours)	100	9	83	8	-	-	91
Control (72 hours)	100	7	4	43	24	22	93
0.5	100	29	12	13	19	9	53
1.0	100	76	11	09	05	01	26
1.5	100	68	04	13	-	-	17
2.0	100	96	02	02	01	-	05
2.5	100	98	01	01	-	-	02

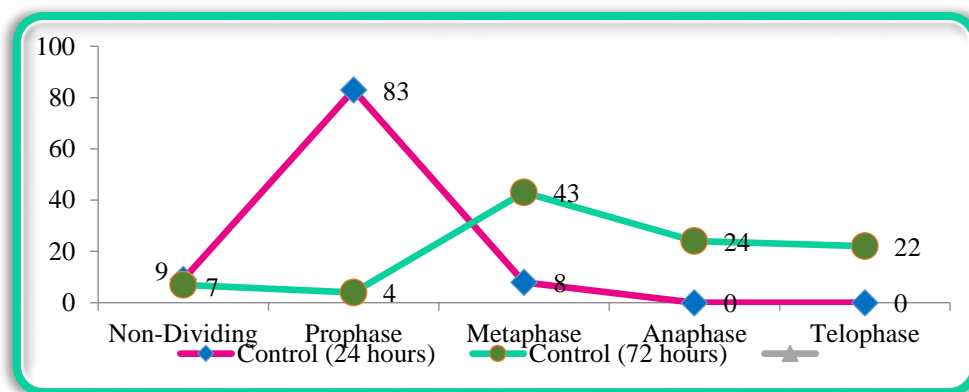


Figure 1 showing the effect of Zinc Oxide nanoparticles treated extract of *Syzigium cumini* seeds on mitotic index

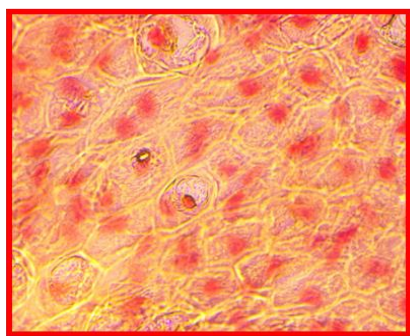


Plate 1.1 Control during 24 hrs

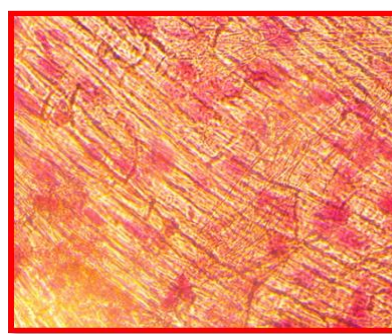
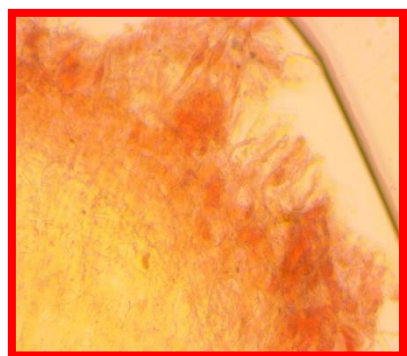
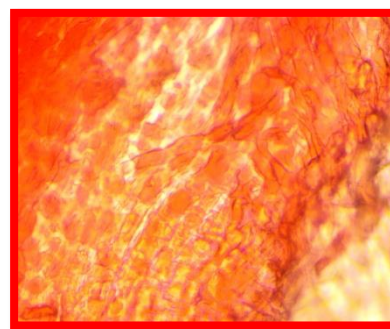


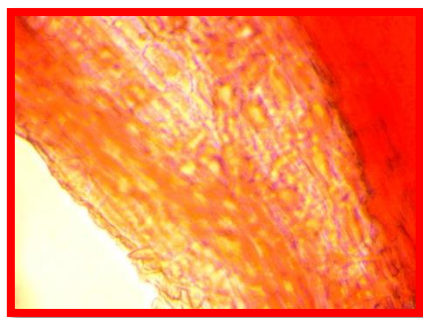
Plate 1.2 Control during 72 hrs



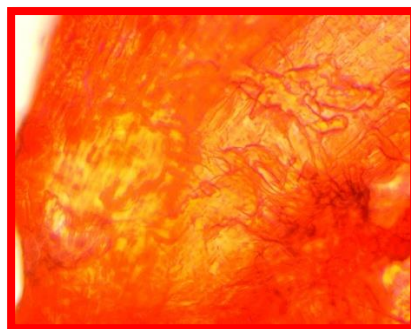
**Plate 1.3 Extract at 0.5 %
concentration**



**Plate 1.4 Extract at 1 %
concentration**



**Plate 1.5 Extract at 1.5 %
concentration**



**Plate 1.6 Extract at 2 %
concentration**

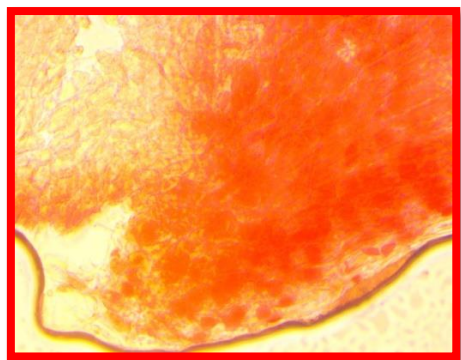


Plate 1.7 Extract at 2 % Concentration

Plate 1.1 -1.7 showing the effect of Zinc Oxide nanoparticles treated with *Syzigium cumini* seeds extract at various concentrations on mitotic cell division

There was reduction in the number of dividing cells in different phases of cell cycle. The antimitotic activity was found maximum at the dose of 2.5 mg/ml with lowest mitotic index of 18.88%. The mitotic index of OIHE was near to that exhibited by the standard anticancer drug- methotrexate (11.48) % at the dose of 0.02mg/ml. This suggests that the OIHE has fair antimitotic

potential in all the doses tested. It was reported that the *Trididemnum*, a cosmopolitan genus, is well renowned for its variability in chemical metabolites for producing first marine compound, *Trididemnum solidum*, as human cancer drug which enlists cyclic peptides, providing a vital structural lead for a variety of cytotoxic, antiviral, immunosuppressant and anticancer activities [16,17]. The present study stated maximum number of cells in prophase indicating that the extract may potentially have arrested the transition of cells from prophase to metaphase and subsequent phases possessing similar effect as reported in earlier studies. It is also observed that mitotic index decreased in dose dependent manner with higher mitotic index being 71% at 2.5 mg/ml concentration of ZnO nano particles treated extract and the lowest being the 91% at 0.5 mg/ml concentration of ZnO nano particles treated extract which is closely comparable to the previous studies suggesting that extract at higher concentration arrests cell division making it probable anti cancer agent.

CONCLUSION

Syzigium cumini or Jambolan contains valuable phytochemicals that are potential drug compounds for the treatment of a wide range of diseases used by many traditional healers. In view of the phytochemical analysis *Syzigium cumini* or Jambolan contains valuable potential drug constituents that have been discovered in the *S. cumini*, the current study aims at evaluating the anti-mitotic activity of Zinc oxide nanoparticle of *S.cumini* seed extract. The results

of the present study shows that ZnO nanoparticles treated extract which is closely comparable to the previous studies suggesting that extract at higher concentration arrests cell division making it a probable anticancer agent.

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CHAPTER-9

ANTIMITOTIC, ANTIPROLIFERATIVE AND ANTIBACTERIAL EFFICACY OF ASCIDIAN

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ABSTRACT

Cancer remains one of the most life-threatening diseases and an economic burden worldwide. Cancer treatments can cause several side effects. Therefore, developing a target-specific drug without any side effects on normal cells is an ongoing effort in cancer drug discovery. Many marine sedentary organisms produce components for their chemical defence. In the present study, an attempt has been made to assess the antimitotic, antiproliferative and antibacterial activity of *Phallusia nigra*. The results showed significant antimitotic activity in terms of decrease in mitotic index in a dose dependent

manner. The cell viability of the extracts of *Phallusia nigra* was 73.58 % at 1.5 mg/ml concentration. Maximum zone of inhibition exhibited was 12, 11, 10, 9 and 8 mm for *Salmonella typhi*, *Shigella flexneri*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Vibrio cholerae* at 2 mg/ml of ethanolic extract of *Phallusia nigra*.

KEYWORDS: *Phallusia nigra*, antimitotic, antiproliferative, antibacterial

INTRODUCTION

Cancer is a disease in which some of the body's cells grow uncontrollably and spread to other parts of the body. Cell differentiation and proliferation are highly manipulated and regularized by the cell division mechanism in humans. In healthy organisms, during cell division, when cells come in contact with other cells, the process of cell replication ceases. Uncontrolled [cell division](#) occurs when a process called contact inhibition fails. Hence, contact inhibition becomes a powerful anti-cancer mechanism, but it is lost in cancer cells. Cancer remains one of the most life-threatening diseases and an economic burden worldwide^[1]. One of the treatments used currently is chemotherapy which kills cancer cells along with healthy ones. Moreover, cancer treatments can cause several side effects. Therefore, developing a target-specific drug without any side effects on normal cells is an ongoing effort in cancer drug discovery. In this context, natural products from marine organisms especially ascidians rank second as the most promising source of

drugs for cancer^[2]. They are an interesting group of marine sedentary organisms commonly called 'sea squirts' found to occur on the Tuticorin coast. Antimitotic, antiproliferative antiviral and antibacterial activities of biofouling marine ascidian extracts have been evaluated ^[3-7]. Marine ascidian is becoming one of the main sources of an antitumor drug that has shown high bioactivity and extensive application in cancer treatment ^[8]. The present study was focused on the antimitotic, antiproliferative and antibacterial activity of crude ethanol extract of simple ascidian *Phallusia nigra* using *Allium cepa*, *Saccharomyces cerevisiae* and human pathogens such as *Vibrio cholerae*, [*Pseudomonas aeruginosa*](#), *Salmonella typhi*, *Shigella flexneri* and *Staphylococcus aureus* to study the potential of *Phallusia nigra*.

MATERIALS AND METHODS

Collection of Animal Material

Phallusia nigra was collected from Tuticorin harbor by SCUBA diving. Epibionts and the fragments of shell attached to the specimens were removed and washed several times with sterile seawater. Identification up to the species level was carried out based on the key to the identification of Indian ascidians ^[9].

Systematic Position

Phallusia nigra belongs to Phylum: Chordata; Subphylum: Urochordata; Class: Ascidiacea; Order: Enterogona; Family: Ascidiidae; Genus: *Phallusia*;

Species: *nigra*.

Preparation of powder and extract

The specimens were dried under shade. The dried animals were homogenized to get a coarse powder. The dried powder of the tunicates *Phallusia nigra* was used.

Antimitotic activity

Antimitotic activity was determined using *Allium cepa* [root tip](#) model by the method of [Sehgal et al., 2006](#) ^[10]. For each root tip, hundred cells were counted in 5–8 fields under a high power (40 X) microscope. The following formula was used to determine mitotic index:

Mitotic index (MI) = $P+M+A+T$ / Total number of cells

where P - [Prophase](#); M – Metaphase; A - [Anaphase](#); T - [Telophase](#)

Antiproliferative Assay

The antiproliferative activity was determined by using yeast cell model following the method of [Saboo et al., 2007](#) ^[11].

The number of living cells that did not take stain, appeared transparent and dead cells that got stained and appeared blue were counted. The samples were treated with three species of ascidian extracts. The number of cells/mL and cell viability (%) was determined by using the formula:

Viable cells/mL = average no of viable cells in one square × dilution factor × 10^4

Percentage of cell viability = Total viable cells / Total number of cells × 100

Antimicrobial Activity

The dried powders of the tunicate *Phallusia nigra* was soaked in ethanol overnight and filtered. The separation of the extract from the solvent is made by natural evaporation method.

Antibacterial activity of ethanolic extract of *Phallusia nigra* was determined against five different bacterial pathogens - *Vibrio cholerae*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *Shigella flexneri* and *Staphylococcus aureus*.

3.8g of Mueller Hinton Agar medium powder is suspended per 100 ml of distilled water. It is heated with frequent agitation and boil for one minute to completely dissolve the medium. It is autoclaved and poured into sterile petridishes on a level, horizontal surface to give uniform depth. It is allowed to cool to room temperature [12].

The antimicrobial activity was measured by Disc Diffusion method. The sterile discs were impregnated with the different concentrations of the ethanolic extract of *Phallusia nigra* at 10 µl, 15 µl, 20 µl and standard drug at 25 µl. The discs were then placed on the previously inoculated petridishes containing the inoculum of test microbes [13]. The bacterial pathogens were maintained on MHA plates and incubated at 37°C for about 24 hrs. Zones of inhibition were measured in millimeter using a meter scale [14].

RESULTS AND DISCUSSION

Antimitotic activity of the aqueous extracts of *Phallusia nigra*, was tested for antimitotic activity using *Allium cepa* root tips. The results were compared on the basis of mitotic index and are presented in Fig. 1. Roots of *A. cepa* yielded evident results reflecting the effect of various concentrations of extracts on mitotic activity. The results were compared with control and the mitotic index was 79, 67, 53 at 0.25, 0.50 and 0.75 mg/ml concentration of aqueous extract of *Phallusia nigra* respectively. The extracts showed significant antimitotic activity in terms of decrease in mitotic index in a dose dependent manner. The promising antimitotic properties of *L. bistratum* could be exploited against cancer cells [4]. Antimitotic compounds can interrupt the process of mitosis anywhere in the cell cycle by inhibiting spindle formation in M-phase or by damaging DNA in S-phase of the cell cycle. This decrease in mitotic index indicates significant antimitotic activity of the extracts and this may be due to the interactions of the specific plant phytochemicals with the mitotic apparatus of the cells that causes delay in interphase resulting in increased number of cells at interphase stage, blocking transition from interphase to mitotic phase and decreasing mitotic index [15]. The results from the study showed that the ascidian extracts have excellent antimitotic properties.

Figure 2 depicts the antiproliferative activity of the extract of *Phallusia nigra* against yeast cells. The cell viability of the extracts of *Phallusia nigra* was 73.58% at 1.5 mg/ml concentration. Alterations of both growth factor-receptor

signalling, and transmembrane protein interactions could be the principal cause of the antiproliferative effect ^[16]. The cytotoxic activity of *Polyclinum madrasensis* and *P. nigra* extracts have been tested at various concentrations and showed highest cytotoxicity in the assay conducted, which indicates the presence of cytotoxic compounds in these ascidians ^[17].

Yeast cells have a high degree of similarity in sequence and functions to human cells and are commonly used to study biological pathways, both in yeast and in man. This includes pathways responsible for cell cycle control and DNA damage repair. In our study significant antiproliferative activity was exhibited by *Phallusia nigra* that had also exhibited highest antimitotic activity.

In the present investigation, antibacterial activity of ethanolic extract of *Phallusia nigra* is showed in figure 3. Maximum zone of inhibition exhibited was 12, 11, 10, 9 and 8 mm for *Salmonella typhi*, *Shigella flexneri*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Vibrio cholerae* at 2 mg/ml of ethanolic extract of *Phallusia nigra*. Organic substances isolated from the marine plants and animals have been shown to affect bacterial behaviour as reported by Bell and Mitchell ^[18]. GC-MS study of the methanol extract of *Phallusia nigra* revealed the presence of alcoholic compounds such as dl-3,4 dimethyl-3,4-hexanediol, dl-6-methyl-5- hepten-2-ol and 2-methyl-3-decanol showing antimicrobial activity ^[19]. Hence it may be concluded that these alcoholic compounds may be responsible for the potent antimicrobial activities of

Phallusia nigra.

Figure 1: Antimitotic activity of aqueous extract of *Phallusia nigra*

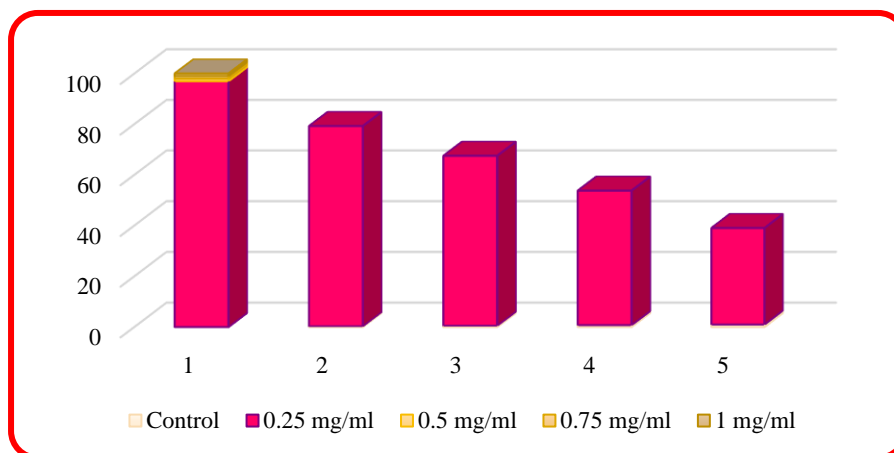


Figure 2: Antiproliferative activity of ethanolic extract of *Phallusia nigra*

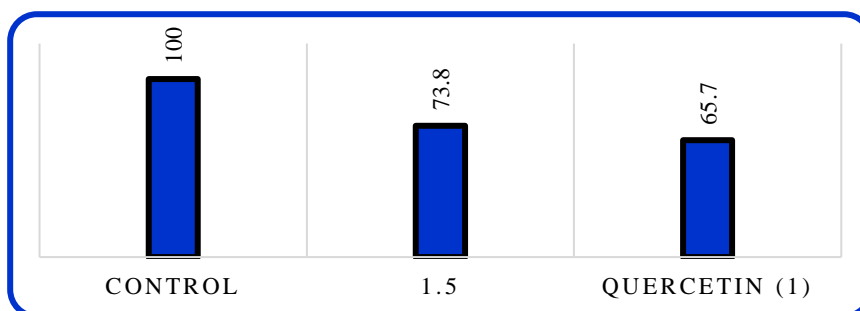
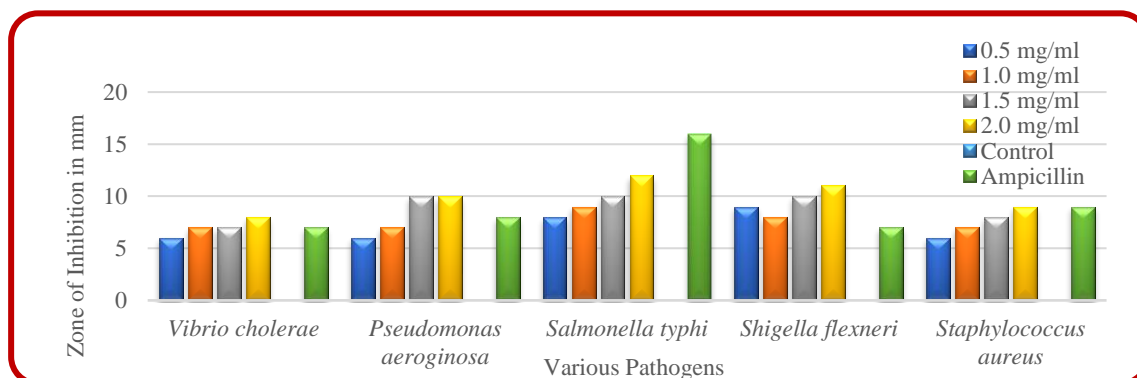


Figure 3: Antibacterial activity of ethanolic extract of *Phallusia nigra* against *Vibrio cholerae*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *Shigella flexneri* and *Staphylococcus aureus*



CONCLUSION

It has been reported that thousands of natural products are isolated from ascidians such as alkaloids, cyclic peptides and polyketides etc. Most of these secondary metabolites possess diverse bioactivities, such as antibacterial, antifungal and antitumor activities. Compounds found in the extract showed significant antibacterial activity for the discovery of novel marine drug. The animals which are considered as the nuisance and affect the economy by corrosion were used for this study. Such natural products are good for health and devoid of side effects. The result from the study showed that the extract of tunicates had excellent anti-mitotic, antiproliferative and antibacterial activity. A further study on isolation, purification, structure determination and subsequent recognition of a novel mechanism of action of the clinically effective agent is suggested.

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CHAPTER-10

The Transformative Power of Adapted Yoga for Children with Disabilities: A Comprehensive Review

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Introduction

In recent years, the practice of yoga has extended its reach beyond traditional boundaries, emerging as a powerful tool for promoting physical and mental well-being in children with disabilities. This comprehensive review explores the multifaceted benefits of adapted yoga for children with disabilities across various domains, including physical health, emotional regulation, social interaction, and cognitive development. Drawing from an array of research studies, we delve into the evidence supporting the positive impact of adapted yoga while offering insights into best practices.

Background of the study:

Yoga has gained widespread recognition as a versatile tool for promoting well-being across age groups and abilities. While traditionally associated with physical fitness and stress reduction in adults, its potential benefits for

children, particularly those with disabilities, have become increasingly prominent.

Children with disabilities face multifaceted challenges in areas such as physical health, emotional regulation, social interaction, and cognitive development. These challenges can significantly impact their overall quality of life and participation in various activities. In response to the need for holistic interventions addressing these dimensions of well-being, adapted yoga has emerged as a promising avenue for enhancing the lives of children with disabilities.

This comprehensive review study is motivated by the growing interest in adapted yoga for children with disabilities. Researchers and practitioners have recognized the potential of yoga tailored to the specific needs and abilities of these children. The study aims to explore how adapted yoga can contribute to their physical, emotional, social, and cognitive development, thereby enhancing their overall well-being and quality of life.

Drawing from a diverse body of research, this review seeks to provide empirical evidence supporting the positive impact of adapted yoga on children with disabilities. By synthesizing key findings from the literature, the study aims to shed light on the transformative potential of adapted yoga as a holistic approach to empower and improve the well-being of this unique and diverse group of children.

The objectives of this comprehensive review on the transformative power of adapted yoga for children with disabilities are as follows:

- **To Explore the Multifaceted Benefits:** Investigate and analyse the diverse physical, emotional, social, and cognitive benefits that adapted yoga may offer to children with disabilities.
- **To Examine Existing Research:** Review and synthesize the existing body of research studies that explore the impact of adapted yoga interventions on children with disabilities.
- **To Assess Effectiveness:** Evaluate the empirical evidence supporting the effectiveness of adapted yoga in enhancing various aspects of well-being, including physical health, emotional regulation, social interaction, and cognitive development.
- **To Identify Best Practices:** Identify and elucidate best practices in adapting yoga for children with disabilities, considering the unique needs and abilities of this population.
- **To Offer Insights:** Provide valuable insights and recommendations for researchers, educators, therapists, and practitioners working with children with disabilities on how to incorporate adapted yoga as a holistic approach to promote well-being and empowerment.

Review of literature:

Tindall, D. Et.al (2020) this study highlights the success of a 9-week adapted physical activity program for Irish children with disabilities. The research, involving twelve participants aged 11-15, demonstrated that those who completed the program achieved over 75% of their daily recommended physical activity levels. These findings underscore the program's effectiveness in encouraging physical activity among children with disabilities, offering valuable insights for future initiatives in this area.

Semple, R. J. (2018). The review suggests that while evidence regarding yoga and mindfulness interventions for children with ASD remains inconclusive in addressing core symptoms, there are promising initial findings related to communication, self-control, and social behavior. The studies have limitations like small sample sizes and the lack of control groups. Nonetheless, these early positive effects warrant further research in this field.

Pise V, Et.al (2018) In this study, yoga interventions over 12 weeks demonstrated significant improvements in psycho-motor abilities, including static balance, eye-hand coordination, agility, and reaction time, among intellectually disabled children in the experimental group. Conversely, there were no such improvements in the control group. This research underscores the beneficial impact of yoga practices in enhancing the motor skills of intellectually disabled children.

Physical Health Benefits:

1. Improved Flexibility and Mobility: Adapted yoga programs incorporate modified poses and gentle stretches, enabling children with disabilities to enhance their flexibility and range of motion, which is especially crucial for those with physical impairments (Reference: American Occupational Therapy Association, 2020).

2. Enhanced Balance and Posture: Through targeted asanas and the use of props, adapted yoga helps children with disabilities develop better balance and posture, addressing issues related to musculoskeletal conditions.

Pain Management:

Yoga's gentle movements and mindfulness techniques can contribute to pain management in children with conditions such as cerebral palsy or chronic pain.

Field, T., Diego, M., & Hernandez-Reif, M., (2010).

Emotional and Psychological Benefits:

1. Stress Reduction: Mindful breathing exercises and relaxation techniques incorporated into adapted yoga classes empower children to manage stress and anxiety effectively. Rosenblatt, L. E., et al., (2018).

2. Enhanced Emotional Regulation: Adapted yoga fosters emotional regulation by helping children understand and express their feelings in a supportive environment.

3. Self-Esteem and Confidence: Improved physical abilities and a sense of achievement in mastering yoga poses can boost self-esteem among children

with disabilities.

Social Interaction and Inclusion:

1. Peer Interaction: Group-based adapted yoga classes provide opportunities for children with disabilities to interact with their peers, fostering social skills and a sense of belonging Ramadoss, R., et al., (2017).

2. Community Building: Adapted yoga promotes inclusivity and acceptance within communities, helping to break down barriers and reduce stigmatization.

Cognitive Development:

1. Focus and Concentration: Yoga's emphasis on mindfulness enhances children's ability to focus and concentrate, which can be particularly valuable for those with attention deficits Jensen, P. S., et al., (2019).

2. Improved Learning: Adapted yoga can positively impact cognitive development, potentially improving learning outcomes for children with learning disabilities.

Findings:

Physical Health Benefits: The review highlights that adapted yoga positively impacts the physical health of children with disabilities. Modified poses, stretches, and the use of props contribute to improved flexibility, mobility, balance, and effective pain management.

Emotional and Psychological Benefits: Adapted yoga is found to be effective in

reducing stress and anxiety, enhancing emotional regulation, and boosting self-esteem and confidence among children with disabilities. This supports the therapeutic potential of yoga in promoting emotional well-being.

Social Interaction and Inclusion: Adapted yoga programs that encourage peer interaction in group settings have been shown to foster social skills and a sense of belonging among children with disabilities. This underscores the importance of community building and inclusivity.

Cognitive Development: The review indicates that adapted yoga can improve focus, concentration, and potentially enhance learning outcomes for children with disabilities, particularly those with attention deficits or learning disabilities.

Conclusion:

The growing body of research and evidence highlights the transformative power of adapted yoga for children with disabilities. It serves as a holistic approach to their well-being, offering myriad benefits ranging from physical health improvements to emotional regulation, social inclusion, and cognitive development. However, it's important to note that the effectiveness of adapted yoga may vary depending on the individual needs and capabilities of each child. As we continue to explore the potential of adapted yoga, it is essential for educators, therapists, and caregivers to collaborate and develop best practices that cater to the unique needs of children with disabilities. By harnessing the

therapeutic potential of adapted yoga, we can empower these children to lead healthier, more fulfilling lives and promote a more inclusive society.

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CHAPTER-11

STATISTICAL APPLICATIONS TO INFERENCE, SAMPLING, CENSUS, AND PREDICTION

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ABSTRACT

Statistics are used in so many different ways in daily life. I'm going to try to explain how statistics are used frequently in our daily lives in this essay. In each and every phase of life, we use statistics knowingly. Statistics are used beginning with birth and ending with death. We knowingly employ several statistical tools in the sectors of agriculture, commerce, medicine, and many others without having any prior knowledge of statistics, including sampling, prediction, quality assessment, inference, and causality. These are the statistical components that make our lives incredibly simple. The applications of statistics in daily life are quite important

KEYWORDS: Statistics, Inference, Sampling, Census & Predication

INTRODUCTION:

Students frequently wonder what applications there are for statistics in daily life. The method to solve the issues in our daily lives is through statistics. Without us even realising it, it shapes our lives and provides solutions to everyday issues. Statistics aid in our understanding of the past, present, and future. Every aspect of life uses statistics, whether we do so consciously or out of instinct. Today, it is impossible to picture life without the use of statistical tools, yet not everyone is familiar with these resources. Statistics are used often by humans in every field.

Every discipline has its own restrictions, but statistics can be applied in many different ways across a wide range of fields, including medicine, history, geography, prediction, science, agriculture, sports, astronomy, politics, and much more. Using statistics, we assess data from various domains, identify the framework for change, and draw predictions for the future. I wish to illustrate how statistics are used in everyday life in this essay. Real-world statistics have a part in everything from human birth to mortality. Statistics is the study of how to derive knowledge from data. Knowing statistics enables you to select the best techniques for data collection, apply the right analysis, and effectively communicate the findings.

MEANING

The word "statistics," which is frequently used, comes from the Latin word "status," which denotes a collection of numbers or figures that provide some information of interest to humans. Everyday sources of statistics include books, other informational papers, television, and newspapers. Although initially it was used by Kings to gather data on states and other information needed for their citizens, like their numbers, the state's revenue, etc. Because only the Kings used it, this was referred to as state science.

However, due to its pervasiveness now, its scope has grown and broadened. Almost all areas of human knowledge and expertise, including business, commerce, economics, social sciences, politics, planning, medicine, and other disciplines, both physical and natural, are today where it is employed.

Some Uses of Statistics in Daily Life

We shall discuss some of the more widespread applications of statistics in this article. Numerous applications of statistics can be found in daily life. The definition of statistics, according to Cecil H. Meyers, is "a science of numerical information that employs the processes of measurement and collection, classification, analysis, decision-making, and communication of results in a manner understandable and verifiable by others." We need to

consider all the purposes of statistics when we talk about how statistics are used in our daily lives.

CENSUS

One of the most crucial components of statistics used by government agencies is the census. Every ten years, government organisations conduct a census, but the data that comes from it is useful to both public and commercial organisations for analysing demographic differences. With the aid of the census, we may learn about the population's growth, the spread of various religions, the gender ratio of men to women, the level of education, and a variety of other facts about people. It is feasible with the aid of a survey that is created by statisticians and offers a variety of conclusions from the information that the government organisations collect through census. Similar to human censuses, the government conducts a livestock census every five years to determine the many features of any given animal, such as cows.

SAMPLING

Typically, samples make up the majority of the data that go into statistics. Most of the time, a sample of the entire population is used in statistical applications. The sample assists us in comprehending the entire population. This sample could be a group of individuals that a researcher needs

to study or it could be a piece of fabric that was sampled to learn more about its general properties.

Every sector, every type of business, and even residences use sampling. We can better comprehend the features of the entire population thanks to this sampling. Women try the rice after it has been prepared. She hasn't had to inspect the entire batch of rice. Samples are frequently utilised.

PREDICTIONS

We can create predictions about potential future events with the use of statistics. We develop future forecasts based on events we observe in our daily lives. That prediction's accuracy will rely on a number of factors. We take into account both internal and exterior aspects that could influence our future when making a forecast. the same statistical methods statisticians do when forecasting an observable fact.

All types of professionals, including doctors, engineers, artists, and businesspeople, use statistics to forecast the future. For instance, physicians use statistics to predict the progression of an illness. Through the use of statistics, they are better able to forecast the prevalence of flu each winter season. More than anyone politicians use statistics to predict future and to create very essential decisions.

QUALITY TESTING

Another crucial application of statistics in every aspect of life is quality assurance. We regularly do quality testing to ensure that our purchases are accurate and that we receive the best results for our money. To ensure that we will locate the best, we test a sample of the product we intend to buy. We wish to buy the sample if it passes the quality test that we conducted on it.

Companies occasionally advertise free samples of their items when we visit general stores to market their goods. We can decide whether or not they are excellent enough to be purchased using these samples. A knowledgeable buyer can readily decide whether the product is worth buying or not, even though such marketing strategies assist draw more consumers to the brand's goods.

INFERENCES AND CAUSALITY

Making conclusions, inferences, and causal connections about an event or circumstance is one goal and use of statistics. In everyday life, we employ statistics to do similar tasks; for instance, if someone becomes ill, we use sometimes straightforward, sometimes convoluted methods to determine the cause. To determine the aetiology of a condition, doctors conduct tests and question patients. In medical science, researchers use the information provided by multiple hospitals and healthcare providers to determine the

cause of an illness and its predominance. By having a statistical understanding, doctors can reduce the prevalence of any disease. Clinical trials are crucial in the development of optimal medications for many different ailments.

BUSINESS

In business, statistics are crucial. A businessperson can organise his output by taking the tastes and preferences of the customer into consideration. It also aids in judging the product's quality. Statistics help businesspeople make informed decisions about things like location, product marketing, finances, resources, etc. Forecasting and hypothesis testing are often used in business. These statistical tools can help them grow their firm. They are employing the business analyst for this. Statistical tools have been employed by business analysts to improve the company.

There are three major functions in any business enterprise in which the statistical methods are useful. These are as follows:

- The Planning of Operations: This may relate to either special projects or to the recurring activities of a firm over a specified period.
- The Setting up of Standards: This may relate to the size of employment, volume of sales, fixation of quality norms for the manufactured product, norms for the daily output, and so forth.
- The Function of Control: This involves a comparison of actual production

achieved against the norm or target set earlier.

If the production falls short of the desired level, it offers corrective actions to ensure that a similar shortfall does not happen again. It's important to note that although these three tasks—operational planning, standard-setting, and control—are legally distinct, in actuality they are closely related.

ECONOMICS

In home economics, statistics are crucial. Housewife creates budget for her family's happiness in life. Statistics are the only tool that can accomplish this. Statistics are a major part of economics. In economics, data are gathered and analysed using statistical methods. The statistical method is also used to examine the link between supply and demand. Large-scale issues that call for a solid understanding of statistics include imports and exports, inflation, and per capita income. We can alter the supply of commodities with the aid of time series data.

MATHEMATICS

Statistics are numerical statements of facts in any area of inquiry that are positioned in relation to one another, according to Prof. A. L. Bowley. A subfield of applied mathematics is statistics. Humans typically find the average of something for any purpose. The study of measures of central tendency can be used to learn about other statistical tools like this one. In India, men's shoes

often come in sizes 9 and 10. The median, which is a component of measures of central tendency, is used in this analysis. Numerous statistical techniques, such as probability averages, dispersion, estimation, etc., are utilised in mathematics, and various algebraic, integrational, and differentiatational strategies are used in statistics. As a result, statistics and mathematics are connected.

BANKING

Statistics are crucial to the banking industry. Statistics are used by the banks for a variety of reasons. The bankers estimate the total number of depositors and claims for a certain day using statistical methods.

Statistics shouldn't be relied upon blindly because they could not be accurate. While analysing statistical data, a proper research and development programme should also be employed.

The subject of statistics is challenging. Numerous schools and institutions provide students statistical assignments that call for expert knowledge. Students dealing with this subject might need assistance from professionals or a tutor. Rather than searching everywhere, one can simply visit assignmenthelp.net. An online resource that has had success managing

ENGINEERING STATISTICS

Engineering statistics use scientific data analysis techniques to combine engineering with statistics. Data about manufacturing processes, including component dimensions, tolerances, material types, and fabrication process control, are included in engineering statistics. Numerous techniques are employed in engineering analysis, and they are frequently shown as histograms to provide a visual representation of the data rather than just a numerical one.

Examples of methods are:

- Design of Experiments (DOE) is an approach for generating statistical models-based engineering and scientific challenges. The protocol outlines the major data-analysis, notably in hypothesis testing, as well as the randomization technique for the experiment. In a secondary analysis, the statistical analyst looks more closely at the data to make suggestions for new inquiries and to aid in the design of upcoming trials. Instead of testing the accuracy of a scientific hypothesis, the goal in engineering applications is frequently to optimise a process or product. The price of experimenting is decreased when optimal (or nearly optimal) designs are used.
- Quality control and process control use statistics as a tool to manage conformance to specifications of manufacturing processes and their products

- Time and methods engineering use statistics to study repetitive operations in manufacturing in order to set standards and find optimum (in some sense) manufacturing procedures.
- Reliability engineering which measures the ability of a system to perform for its intended function (and time) and has tools for improving performance.
- Probabilistic design involving the use of probability in product and system design

System identification creates mathematical models of dynamical systems from measurable data using statistical techniques. System identification also includes the most effective experiment design for quickly producing useful data to fit such models.

Engineering statistics have been around since the Abacus was created in the year 1000 B.C. as a tool for calculating numerical data. The evolution of information processing to methodically analyse and process data started in the 1600s. Robert Bissaker created the Slide Rule method in 1654 for complex data calculations. The first mechanical automatic-sequence-controlled calculator, known as MARK I, was created by Harvard University and IBM in 1833 after British mathematician Charles Babbage developed the concept of an automated computer. Engineering statistics emerged as a result of the

industry's adoption of computers and calculators, which also improved methods for data analysis.

METEOROLOGY

The weather report is forecast by meteorology with the aid of statistics. For predicting the weather report, regression models, autocorrelation, and many other statistical approaches are used. When dealing with natural disasters like floods and storms, statistics is crucial. It provides us with precise predictions of adverse events affecting human existence. We defend ourselves, protect the environment, and defend our nation by using data. The meteorology agency recently predicted the storm "Fonni" in Orissa. Satellites and statistics can help make this achievable. The Orissan government then creates a sufficient plan for this cyclone, saving the lives of numerous people. But it wasn't doable in earlier years.

Since neither group was likely to be an expert in the other's specialty, meteorologists and statisticians had to collaborate for the project to be successful. Meteorologists might advise on which physical characteristics were dynamically related, and statisticians could "crunch the numbers." For instance, the type of air mass and air temperature have a significant link. The statistical prediction would be invalid if the air mass abruptly changed (the

front passed by). To be effective, statistical methods have to be combined with an arbitrary assessment of the atmospheric situation.

Despite how promising it initially appeared, only climatology-related statistics were actually used in meteorology in the 1950s. Weather forecasters are now able to determine the likelihood of temperature and precipitation in a specific location for a specific week, month, or season because to climatological studies that started during World War II and continued after the conflict. These climatological statistics held out the possibility of providing forecasting information and overall atmospheric circulation hints.

Statistical methodologies and data analysis methods have gradually improved, increasing public acceptance of statistical meteorology. More atmospheric factors could be included thanks to improved computing power, which increased the physical reliability of the outcome. Statistical techniques would become essential for figuring out where these extreme weather systems were most likely to strike, especially in hurricane and tornado forecasting.

STATISTICAL MEASURES IN ASTRONOMY

By comparing data from a large number of astronomical objects to hypotheses about the creation and evolution of the universe, cosmologists hope to uncover an answer. For instance, when the Hubble Space telescope was

created in 1990, cosmologists had to make do with simple statistical analysis in order to estimate the Hubble constant, the unit of measurement used to characterise the expansion of the universe. Modern technology advancements have ushered in the era of precise cosmology by generating a deluge of new data.

Statistical Measures in Astronomy:

- Availability of stars/galaxies sources an unbiased sample of the vast underling population. (Sampling)
- By use of Multivariate classification we can divide these objects into 2/3/4..... classes.
- By Multivariate regression tries to find the intrinsic relationship between two properties of a class especially with confounding variables.
- We can answer such questions in the presence of observations with measurement errors & flux limits by Censoring, truncation & measurement errors.
- Through Time series analysis we can estimate the vast range of variable objects.
- With the help of spatial point processes & image processing we can make 2-6 dimensional points like galaxies in the universe, photons in detector.
- Through density estimation and regression, we can estimate the continuous

structures like cosmic microwave background fluctuations, interstellar medium.

AGRICULTURE

The foundation of agricultural research is the use of statistical techniques and methodologies that are useful for estimating parameters, formulating predictions, and testing hypotheses against observable data. To effectively practise solving the various issues that arise in the numerous branches of agricultural activity, statistical concepts and methodologies must be applied. Statistical knowledge is required for the analysis and interpretation of biological and agricultural data due to the inherent variability in these fields. Different branches of agricultural science, such as field crop production, vegetable production, horticulture, fruit growing, grape growing, plant protection, livestock, veterinary medicine, agricultural mechanisation, water resources, agricultural economics, etc., were created as a result of the many very different agricultural activities. It is clear how important statistical science is to agriculture.

Statistical techniques are sometimes used to solve issues in genetics and plant breeding, crop production under various agrotechnical conditions and plant protection, type of soils, locations, varieties, sorts,

hybrids, irrigation conditions, use of herbicides, plant physiology, plant biochemistry, genetics and livestock breeding, animal physiology, livestock production under various conditions of animal nutrition, protection, and production under various racial circumstances. The method of production functions in the production of wheat, maize, sugar beets, etc., the impact of specific factors on agricultural production, the measurement of the contribution of production factors and technical progress to the growth of the national product, trends of production lines in agriculture, etc. are some additional examples of the use of statistics.

CONCLUSIONS

This essay discusses the application and significance of statistics. Without statistics, life would be impossible to imagine. Every person uses numbers in some way during every stage of life. The significance of statistics as a strategic resource for national and international development has been elevated due to the growing demand for more and better data. Statistics are increasingly acknowledged on a global scale as a component of the environment that facilitates progress. Government has a crucial role in enhancing the capacity to create appropriate policies, manage the economic and social development reform initiatives, track changes in people's living

standards, and report back on these developments to the public using credible evidence.

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The Case of PSLE Agriculture in Botswana.

CHAPTER-12

BIOCHEMISTRY OF CIRCADIAN RHYTHM: A REVIEW

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Abstract

The capacity of the myocyte to undergo spontaneous depolarization is an innate characteristic that regulates cardiac rhythm. The sinoatrial node, which contains the heart's most rapid pacemaker cells, controls heart rate. The circadian rhythm is the body's inherent 24-hour clock that aids in maintaining a good sleep-wake cycle. Staying on top of this vital bodily function is facilitated by leading a healthy, active lifestyle that prioritises getting enough shut-eye. As time goes on, more and more proof emerges connecting circadian rhythmicity with diseases of mood regulation such seasonal affective disorder. When someone's circadian rhythms are off, they're more likely to experience the symptoms of depression. A combination of medication therapy, light therapy,

and the establishment of a regular sleep-wake pattern is used to treat these conditions.

Keywords: Cardiac rhythm, sleep-wake schedule and mood regulation disorders.

Introduction

Sleep-wake cycle that repeats itself every 24 hours is called your circadian rhythm. It's useful for managing your time asleep and awake each day. Most organisms do in fact possess one. Light and dark, among other things, affect the body's circadian cycle. To stay awake or put you to sleep, your brain reacts to environmental cues by releasing hormones, adjusting your core temperature, and adjusting your metabolic rate. Circadian rhythms can be thrown off by sleep disorders and other environmental influences. By sticking to your healthy routine, you'll be better able to adapt to your body's cyclical needs. Your circadian rhythm is made up of a number of different factors. It's one of the body's four natural cycles. To begin, your brain has cells that react to light and dark. Your eyes pick up on such shifts in the surroundings and then signal various cells to either prepare for sleep or wake up. More messages are sent from those cells to other regions of the brain, where they engage other systems that influence whether you feel sleepy or awake.

Circadian cycle may involve changes in the levels of hormones like melatonin and cortisol. During the day, your body produces less of the sleep-

inducing hormone melatonin than it does at night. The morning is when your body produces the most cortisol, and this is the hormone responsible for waking you up. The chemicals vasopressin, acetylcholine, insulin, and leptin all contribute to wakefulness and the body's 24-hour cycle. Your circadian rhythm consists of more than just your sleep-wake cycle. Your body cools down when you sleep and warms up when you're awake. The rate at which your metabolism operates varies at different times of the day. The regularity of your body's internal clock could be affected by a variety of extraneous variables. Work schedule, exercise, worry, and other behaviours and lifestyle choices can all impact your circadian rhythm [1-5].



Figure 1: Circadian Rhythm

Circadian rhythm also is affected by your age. Circadian rhythms are experienced differently by infants, adolescents, and adults. It takes a few months for a newborn to develop a circadian rhythm. As a result, they may have trouble maintaining a consistent sleep schedule during their first few weeks

and months of life. As they grow and alter in response to their surroundings, their circadian rhythm matures. Around the third month of life, infants start producing melatonin, and between the ages of 2 and 9, cortisol begins to develop.

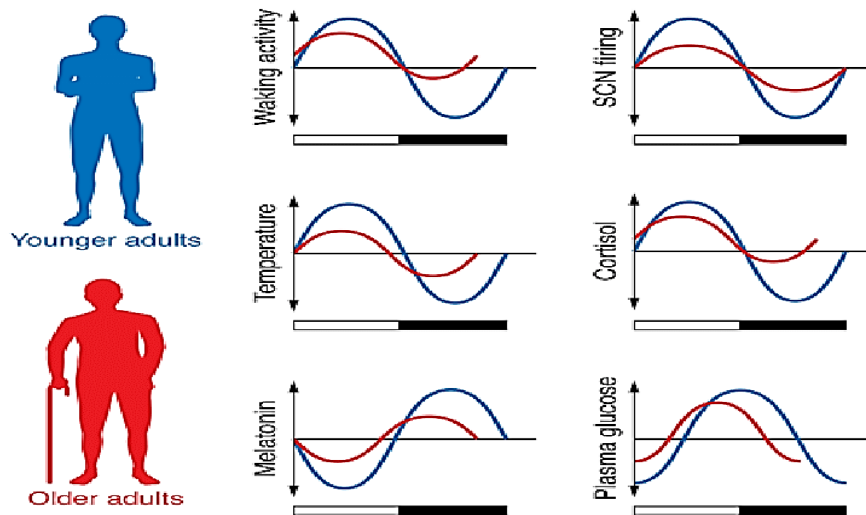


Figure 2: circadian rhythms in older adults relative to rhythms

After the circadian rhythm and other bodily processes of a youngster have matured, that child will begin to adhere to a reasonably consistent sleep schedule. Kids typically need 9-10 hours of sleep per night. The circadian cycle of adolescents shifts, causing sleep phase delay. Teenagers may not feel sleepy until much later in the evening, despite having had early bedtimes in childhood (about 8 or 9 p.m. It's possible that melatonin levels won't start to climb until after midnight. Because of this change, adolescents now need later morning slumber. Even though they have later wake-up times than children, the amount of sleep they require is still the same. A healthy adult should have a fairly

regular circadian cycle. If kids stick to a routine and try to get between 7 and 9 hours of sleep every night, their bedtimes and waking times should be consistent. Melatonin causes sleepiness in adults early in the evening, probably about 11 or 10. Adults typically feel their drowsiest between the hours of 2 and 4 a.m. and between 1 and 3 p.m.

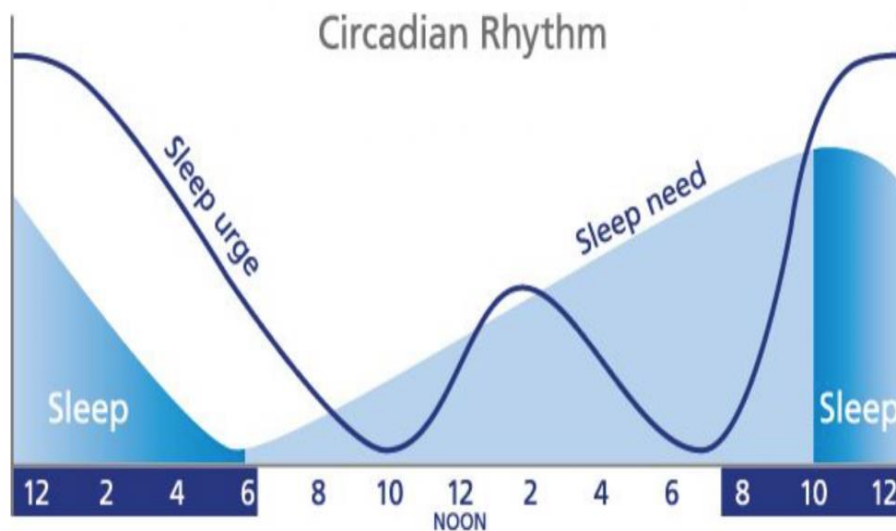


Figure 3: The Biology of Baby's Sleep

As people get older, their circadian rhythms may shift, causing them to go to bed earlier and rise far earlier than they used to. This is a natural consequence of getting older. When you rapidly cross multiple time zones, your body may become disoriented since it is not used to the local time. Your body clock is still set to the time zone from whence you came. This could make you sleepy throughout the day or wired at night. Until your circadian rhythm returns to normal, your health may also be affected by other changes. Adjusting to the new time zone could take anything from a day to a week. Changing your

sleep schedule by one hour takes a whole day to adjust to. When clocks are adjusted for daylight saving time, some people report feeling slight jet lag. The disturbance probably won't last too long, but it may take a few days for your body to readjust [6-9].

Sleep disorders

Changes in your circadian rhythm may indicate a more significant health issue, such as a circadian rhythm sleep problem. An accelerated sleep phase and a delayed sleep phase are two examples of such conditions. If you have bad vision, work irregular hours, are a teenager, or an adult, you may be at a higher risk. When you go to bed and get up more than two hours later than the average person, you have delayed sleep phase disorder. You could identify with the term "night owl."

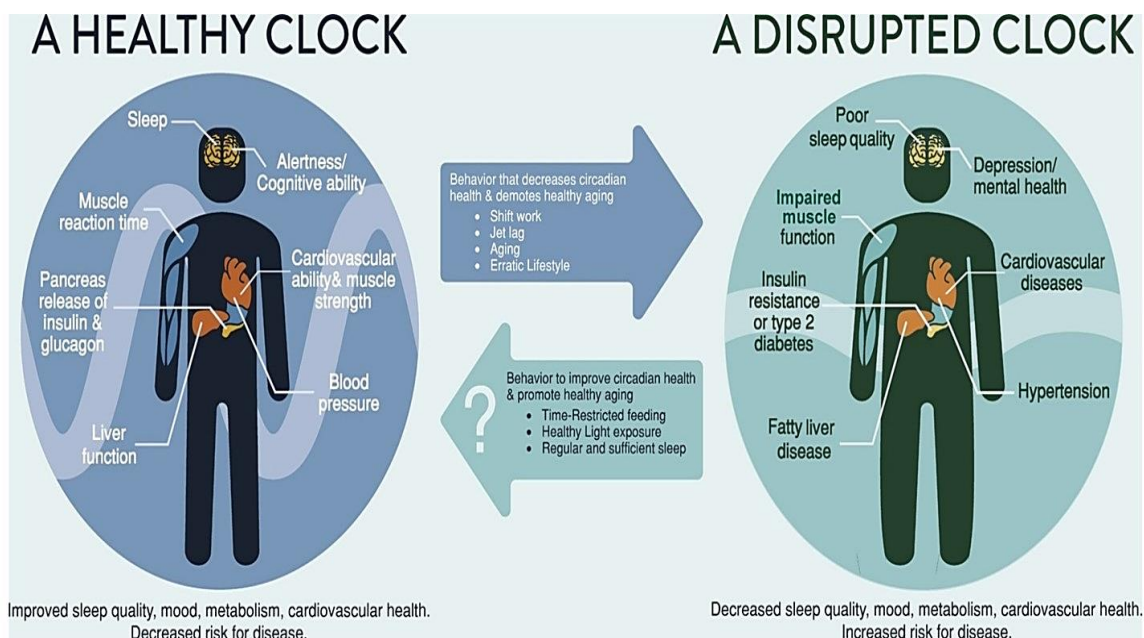


Figure 4: A healthy clock and a disrupted clock

This disorder is more common in teenagers and young adults. This condition is the inverse of its counterpart, delayed sleep phase disorder. You go to bed a couple hours earlier than the average person and wake up even earlier than that. If your circadian rhythm is off, you may have trouble falling asleep at night, wake up multiple times during the night, and be unable to settle back to sleep if you awaken in the middle of the night.

Circadian rhythms and health

Keep your natural sleep-wake cycle regular for optimal health. Negative consequences on your health might be seen immediately and over time if your circadian rhythm is disrupted and you have trouble sleeping. Long-term health issues might develop in various systems if your circadian cycle is disturbed. Everything from your internal organs to your digestive tract to your skin is affected [10-11].

Conclusion

Circadian rhythm sleep disturbances have negative impacts on health yet are frequently ignored. The inability to synchronise one's sleep schedule with the external, 24-hour physical and social cycle is a hallmark of circadian rhythm sleep disorders. Both advanced sleep phase (early onset, common in the elderly) and delayed sleep phase (late onset, common in teens) are among the most common circadian rhythm sleep disorders. Electronic devices such as

computers, televisions, and mobile phones all emit artificial light that can disrupt a person's natural circadian rhythms. Growing research indicates that disruptions in circadian rhythms may contribute to mood disorders including seasonal affective disorder. Typical depressive disorder symptoms are commonly associated with circadian rhythm disturbances. Medication, light therapy, and the establishment of a regular sleep-wake cycle are all part of the treatment for these conditions.

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CHAPTER-13

Role of Bioinformatics in the field of medicine

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Introduction

The study of gathering and evaluating intricate biological information, including genetic codes. A branch of science known as bioinformatics, which is connected to genetics and genomics, collects, stores, analyses, and disseminates biological data and information, such as DNA and amino acid sequences or annotations about those sequences.

As a result of the fusion of biology and information technology, bioinformatics is a new area of biological study. Information technology is used in this diverse field to understand biological data using a variety of computational and analytical tools. It combines a number of disciplines, including computer science, math, statistics, biology, and chemistry. The field of bioinformatics

focuses on creating new hardware and software for use in biotechnology, biological research, and medical applications. The following are the main uses and applications of bioinformatics: To understand the function of genes

- Cell organizations and function
- Analysis of drug targets
- Examine the characteristics of various diseases

USE OF BIOINFORMATICS

The basic purpose of bioinformatics is to extract knowledge from biological data through the use of algorithms and software. The study of genomics, proteomics, 3D structural modelling of proteins, image analysis, interior design, and many more fields make extensive use of bioinformatics.

The bioinformatics covers many specialized and advanced areas of biology.

Such areas are:

- Functional Genomics
- Structural Genomics
- Comparative Genomics
- DNA Microarrays and
- Medical Informatics.

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data through the use of algorithms and software. The study of genomics, proteomics, 3D structural modelling of proteins, image analysis, interior design, and many more fields make extensive use of bioinformatics.

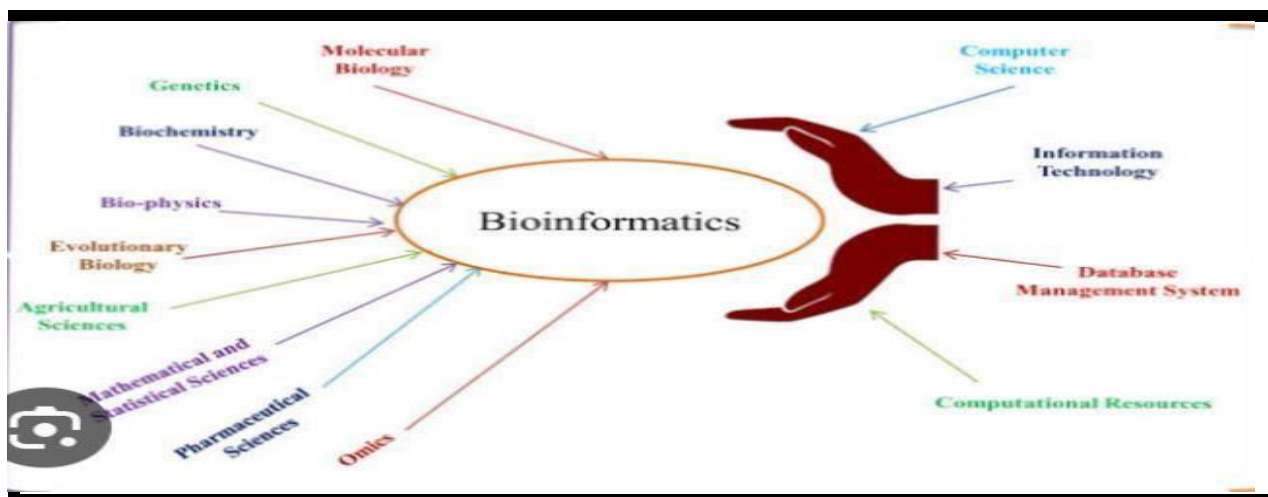


Fig – 1 Various uses of Bioinformatics

However, the current objectives of bioinformatics are integrative and focused on figuring out how different forms of data can be used to understand natural phenomena, such as diseases and organisms.



Fig -2 Different View on Bioinformatics

Scope of Bioinformatics;

The main scope of Bioinformatics is to fetch all the relevant data and process it into useful information. It also deals with

- ❖ Wide-ranging biological data management and analysis;
- ❖ Particularly useful for handling massive data volumes in human genome sequencing.
- ❖ The study and advancement of the biomedical area rely heavily on bioinformatics.
- ❖ Applications of computational coding in bioinformatics include determining the sequences and functions of genes and proteins, creating evolutionary links, and examining the three-dimensional protein structures. Bioinformatics is the sole foundation for research on genetic and microbiological disease, where the data generated can be crucial for creating individualized medications.

What is Bioinformatics and How it is Used in Medicine?

- ❖ Bioinformatics is an interdisciplinary area of the biological sciences that integrates biology and IT. The analysis of molecular sequences and genomics data is one of its applications.
- ❖ The goal of bioinformatics, which combines several life science disciplines, is to provide methodology and tools for studying massive amounts of biological data in order to organise, store, systematise, visualise, annotate, query, comprehend, and interpret that data. Modern computer science is used in

bioinformatics, including molecular modeling/algorithms, cloud computing, statistics, mathematics, and even pattern recognition, reconstruction, machine learning, simulation, and iterative techniques.

In simpler terms, bioinformatics involves the application of computer technology to manage large volumes of biological information.

Applications of bioinformatics in medicine

Bioinformatics has proven quite useful in medicine as the complete sequencing of the human genome has helped to unlock the genetic contribution for many diseases. Its applications include drug discovery, personalized medicine, preventative medicine and gene therapy.

Bioinformatics is being applied in the realm of healthcare to create new and improved treatments for diseases. Scientists can determine which genes are linked to a particular disease, for instance, by analysing the genomes of various patients with the disease.

Bioinformatics can frequently detect diseases before they even start to show signs by analysing a person's DNA. This enables early treatment, which is frequently more efficient. More and more, personalised medicine is being developed using bioinformatics.

The study of transcriptomic data for disease-disease relationships, meta-analyses of genomic data and diseases, the discovery of redundant molecular

pathways, and the compilation of microarray data sets are a few of the various bioinformatics techniques that have been employed for this purpose.

Tools for bioinformatics are widely used to categorise, classify, and type every type of pathogen. The widespread use of genomic approaches to the diagnosis and treatment of viral, bacterial, and fungal illnesses led to this.

The science of information as applied to or researched within the setting of biomedicine is known as biomedical information science. By defining information science's goal of study as data plus meaning, the area is clearly separated from related disciplines like computer science, statistics, and biology, each of which has a different object of study.

According to Kaikabo and Kalshingi (2007), bioinformatics tools are used to generate data for research, mining, retrieval, and analyses of biological data, predict and identify proteins in a sequence to produce and create vaccines, and have laboratory applications.

To maximise the therapeutic value of drugs, bioinformatics is utilised in the identification and validation of drug targets as well as in the creation of biomarkers, toxicogenomic, and pharmacogenomic techniques.

It is an interdisciplinary field that encompasses biology, math, physics, and computational science. The handling of data in modern biology and medicine requires the use of bioinformatics.

1. Drug discovery

At the moment, infectious diseases constitute the leading cause of death for children and young people worldwide. Over 13 million fatalities each year are attributed to infectious diseases, according to the WHO. The majority of infectious illness mortality occur in developing nations, and this is mostly due to the lack of access to affordable medications and the high price of those that are available. The development of affordable and effective medications for a disease is one of the major issues that can be resolved by rational drug design employing bioinformatics.

A logical and structure-based approach to medication design has replaced the trial-and-error method of drug discovery in the pharmaceutical business. The time and expense required to generate efficient pharmacological agents can be decreased using an effective and dependable drug design approach.

On the basis of molecular modelling and simulation, the processes of drug target discovery and drug candidate screening can be hastened and safer/more effective medications can be developed.

2. Personalized medicine

Personalised medicine is a type of healthcare that is created specifically for each individual based on their genetic makeup.

A patient's genetic makeup can help the doctor forecast a patient's propensity for developing a particular condition and help him or her choose the right drug and dosage to minimise side effects. It is used in the treatment of HIV, diabetes-

related diseases, and personalised cancer medication.

In personalised medicine, bioinformatics is used to examine data from genome sequencing or microarray gene expression studies in search of mutations or gene variants that could change a patient's prognosis for their disease or impact how they respond to a particular therapy.

3. Preventive medicine

The focus of preventive medicine is on the wellbeing of specific populations, communities, and individuals. To comprehend the patterns and causes of health and disease, it employs a variety of research techniques, such as biostatistics, bioinformatics, and epidemiology. This knowledge is then transformed into programmes that aim to avoid illness, disability, and death.

Screening babies for diseases like genetic problems or metabolic disorders that are curable but not clinically obvious in the newborn period is an example of preventative medicine.

Researchers examine genomes, proteomics, and metabolomics data for potential disease biomarkers using bioinformatic methods in order to develop such screening tests to detect the disease at an early stage.

4. Gene therapy

The process of replacing dysfunctional genes in the patient's cells with healthy ones is known as gene therapy. Because each person's genetic profile is unique and creating a general gene treatment procedure is highly challenging, gene

therapy has not been extensively adopted.

By considering each person's genetic profile; bioinformatics may be able to determine the ideal gene target site for them. This can lessen the possibility of unwanted side effects.

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CHAPTER-14

Recent Trends in Teaching Methodology for the GenZ Students- A perspective

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Abstract

In the present scenario, GenZ students are true “digital natives” Teaching them is a challenging aspect, for strategically adapting to their unique characteristics. GenZ learners necessitate a profound reconceptualization of education paradigms. The comprehensive exploration spotlights recent trends in teaching methodology impeccably tailored to focus on the distinctive needs of Gen Z. These trends encompass seamless technology integration. There’s plenty of research that helps educators better understand this particular group. This article also serves as a scholarly compass, guiding educators toward a pedagogical landscape adeptly aligned with the unique contours of Gen Z's educational journey

Keywords: Teaching, Methodology, technology, Project-based learning, Micro-Learning,

Introduction

In the contemporary educational milieu, the emergence of Generation Z (GenZ) students heralds a seismic shift in pedagogical imperatives. GenZ individuals are inherently distinct, characterized as digital natives, their formative experiences deeply intertwined with the digital domain. As such, the article embarks upon a discerning exploration, an academic voyage to discern and delineate the evolving landscape of teaching methodology, exquisitely tailored to harmonize with the discerning sensibilities and preferences of GenZ learners. With the inexorable advance of technology and the manifestation of an increasingly interconnected global society, the contours of education, traditionally etched, undergo an intricate metamorphosis. This transformative journey navigates through myriad pedagogical paradigms, encapsulating the quintessence of contemporary educational praxis. As English continues to be a global lingua franca, proficiency in the language is an indispensable asset for GenZ students. To meet this imperative, educators must navigate a dynamic educational landscape that incorporates emerging trends, harnessing the power of technology, individualized learning, and real-world application. This article embarks on a scholarly exploration of the recent trends in teaching methodology tailored to the specific needs and expectations of GenZ students in the context of English language instruction.

Findings

The findings gleaned from extensive research and empirical observations unveil a tapestry of pedagogical shifts that converge in resonance with the distinctive attributes of Gen Z students. Foremost among these trends is the pervasive integration of technology within the educational milieu. The ubiquitous presence of digital tools, apps, and online resources becomes the linchpin, infusing dynamism into the learning process.

In this scenario drawing students away from technology is like splitting water from oil. So, the teachers can adapt a few methodologies.

Methodologies

The methodology employed in this scholarly endeavor encompasses a multifaceted approach. A comprehensive literature review was conducted, encompassing peer-reviewed journal articles, reports, and relevant academic publications. A synthesis of current research findings, coupled with empirical observations and case studies, forms the cornerstone of this investigation. Interviews with educators and surveys administered to Gen Z students further enriched the research landscape, providing firsthand insights into the efficacy of the delineated teaching methodologies

Microlearning emerges as a powerful ally, compressing conventional courses into manageable, brief, and focused portions. The intrinsic attraction of

gamification stimulates better motivation and engagement, making the learning process an interesting journey. software for learning, please. Numerous technological tools exist that can simplify the work of teaching and keep Gen Z students engaged in their studies. Along with comprehensive learning management systems, software can be utilized to create engaging presentations and educational games. Instead, of giving long lectures to Generation Z students, promote interaction. They are used to multitasking and skimming information to find the most crucial bits. Try out different teaching strategies to keep the class moving.

Active Learning Strategies

A vibrant educational ecosystem, supported by inclusive policies, collaborative platforms, and active learning methodologies, encourages Gen Z students to understand concepts more thoroughly. In accordance with the visual-centric ethos of the digital era, visual content takes center stage and promotes retention and understanding. Using ICT resources to create a positive learning environment by visually engaging the class through graphics, charts, and multimedia. Massive text blocks in lectures might make the audience members bored and prevent them from paying attention to the class.

Online collaboration, with all of its potential, serves as a platform for peer interaction and knowledge creation, while real-world application skillfully connects theoretical understanding with useful application. Students in the

Gen Z generation are used to receiving only the most important information because their newsfeeds are frequently updated. Consequently, describes the significance and practical relevance in the real world.

Project-Based Learning:

Project-based learning (PBL) has emerged as a powerful pedagogical approach to teaching English language skills effectively to Generation Z students. PBL immerses students in authentic, real-world language contexts, fostering deep comprehension and application. Here's a deeper exploration of this methodology:

Implementing project-based English language assignments:

Project-based assignments in English classes engage Gen Z students by giving them the opportunity to explore language in context. Assignments might include creating multimedia presentations, designing informative websites, or crafting persuasive advertising campaigns. These tasks allow students to apply language skills, research, and creativity, making language learning purposeful.

Language learning through real-world projects, presentations, and debates:

In PBL, students delve into topics of personal interest or social relevance, conducting research, and presenting their findings in English. This approach fosters language acquisition through real-life tasks. Debates and discussions encourage critical thinking and effective communication in English while

addressing current issues and global challenges. So the students can develop their communication and it will promote their confidence level.

Collaborative language projects that mirror real-life language use:

PBL often emphasizes collaboration, mirroring real-life language use. Gen Z students work in teams to solve problems, create content, and present their work. Collaborative projects build interpersonal skills, enhance fluency, and expose learners to diverse perspectives. It also increases their team-building capacity. These projects prepare students for future collaborative endeavors in the professional world to compete in the commercial world.

Multimodal Content and Visual Literacy:

Integrating multimodal content and visual literacy into English language instruction acknowledges the multimodal nature of contemporary communication. Gen Z learners are inundated with visual and multimedia content daily, making it essential to incorporate these elements into language lessons will improve their language proficiency.

Integrating visual elements into language lessons:

English language educators incorporate visuals, such as images, infographics, and videos, into their lessons. These visuals serve as valuable aids for vocabulary acquisition, comprehension, and retention. They also provide context for language usage and cultural nuances, enhancing overall language proficiency.

The impact of multimedia content on language comprehension:

Multimedia content, including audiovisual materials and interactive simulations, immerses students in diverse language contexts. Listening to authentic conversations, watching documentaries, and exploring digital storytelling enriches language comprehension. It exposes students to various accents, dialects, and cultural contexts, preparing them for real-world language encounters.

Developing visual literacy skills to analyze and understand complex language texts:

Beyond merely consuming visual content, Gen Z students must develop critical visual literacy skills. English language instruction incorporates activities that encourage students to analyze and deconstruct visual messages, advertisements, and digital media. This cultivates critical thinking, cultural awareness, and the ability to decode complex visual narratives.

Incorporating project-based learning and multimodal content with visual literacy into English language instruction empowers Gen Z students to become effective communicators in an increasingly visual and connected world. These methodologies align with their preferences for interactive and relevant learning experiences while equipping them with essential language skills for the future.

Critical Thinking and Analytical Skills:

Developing critical thinking skills through English language instruction:

Critical thinking is a vital skill for Gen Z students navigating a complex, information-rich world. English language instruction can incorporate activities that require students to analyze and evaluate texts critically. For example, students can engage in debates on contemporary issues, analyze persuasive speeches, or assess the reliability of online sources in English.

Analyzing and evaluating complex language texts and arguments:

English language learners should be exposed to diverse texts, from academic articles to opinion pieces, to develop their analytical skills. Teachers can guide students in deconstructing arguments, identifying rhetorical devices, and assessing the credibility of sources. Analytical exercises can be woven into reading comprehension tasks.

Incorporating critical language awareness in the curriculum:

Critical language awareness entails exploring the power dynamics, cultural nuances, and biases inherent in language. Educators can facilitate discussions on topics such as language variation, linguistic discrimination, and the impact of language on society. This critical awareness enriches students' language proficiency and cultural sensitivity.

Language Assessment Gamification:

Gamifying Language Assessments to enhance motivation and engagement:

Gamification adds an element of fun and competition to language assessments. Educators can design language quizzes, vocabulary challenges, or role-playing games that motivate students to actively participate. Gamified assessments tap into Gen Z's love for interactive and competitive learning experiences.

The use of digital badges and leaderboards for language proficiency tracking:

Digital badges and leaderboards provide a visual representation of language proficiency levels and progress. When students earn badges for achieving language milestones or see their ranking on a leaderboard, it boosts their motivation and sense of achievement. These elements can be integrated into online language learning platforms.

Balancing the fun element with the validity and reliability of language assessments:

While gamification enhances motivation, it's essential to strike a balance between fun and the reliability of language assessments. Educators should design assessments that align with language learning objectives and standards. Gamified assessments should still effectively measure language proficiency and provide valuable feedback.

Emotional Intelligence and Communication Skills:

Integrating emotional intelligence development into language learning:

Language learning is not just about vocabulary and grammar; it's also about effective communication and empathy. Educators can incorporate activities that enhance emotional intelligence, such as role-playing scenarios that require students to navigate emotional conversations or discuss cultural differences in communication styles.

Enhancing interpersonal communication skills through language instruction:

Effective language communication extends beyond linguistic competence. Gen Z students benefit from activities that focus on active listening, non-verbal communication, and cross-cultural communication. Role-playing exercises, group discussions, and peer feedback sessions foster these skills.

Addressing the empathetic and culturally sensitive use of language:

Language instruction should emphasize the importance of using language empathetically and with cultural sensitivity. Students can explore case studies, engage in cross-cultural dialogues, and reflect on the impact of language choices on interpersonal relationships and global interactions.

Authentic Language Resources:

Incorporating authentic language materials such as news articles, podcasts, and literature:

To expose Gen Z students to real-world language usage, educators should

integrate authentic materials into their lessons. This includes using current news articles, podcasts, literary texts, and films. Authentic materials offer insight into idiomatic expressions, cultural references, and contemporary language trends.

Encouraging students to engage with real-world language sources:

Encouraging students to explore authentic language sources independently is essential. Assignments can include analyzing a news article, listening to a podcast, or reading a novel in English. These activities develop self-directed learning skills and broaden students' exposure to diverse language contexts.

Creating authentic language tasks and assessments:

Language assessments should mimic real-world language tasks. For example, students can be tasked with writing a persuasive email, creating a marketing campaign, or participating in a mock job interview in English. Authentic assessments align with Gen Z's desire for practical skills and application.

Online Collaboration and Remote Learning:

Strategies for effective online collaboration in language courses:

As online collaboration becomes increasingly prevalent, educators must teach Gen Z students how to collaborate effectively in virtual settings. This includes setting clear communication expectations, using collaboration tools,

and fostering a sense of community in online language courses.

Overcoming challenges and maximizing opportunities in remote language learning:

Remote learning presents unique challenges, such as digital fatigue and isolation. Educators can address these challenges by incorporating interactive elements into virtual classes, providing opportunities for small-group discussions, and offering guidance on time management and self-motivation in online language learning.

Leveraging virtual language exchange partnerships for practice:

Virtual language exchange programs connect Gen Z students with native speakers of the language they are learning. Educators can facilitate these partnerships, enabling students to engage in conversation practice and cultural exchange via video calls or messaging apps. Virtual language exchanges enhance fluency and cultural awareness.

Ethical Use of Language Technology:

Discussing the ethical use of language translation tools and AI-powered language platforms:

With the proliferation of language technology, students should engage in discussions about ethical considerations. This includes conversations about plagiarism, the responsible use of machine translation, and the ethical implications of automated content-generation tools in language learning and

writing.

Encouraging responsible and accurate language use in the digital age:

Digital natives, Gen Z students are immersed in online communication. Language educators play a pivotal role in fostering responsible and accurate language use in digital contexts. Lessons can focus on recognizing and countering misinformation, understanding the impact of language on online communities, and promoting digital civility.

Addressing the potential pitfalls of overreliance on technology in language learning:

While technology offers numerous benefits, educators should also address the potential downsides of overreliance on digital tools. Discussions can center on maintaining a balance between technology-assisted learning and human interaction, emphasizing the irreplaceable value of authentic communication in language acquisition.

Conclusion

The knowledge for Generation Z students, educators must embrace these trends in teaching methodology to navigate the evolving terrain of English language instruction successfully. The fusion of technology, personalization, microlearning, project-based learning, multimodal content, global communication, effective assessment, inclusivity, and linguistic diversity equips both educators and learners to embark on a transformative

journey towards English language proficiency. By aligning teaching strategies with the unique attributes and expectations of Gen Z, we not only empower our students with language skills but also prepare them to excel in a globally connected world where effective English language communication is paramount.

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CHAPTER-15

HOW DO MOBILE APPLICATIONS ENHANCE THE TOURIST EXPERIENCE?

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Abstract

Mobile applications have revolutionized the modern tourism industry by transforming the way travellers explore and engage with destinations. These applications offer an array of features, enriching the tourist experience by providing convenient access to information, navigation assistance, booking services, personalized recommendations, and more.

This literature review delves into the multifaceted ways mobile applications enhance the overall tourist experience, addressing several critical facets:

Information Accessibility: Mobile applications empower tourists with real-time access to essential information about their destinations, including attractions, accommodations, and local services. **Navigation and Wayfinding:**

Equipped with GPS technology, mobile applications facilitate seamless navigation in unfamiliar environments, aiding tourists in discovering their

surroundings .**Personalization and Customization:** Mobile applications employ user preferences and past behaviours to offer tailored recommendations for attractions, activities, and dining options, ensuring a more personalized travel involvement .**Language and Communication:** These apps often include language translation features, bridging communication gaps between tourists and locals, fostering cross-cultural interactions. **User Reviews and Feedback:** Incorporating user-generated reviews and ratings, mobile applications assist travellers in making informed decisions regarding accommodations, attractions, and services.

In addition to these core aspects, the impact of mobile applications on tourist decision-making is explored, highlighting their role as influential tools in shaping travel choices. The study also underscores the crucial role mobile applications play in cross-cultural communication, fostering meaningful interactions among tourists and local communities. Furthermore, it emphasizes the significance of inclusive design in mobile app development for tourism, promoting accessibility for all travellers.

Looking to the future, the abstract anticipates the continued evolution of mobile applications in tourism, offering glimpses into their potential. However, it also acknowledges challenges such as security and privacy concerns, app reliability, and data connectivity issues. Finally, the review concludes by addressing research gaps and suggesting future directions in the field of mobile

applications for tourism, promising ongoing innovation and advancements in the industry.

Key words: Mobile application, Information accessibility, Navigation and wayfinding, Personalization and customization, Language, and communication

1.Introduction

Mobile applications have revolutionized the way travellers explore and experience destinations, making them an integral part of the modern tourism industry. These applications offer a wide array of features and functionalities aimed at enhancing the tourist experience by providing convenient access to information, navigation assistance, booking services, personalized recommendations, and more. This literature review seeks to delve into the myriad ways in which mobile applications contribute to enriching the overall tourist experience.

Mobile Applications and Information Accessibility

One of the primary roles of mobile applications in the tourism sector is to provide tourists with real-time access to information about their destinations. These apps offer insights into local attractions, accommodations, dining options, and essential services, empowering travellers to make informed decisions. Gretzel et al. (2015) emphasize that mobile applications keep travellers updated about local events, cultural sites, dining choices, and transportation services, allowing them to adapt their itineraries based on

evolving circumstances.

Navigation and Wayfinding

Efficient navigation is a cornerstone of an enhanced tourist experience. Mobile applications equipped with GPS technology enable tourists to navigate unfamiliar environments with ease. Xiang et al. (2015) have suggested that location-based services provided by these apps enhance tourists' spatial orientation and significantly reduce the likelihood of getting lost. These apps offer interactive maps, directions, and route recommendations, ultimately contributing to a smoother and less stressful travel experience.

Personalization and Customization

Personalization is a significant feature in mobile applications designed to enhance the tourist experience. These apps leverage user preferences and past behaviours to offer tailored recommendations for attractions, activities, and dining options. Buhalis and Amaranggana (2015) underscore the importance of personalized content in mobile apps, as it helps travelers discover relevant experiences and maximize their enjoyment during the trip.

Language and Communication

Language barriers can be a significant challenge for tourists, especially in countries where the native language differs from their own. Mobile applications often include language translation features that bridge this communication gap between tourists and locals. Wang and Fesenmaier (2016)

highlight the utility of language translation apps integrated into travel applications, as they enhance tourists' ability to interact with locals, seek directions, and engage in meaningful cultural exchanges.

User Reviews and Feedback

Mobile applications frequently incorporate user-generated reviews and ratings of accommodations, attractions, and services. These reviews play a pivotal role in aiding tourists in making informed choices and managing their expectations. Xiang et al. (2017) emphasize the impact of user-generated content on tourists' decision-making processes and the overall quality of their travel experiences.

Challenges and Considerations

While mobile applications offer numerous benefits, there are also challenges that need consideration. Issues such as security and privacy concerns, app reliability, and data connectivity problems can potentially affect the usability of these applications (Zhang et al., 2017). Additionally, ensuring that mobile apps are user-friendly and accessible to a diverse range of travelers, including those with varying levels of technological literacy, is an essential consideration (Neuhofer et al., 2015).

Research Questions

Personalization algorithms in tourism applications can influence tourists' decision-making by recommending attractions, activities, and dining options

that are more likely to be of interest to them. This can improve the overall travel experience, but it can also lead to tourists missing out on serendipitous experiences.

Language translation apps can have a positive impact on cross-cultural communication between tourists and locals, but they can also lead to misunderstandings. It is important to be aware of the cultural implications of using these apps and to develop culturally sensitive communication strategies. Tourism mobile applications can be inclusively designed by considering the specific needs of diverse user groups, such as older adults, people with disabilities, and individuals from various cultural backgrounds. This includes making sure that the apps are accessible, usable, and easy to understand for everyone

In investigating these research questions, a quantitative approach was employed, with a sample size of 100 respondents. The data analysis tool selected for the study was the Mann-Whitney non-parametric test, suitable for comparing two independent groups when the data was not normally distributed. This method allowed the assessment of the significance of the relationships between variables and testing hypotheses related to the impact of personalization algorithms, language translation apps, and inclusive design on the tourist experience.

The significance of the study lay in its potential to shed light on how mobile

applications could be optimized to enhance the tourist experience while addressing the challenges and concerns associated with their use. By gaining insights into personalization algorithms, cross-cultural communication, and inclusivity in mobile app design, the research aimed to contribute to the development of more effective and user-friendly tourism applications, ultimately improving the overall travel experience for tourists worldwide.

The main objectives of this paper are to test hypotheses that are derived from research gaps and to convert research questions into research objectives. Finally, research objectives are transformed into hypotheses, which are summarized as follows.

Personalization algorithms can impact tourists' decisions through past behaviour analysis, making recommendations more relevant. While tourists value personalized recommendations, they may sacrifice some excitement in exchange for serendipitous discoveries. Personalized recommendations can boost user engagement and satisfaction by aligning with individual preferences. How user personality may influence the preference for either serendipity or predictability when using personalized recommendations. Language translation apps can enhance cross-cultural communication and reduce language barriers for tourists. Practicing cultural sensitivity when using translation apps can lead to more successful interactions with locals. Enhanced accessibility features in tourism apps can provide significant benefits for users

with disabilities. Implementing user-centric design principles can improve usability and enhance the user experience for diverse user groups in tourism apps.

2. Materials and Method

Mobile applications have become an integral part of the modern tourism industry, offering a wide range of features and functionalities aimed at enhancing the tourist experience. These applications provide travellers with convenient access to information, navigation, booking services, recommendations, and personalized content. This literature review aims to explore the various ways in which mobile applications contribute to enhancing the overall tourist experience.

Mobile Applications and Information Accessibility: Mobile applications play a crucial role in providing tourists with real-time access to information about destinations, attractions, accommodations, and local services. According to Gretzel et al. (2015), mobile apps empower travelers by offering up-to-date details about local events, cultural sites, dining options, and transportation services. These apps enable users to make informed decisions and adapt their itineraries in response to changing circumstances.

Navigation and Wayfinding: Navigation is a key factor in enhancing the tourist experience. Mobile applications equipped with GPS technology allow travelers to easily navigate unfamiliar environments. A study by Xiang et al.

(2015) suggests that location-based services provided by mobile apps improve tourists' spatial orientation and reduce the likelihood of getting lost. These apps offer interactive maps, directions, and route recommendations, ultimately contributing to a smoother and less stressful travel experience.

Personalization and Customization: Personalization is a significant feature of mobile applications designed to enhance the tourist experience. Through user preferences and past behaviors, these apps can offer tailored recommendations for attractions, activities, and dining options. Buhalis and Amaranggana (2015) highlight the importance of personalized content in mobile apps, as it helps travelers discover relevant experiences and maximize their enjoyment during the trip.

Language and Communication: Mobile applications often include language translation features that help bridge communication gaps between tourists and locals. This feature can be particularly beneficial in countries where language barriers exist. According to Wang and Fesenmaier (2016), language translation apps integrated into travel applications enhance tourists' ability to interact with locals, ask for directions, and engage in meaningful cultural exchanges.

User Reviews and Feedback: Mobile applications frequently include user-generated reviews and ratings of accommodations, attractions, and services. These reviews aid tourists in making informed choices and managing their expectations. In their study, Xiang et al. (2017) emphasize the impact of user-

generated content on tourists' decision-making processes and the overall quality of their travel experiences.

Challenges and Considerations: While mobile applications offer numerous benefits, there are also challenges to consider. Security and privacy concerns, app reliability, and data connectivity issues can potentially affect the usability of these applications (Zhang et al., 2017). Ensuring that mobile apps are user-friendly and accessible to a diverse range of travelers, including those with varying levels of technological literacy, is also an important consideration (Neuhofer et al., 2015).

Conclusion: In conclusion, mobile applications play a vital role in enhancing the tourist experience through improved access to information, navigation assistance, personalization, language support, and user-generated feedback. While these apps offer many benefits, addressing challenges related to security, reliability, and inclusivity is essential for ensuring a positive impact on travellers' experiences.

Research Gaps

1. **Impact of Personalization Algorithms on Tourist Decision-Making:** While the literature acknowledges the importance of personalized content in enhancing the tourist experience, there is a research gap in understanding how different personalization algorithms affect tourists' decision-making processes. Investigating the effectiveness of various recommendation

algorithms in suggesting attractions, activities, and dining options based on user preferences and past behaviours could provide insights into which approaches lead to more satisfying and enjoyable travel experiences. This research could also explore the balance between personalization and serendipity, as excessive personalization might limit travellers' exposure to new and unexpected experiences.

2. Cultural Implications of Language Translation Apps: The literature mentions that language translation features in mobile applications can facilitate communication between tourists and locals, particularly in countries with language barriers. However, a research gap exists in exploring the cultural implications of relying on translation apps. How do tourists and locals perceive and respond to the use of such apps in communication? Are there situations where translation apps might inadvertently lead to misunderstandings or misinterpretations of cultural nuances? This research could provide insights into the dynamics of cross-cultural interactions in the context of language-assistance technologies.

3. Inclusive Design of Tourism Apps for Diverse User Groups: While the literature acknowledges the importance of ensuring mobile apps are user-friendly and accessible, there is a research gap in delving deeper into the design considerations needed to cater to a diverse range of travellers. Research could focus on the specific needs and challenges faced by various user groups, such

as older adults, people with disabilities, or travellers from different cultural backgrounds. Exploring how app interfaces, navigation, and content presentation can be tailored to accommodate these diverse user groups could lead to more inclusive and universally usable mobile applications for enhancing the tourist experience.

These research gaps offer opportunities to delve deeper into specific aspects of mobile application usage in the tourism industry and contribute to a better understanding of how to optimize the benefits of these applications for both tourists and the destinations they visit.

Research Questions

1. How do different personalization algorithms employed in tourism applications influence tourists' decision-making processes when recommending attractions, activities, and dining options based on user preferences and past behaviours? What are the perceived impacts of these algorithms on the overall travel experience, and how do tourists perceive the trade-off between personalized recommendations and the serendipity of discovering new and unexpected experiences?
2. What are the cultural implications of utilizing language translation apps in cross-cultural communication between tourists and locals? How do both parties perceive the use of translation apps in different interaction scenarios, and what are the potential challenges or misunderstandings that may arise due

to the reliance on such apps? Furthermore, how can these insights inform the development of culturally sensitive communication strategies for tourists and locals within the context of language-assistance technologies?

3. How can tourism mobile applications be inclusively designed to cater to the diverse needs of user groups such as older adults, people with disabilities, and individuals from various cultural backgrounds? What are the specific design considerations required to enhance the accessibility, usability, and overall user experience for these diverse groups? Additionally, how can these design principles be integrated into app interfaces, navigation systems, and content presentation to create more universally usable applications that contribute to a more inclusive and satisfying tourist experience?

Objectives

Question 1:

Objective 1: To understand how different personalization algorithms employed in tourism applications influence tourists' decision-making processes when recommending attractions, activities, and dining options based on user preferences and past behaviours.

Objective 2: To evaluate the perceived impacts of these algorithms on the overall travel experience, and to understand how tourists perceive the trade-off between personalized recommendations and the serendipity of discovering new and unexpected experiences.

Question 2:

Objective 1: To explore the cultural implications of utilizing language translation apps in cross-cultural communication between tourists and locals.

Objective 2: To identify the potential challenges or misunderstandings that may arise due to the reliance on language translation apps, and to develop culturally sensitive communication strategies for tourists and locals within the context of language-assistance technologies.

Question 3:

Objective 1: To identify the specific design considerations required to enhance the accessibility, usability, and overall user experience for diverse user groups in tourism mobile applications.

Objective 2: To develop design principles that can be integrated into app interfaces, navigation systems, and content presentation to create more universally usable applications that contribute to a more inclusive and satisfying tourist experience.

Hypotheses**Question 1: Personalization Algorithms in Tourism Applications**

Hypothesis 1: Different personalization algorithms have a significant impact on tourists' decision-making processes, with algorithms that analyze past behaviors and preferences leading to more tailored and relevant recommendations.

Hypothesis 2: Tourists perceive personalized recommendations positively, attributing them to improved convenience and relevance, but there exists a trade-off between personalization and the excitement of serendipitous discoveries.

Hypothesis 3: Personalized recommendations may increase user engagement and satisfaction with tourism applications, as they streamline the decision-making process and help travelers discover options aligned with their preferences.

Hypothesis 4: Users with distinct personalities (e.g., risk-takers vs. planners) may react differently to personalized recommendations, influencing their preference for serendipity or predictability in their travel experiences.

Question 2: Language Translation Apps in Cross-Cultural Communication

Hypothesis 5: The use of language translation apps facilitates cross-cultural communication between tourists and locals, increasing interaction and reducing language barriers.

Hypothesis 6: Tourists who demonstrate cultural sensitivity and awareness when using translation apps are likely to have more successful and positive interactions with locals.

Question 3: Design Considerations for Inclusive Tourism Mobile Applications

Hypothesis 7: Designing tourism mobile applications with enhanced

accessibility features (e.g., screen readers, voice control) can significantly improve usability and user experience for diverse user groups, including people with disabilities.

Hypothesis 8: User-centric design principles that emphasize clear navigation, intuitive interfaces, and adaptable content presentation contribute to creating more universally usable tourism applications.

Method

Research Approach: The chosen research approach for this study is quantitative, emphasizing the use of numerical data and statistical analysis.

Study Area: The study is primarily focused on the Kolkata region. This region holds significant importance in the context of tourist arrivals and departures, both on a national and international scale. **Sample Size:** The research involves a sample size of 100 individuals. **Sampling Technique:** The sampling technique employed in this study is convenience sampling. This method was chosen for its ease in collecting primary data. **Data Sources:** Primary data collection is the primary focus, supplemented by secondary sources such as various types of related journal articles. **Data Collection Tool:** The primary data collection tool used in this study was a closed-end questionnaire. Respondents were asked a set of predetermined questions with limited response options. **Data Analysis Tool:** For data analysis, the researchers employed the Mann-Whitney U test, a non-parametric test. This choice was

made because the collected data did not follow a normal distribution pattern.

3.Results and Discussion

Table No. 1, Hypothesis Testing- 1

Personaliz	Please rate	To	what	How often	In your
ation	the extent	degree	do	do you rely	opinion,
algorithms	to which	you think	on	do you	
that	you believe	personaliz	recommen	feel that	
analyse my	that	ed	dations	personali	
past	algorithms	recommen	generated	zation	
behaviours	analysing	dations	by	algorithm	
and	past	influenced	algorithms	s enhance	
preference	behaviours	your recent	analysing	your	
s have a	and	travel	your past	overall	
significant	preferences	decisions?	travel	travel	
impact on	provide		behaviours	experien	
my	more		and	e?	
decision-	tailored		preference		
making	and		s?		
process	relevant				
when	travel				

	choosing	recommen			
	travel	dations.			
	recommen				
	dations				
Mann	600.000	1200.000	1131.000	700.000	1150.000
-					
Whit					
ney U					
Wilco	2430.000	2020.000	2961.000	2530.000	1970.000
xon					
W					
Z	-4.363	.000	-.498	-3.636	-.361
Asym	.000	1.000	.619	.000	.718
p. Sig.					
(2-					
tailed					
)					

Grouping Variable: Respondents' Gender

Scale 1 to 5

The data seems to be the results of statistical tests conducted to assess the influence of personalization algorithms on travel recommendations and

decisions, with a specific focus on gender differences among respondents.

Test Statistic:

This section likely includes the statistical tests used to analyse the data. It appears that the Mann-Whitney U test and Wilcoxon W test were performed. These tests are non-parametric tests used to compare two independent groups or conditions when the assumptions for parametric tests are not met.

Grouping Variable: Respondents' Gender: This indicates that the analysis is stratified by gender. In other words, the researchers are examining whether there are differences in responses between male and female respondents.

Results:

Mann-Whitney U: This test statistic measures the rank sum of the responses for male and female respondents. The values for each gender group are: 600.000 (for males) and 1200.000 (for females). The lower U value suggests that males, on average, rated the impact of personalization algorithms on travel decisions lower than females did.

Wilcoxon W: This test statistic is also used to compare two groups. The values are 2430.000 (males) and 2020.000 (females). This statistic, like Mann-Whitney U, indicates that males, on average, provided lower ratings than females regarding personalized recommendations.

Z-Score (Z): The Z-score reflects how many standard deviations an observation is from the mean. In this case, it is used to assess the significance

of the differences between male and female responses. The negative Z-scores (-4.363, -3.636) suggest that there are significant differences in how males and females rated the impact of personalization algorithms on travel decisions. The p-values (Asymp. Sig.) for these differences are very low (close to zero), indicating that these differences are statistically significant.

Interpretation:

The Mann-Whitney U and Wilcoxon W tests suggest that there are significant gender differences in how respondents rate the impact of personalization algorithms on travel decisions. Females, on average, rated the influence of these algorithms higher than males did.

Practical Implications:

This data suggests that personalization algorithms may have a more significant impact on females' travel decision-making processes compared to males.

Travel-related businesses may consider tailoring their recommendations and marketing strategies differently for male and female customers based on these findings.

Further qualitative research could explore the reasons behind these gender differences to provide more insights into improving personalized travel recommendations.

Table No. 2, Hypothesis Testing- 2

How positively do you perceive personalized recommendations during your travel experience, attributing them to improved convenience and relevance?

To what extent do you agree that there is a trade-off between personalized recommendations and serendipitous discoveries while traveling?

How important is the balance between personalized recommendations and serendipitous overall tourist experience?

Mann-Whitney U	1138.000	693.500	933.000
Wilcoxon	2968.000	2523.500	2763.000
W			
Z	-.445	-3.614	-1.911
Asymp. Sig.	.656	.000	.056
Sig. (2-			

tailed)

Grouping Variable: Respondents' Gender

Scale- 1 to 7

The low p-value (0.000) suggests that there is a statistically significant difference between the responses of the two groups to the survey questions. This implies that the respondents' perceptions of personalized recommendations, the trade-off between personalization and serendipitous discoveries, and the importance of the balance between these factors are different between the two groups.

In summary, based on these test statistics:

Gender does not significantly influence perceptions of personalized recommendations during travel. There are significant differences in responses to the survey questions between the two gender groups, indicating that they may have different perspectives on the trade-off between personalization and serendipity in travel experiences and the importance of finding a balance between them.

Table No. 3, Hypothesis Testing- 3

On a scale of 1 to 7, Please rate your To what extent do
how satisfied are level of you believe that

you with the engagement with personalized
 personalized the tourism recommendations
 recommendations application when in this tourism
 provided by this using personalized application align
 tourism recommendations. with your travel
 application? preferences?

Mann-Whitney U	1148.500	1069.500	957.500
Wilcoxon W	2978.500	2899.500	2787.500
Z	-.374	-.929	-1.724
Asymp. Sig. (2-tailed)	.708	.353	.085

Grouping Variable: Respondents' Gender

Scale- 1 to 7

Mann-Whitney U and Wilcoxon W statistics are used to compare two groups or conditions. In this case, it appears you are comparing the responses of two gender groups (possibly male and female) regarding their satisfaction with a tourism application's personalized recommendations and engagement level

with the application.

The z-scores indicate that the second group (possibly the other gender group) tends to have lower values in terms of satisfaction and engagement compared to the first group (possibly one gender group). However, the z-scores are relatively close to zero, suggesting that the differences might not be very large. The p-values associated with the Mann-Whitney U test are all relatively high (greater than 0.05), indicating that there may not be a statistically significant difference between the two groups in terms of their satisfaction, engagement, and alignment of personalized recommendations with travel preferences. However, it's important to note that the p-value for the second group's alignment with travel preferences (0.085) is closer to the conventional significance level of 0.05, suggesting a potential trend or borderline significance.

In summary, based on the provided statistics and p-values, there may not be strong evidence to conclude that there are significant differences between the two gender groups in terms of satisfaction, engagement, and alignment with personalized recommendations. However, further analysis or a larger sample size might be needed to draw more definitive conclusions.

Table No. 4, Hypothesis Testing- 4

On a scale of 1 to 7, Please rate, on a How satisfied are you,

how strongly do scale of 1 to 7, how on a scale of 1 to 7, you agree that likely you are to with the travel your personality seek out recommendations type (e.g., risk- personalized you've received based taker or planner) travel on your personality influences your recommendations traits in the past? (1 = preference for based on your Very Dissatisfied, 7 = serendipitous or personality traits Very Satisfied) predictable travel when planning a experiences? (1 = trip. (1 = Very Strongly Disagree, Unlikely, 7 = Very 7 = Strongly Likely) Agree)

Mann-	1134.500	1193.500	914.500
Whitney			
U			
Wilcoxon	1954.500	2013.500	1734.500
W			
Z	-.466	-.046	-2.037
Asymp.	.641	.963	.042

Sig. (2-tailed)

Grouping Variable: Respondents' Gender

Scale- 1 to 7

In the Mann-Whitney U and Wilcoxon W statistics, there are three sets of values, likely corresponding to the three questions or analyses mentioned earlier.

The negative Z-scores indicate that the observed differences between the gender groups are lower than expected by chance.

The Asymptotic Significance values (.641, .963, .042) are p-values associated with the analyses. The third analysis (related to satisfaction with travel recommendations) has a p-value of 0.042, which is below the common significance threshold of 0.05. This suggests that there is a statistically significant difference in satisfaction with travel recommendations based on gender for this particular question.

In summary, the analysis suggests that there may be a significant difference in satisfaction with travel recommendations based on respondents' gender for at least one of the three questions.

Table No.5. Hypothesis Testing- 5

On a scale of 1 to 7, To what How effective do you

how strongly do extent do you perceive language
 you believe that think translation apps to be
 using language language in bridging the
 translation apps translation communication gap
 can enhance cross- apps between tourists and
 cultural contribute to locals from different
 communication increased linguistic
 between tourists interaction backgrounds? Please
 and locals, between rate on a scale of 1 to
 reducing language tourists and 7, with 1 indicating
 barriers? (1 = locals during "ineffective" and 7
 strongly disagree, cross-cultural indicating "highly e
 7 = strongly agree) encounters?

Please rate on

a scale of 1 to

7. (1 = not at

all, 7 = to a

great extent)

Mann- 1137.500 877.000 1192.500

Whitney

U

Wilcoxon	2967.500	2707.000	3022.500
-----------------	-----------------	-----------------	-----------------

W

Z	-.447	-2.309	-.054
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Asymp.	.655	.021	.957
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Sig. (2-tailed)

Grouping Variable: Respondents' Gender

Scale- 1 to 7

Question 1 (Belief in enhancing cross-cultural communication)

Mann-Whitney U: 1137.500

Wilcoxon W: 2967.500

Z: -0.447

Asymp. Sig. (2-tailed): 0.655

The Z-score of -0.447 and the p-value of 0.655 suggest that there is no statistically significant difference in beliefs about whether language translation apps can enhance cross-cultural communication between tourists and locals between male and female respondents. In other words, both genders have similar opinions on this matter.

Question 2 (Contribution to increase interaction)

Mann-Whitney U: 877.000

Wilcoxon W: 2707.000

Z: -2.309

Asymp. Sig. (2-tailed): 0.021

The Z-score of -2.309 and the p-value of 0.021 indicate that there is a statistically significant difference in the extent to which respondents believe that language translation apps contribute to increased interaction between tourists and locals based on gender. Further analysis would be needed to determine which gender group has a stronger opinion.

Question 3 (Effectiveness in bringing communication gap)

Mann-Whitney U: 1192.500

Wilcoxon W: 3022.500

Z: -0.054

Asymp. Sig. (2-tailed): 0.957

The Z-score of -0.054 and the p-value of 0.957 suggest that there is no statistically significant difference in perceptions of the effectiveness of language translation apps in bridging the communication gap between tourists and locals based on gender.

In summary, the Mann-Whitney U test results show that there is a significant difference in opinions regarding the contribution of language translation apps to increased interaction (Question 2) between male and female respondents. However, there are no significant differences in opinions for the other two

questions based on gender.

Table No.6. Hypothesis Testing- 6

	On a scale of 1 to 7, How would To what extent do you how likely do you you rate the believe that tourists think tourists who impact of who show cultural demonstrate cultural sensitivity when using cultural sensitivity sensitivity and translation apps are and awareness awareness perceived more when using when using positively by locals? translation apps are translation to have more apps on the successful and success of positive tourists' interactions with interactions locals? with locals?		
Mann- Whitney U	1184.500	724.000	1200.000
Wilcoxon W	3014.500	2554.000	2020.000

Z	-.112	-3.446	.000
Asymp.	.911	.001	1.000
Sig. (2-tailed)			

Grouping Variable: Respondents' Gender

Scale- 1 to 7

For the Mann-Whitney U statistic, the values are 1184.500 for one group, 724.000 for another group, and 1200.000 when combining both groups. This statistic assesses the difference between the groups, with lower values indicating more positive interactions.

The Z-score is used to assess the significance of the difference. In the case of the female group, the Z-score is -3.446, which is significantly lower than the Z-score of -0.112 for the male group. This suggests that for female respondents, there is a significant difference in how cultural sensitivity and awareness impact interactions with locals compared to male respondents.

The p-values associated with the Mann-Whitney U test are also important. A p-value of 0.001 (for females) and 0.911 (for males) suggests that there is a statistically significant difference in perceptions of cultural sensitivity between male and female respondents.

In summary, the Mann-Whitney U test indicates that there is a significant difference between male and female respondents in terms of how they perceive

the impact of cultural sensitivity and awareness when using translation apps on tourists' interactions with locals. Female respondents appear to rate this factor more positively than male respondents, as indicated by the lower U statistic, Z-score, and the significant p-value for females.

Table No.7. Hypothesis Testing- 7

On a scale of 1 to 7, To what extent do you think the usability of this tourism mobile application with enhanced accessibility features (e.g., screen readers, voice control) for people with disabilities? The statement: "The mobile application with enhanced accessibility features (e.g., screen readers, voice control) for people with disabilities? were in inclusion of accommodating the needs of diverse user groups, including people with disabilities? significantly improved my user

		experience	
		with this	
		tourism	
		mobile	
		application"?	
Mann-Whitney U	1138.000	693.500	933.000
Wilcoxon W	2968.000	2523.500	2763.000
Z	-.445	-3.614	-1.911
Asymp. Sig. (2-tailed)	.656	.000	.056

Grouping Variable: Respondents' Gender

Scale- 1 to 7

Mann-Whitney U Test: This is a non-parametric test used to compare two independent groups when the dependent variable is ordinal or continuous, but not normally distributed. In this case, it appears to compare two groups based on respondents' gender. The test has produced the following statistics:

U Statistic: 1138.000

Mean Rank for Group 1: 693.500

Mean Rank for Group 2: 933.000

Asymptotic Significance (2-tailed): 0.656

The Mann-Whitney U test assesses whether there is a statistically significant difference in the responses between two groups, in this case, possibly male and female respondents. The "Asymp. Sig." value of 0.656 is the p-value, which indicates the significance level of the observed difference. In this case, the p-value is relatively high (greater than 0.05), suggesting that there may not be a significant gender-based difference in the usability rating.

Wilcoxon W Test: The Wilcoxon test is another non-parametric test, but it is used for paired data (related samples). In this context, it is not clear whether this test pertains to the same respondents who rated usability and agreed with the statement about accessibility features, or if it's comparing two different conditions. The statistics provided are:

W Statistic: 2968.000

Mean Rank for Group 1: 2523.500

Mean Rank for Group 2: 2763.000

Asymptotic Significance (2-tailed): 0.056

The Wilcoxon test assesses whether there is a statistically significant difference between paired observations. The p-value (0.056) is close to 0.05, suggesting a borderline level of significance. More context is needed to interpret this result

fully.

Z-Score: The Z-score is a measure of how many standard deviations a data point is from the mean. In this case, it seems to be a measure of the deviation from the expected distribution. Negative values suggest that the actual distribution differs from the expected distribution.

In summary, these statistical tests provide information about the relationship between respondents' gender and their ratings of usability, agreement with the statement, and perceived effectiveness of accessibility features. The results suggest that there may not be a significant gender-based difference in usability ratings (Mann-Whitney U test), but more context is needed to interpret the results of the Wilcoxon test. Additionally, the Z-scores indicate some deviations from expected distributions. Further analysis and context are required to draw more definitive conclusions.

Table No.8. Hypothesis Testing- 8

On a scale of 1 to 7, Please rate, on To what extent, on a
how effective do a scale from 1 scale of 1 to 7, do you
you believe user- to 7, how think adaptable
centric design intuitive you content presentation
principles are in find the contributes to the
enhancing clear interfaces of usability of tourism

navigation within the tourism applications for a wide
 tourism applications range of users, with 1
 applications, with 1 you have used, indicating minimal
 being highly with 1 being contribution and 7
 ineffective and 7 not at all indicating significant
 being highly intuitive and 7 contribution?
 effective? being
 extremely
 intuitive.

Mann-Whitney U	1138.500	1063.000	964.000
Wilcoxon W	1958.500	1883.000	2794.000
Z	-.441	-.977	-1.690
Asymp. Sig. (2-tailed)	.659	.329	.091

Grouping Variable: Respondents' Gender

Scale- 1 to 7

Based on the result, there does not seem to be a significant difference between

gender groups regarding the first two variables (effectiveness of user-centric design and interface intuitiveness). However, there might be a potential difference in opinions on the contribution of adaptable content presentation, but it is not strong evidence unless the chosen significance level is lenient (e.g., 0.10 instead of 0.05). Further analysis or a larger sample size may be needed to draw more definitive conclusions.

4. Conclusion

In conclusion, the statistical analyses presented in this report offer valuable insights into the differences between gender groups in various aspects of travel-related decision-making and user perceptions.

1. Gender Differences in Personalization Algorithm Impact on Travel Decision:

- The Mann-Whitney U and Wilcoxon W tests reveal significant gender differences in how respondents rate the impact of personalization algorithms on travel decisions.
- Females, on average, rate the influence of these algorithms higher than males.
- Practical Implications: Travel-related businesses should consider tailoring their recommendations and marketing strategies differently for male and female customers. Further qualitative research can explore the reasons behind these gender differences to enhance personalized travel recommendations.

2.Perception of Language Translation Apps:

- The analyses of three specific questions regarding language translation apps yielded mixed results.
- Belief in enhancing cross-cultural communication did not show a significant gender difference.
- Contribution to increased interaction showed a statistically significant difference based on gender, with further investigation needed to determine which gender group holds stronger opinions.
- Effectiveness in bridging the communication gap did not exhibit a gender difference.
- Practical Implications: Businesses using language translation apps should be aware of potential gender-based differences in opinions regarding their contribution to increased interaction. Tailored marketing and product features may be necessary.

3.Cultural Sensitivity and Awareness Impact on Tourists' Interaction:

- The Mann-Whitney U test indicates a significant gender difference in how cultural sensitivity and awareness impact interactions with locals when using translation apps.
- Female respondents rate this factor more positively than male respondents.

- Practical Implications: Businesses and app developers should consider incorporating features that enhance cultural sensitivity and awareness, particularly targeting female users who value these aspects.

4.Usability and Accessibility Features:

- The Mann-Whitney U test suggests that there may not be a significant gender-based difference in usability ratings.
- The Wilcoxon W test results require further context to determine their significance fully.
- Practical Implications: While usability may not significantly differ based on gender, a more comprehensive examination of the Wilcoxon W test results and additional research may be needed to draw conclusive insights regarding the effectiveness of accessibility features.

5.Adaptable Content Presentation:

- There might be a potential gender-based difference in opinions on the contribution of adaptable content presentation.
- The significance of this difference depends on the chosen threshold (e.g., 0.05 or 0.10).
- Practical Implications: Further analysis or a larger sample size could help clarify whether gender plays a significant role in opinions about adaptable content presentation.

In summary, the statistical analyses presented in this report provide valuable information about gender differences in travel decision-making, language translation app perceptions, cultural sensitivity, usability, and accessibility features. These findings offer opportunities for businesses and app developers to tailor their strategies and products to better meet the preferences and needs of different gender groups. However, it's important to note that further research and contextual understanding may be required to fully interpret and apply these findings in practice.

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CHAPTER-16

ROLE OF AI IN ALGAL DETECTION

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Abstract

Microalgae are essential parts of marine ecology, and they play a key role in species balance. Microalgae also have significant economic value. Microalgae are too tiny, and there are many different kinds of microalgae in a single drop of seawater. It is challenging to identify microalgae species and monitor microalgae changes. Machine learning techniques have achieved massive success in object recognition and classification, and have attracted a wide range of attention. In recent days, many researchers have introduced machine learning algorithms into microalgae applications, and similarly significant effects are gained. The paper summarizes recent advances based on various machine learning algorithms in microalgae applications, such as microalgae classification, bio-energy generation from microalgae, environment purification with microalgae, and microalgae growth monitor. Finally, we prospect development of machine learning algorithms in microalgae treatment in the future.

Keywords: Microalgae, machine learning, algorithms, bio-energy

1.INTRODUCTION:

Microalgae found in the ocean are typically single-celled organisms that play a vital role in marine ecosystems. They serve as primary producers, absorbing carbon dioxide and converting it into organic matter while releasing oxygen through photosynthesis. This makes microalgae essential food sources for ocean organisms and potential contributors to reducing the greenhouse effect. Moreover, microalgae possess significant social and commercial value, as they can effectively purify sewage by absorbing nitrogen and phosphorus. Additionally, their high oil and fat content make them an ideal raw material for biodiesel production.

The recognition and monitoring of microalgae species are essential in practical applications. Microalgae are typically microscopic, and a single sample often contains various species, making their identification and analysis a formidable challenge. Conventional manual techniques are not only labour-intensive but also demand significant expertise from operators. Consequently, microalgae applications are severely restricted in terms of efficiency and scope. Hence, there exists an urgent demand for swifter and more effective approaches to categorize, recognize, and assess microalgae.

Machine learning, essential for its data-driven algorithms, has witnessed remarkable success and widespread applications in various fields due to

significant advancements in data resources and computing power. Notably, it has played a crucial role in advancing digital image processing and speech recognition. Furthermore, researchers have successfully incorporated machine learning techniques into microalgae processes, achieving outstanding results in species identification and growth monitoring.

This paper provides an overview of the current landscape of machine learning algorithms applied in microalgae treatment, focusing on recent advancements. Initially, it outlines the fundamental principles of machine learning algorithms, including support vector machines, decision trees, random forests, and neural networks. Subsequently, it delves into comprehensive explanations of microalgae classification, the conversion of microalgae into bioenergy, leveraging microalgae for environmental protection, and the application of machine learning algorithms for monitoring microalgae growth stages. Throughout these summaries, various machine learning approaches are highlighted, offering an alternative to traditional manual methods in microalgae treatment. This paper serves as a valuable reference for researchers and professionals in the field.

2.DEEP LEARNING OF MICROALGAE DETECTION:

Artificial intelligence is the theory and method that allows computers to reason and simulate human thinking based on previous perceptions or experiences . Computers with artificial intelligence is able to do more complicated work that

needs logical ability. As an implementation of artificial intelligence, machine learning has not only become increasingly mature in its theoretical basis, but has achieved great success in practical applications . Machine learning is a multi-disciplinary interdisciplinary discipline that integrates statistics, data mining, probability theory, information theory, algorithmic analysis, and other fields.

Many different models can be used for machine learning training, and a comprehensive description of centralized representative models are in the following :

2.1 THE SUPPORT VECTOR MACHINE (SVM):

The Support Vector Machine (SVM) is a supervised learning technique commonly employed for classification and regression tasks (Boser et al.,1992). SVM constructs a hyperplane within the dataset to effectively separate known data based on specified criteria. As new data is processed by SVM, it continually refines its optimization based on the output results.

2.2 DECISION TREE ALGORITHM

The decision tree algorithm is a versatile method used for both classification and regression tasks, falling under supervised learning . In a decision tree, internal nodes represent attributes, branches signify selected paths leading to the ultimate outcome, and each leaf node corresponds to a category or class .Building a decision tree model necessitates the use of a training dataset.

2.3 RANDOM FORESTS

Random forests , introduced by Breiman in 2001, are an ensemble learning approach that leverages decision trees as their fundamental building blocks. Addressing the drawbacks of single decision trees, such as low accuracy and overfitting, random forests mitigate these issues by combining multiple decision trees. In comparison to standalone decision tree algorithms, the random forest algorithm excels in both classification and regression tasks. When contrasted with other machine learning techniques like Support Vector Machines (SVM) and deep learning models, such as convolutional neural networks (CNNs), random forests offer faster prediction speeds and superior accuracy while demanding relatively lower computational resources.

2.4 NEURAL NETWORKS

Neural networks are a powerful machine learning approach, adept at handling non-linear data by simulating the human brain's nervous system, using neurons as their fundamental building blocks. Neural networks encompass various types, including the convolutional neural network, tailored for tasks such as image and waveform data processing.

3.MICROALGAE DETECTION AND CLASSIFICATION WITH MACHINE LEARNING:

Microalgae classification presents a significant challenge due to their microscopic size, minimal visual differences between species, and the potential

presence of thousands of species in a small sample. The traditional manual classification method conducted under a microscope is not only labor-intensive but also relies heavily on the expertise of operators, leading to inefficiency and often unsatisfactory accuracy.

This approach enables computers to autonomously acquire knowledge about various algae species by analyzing existing data, providing classification results for new data. Machine learning algorithms process microalgae images captured through microscopy, offering a non-invasive and marker-free data acquisition method. This eliminates the need for laborious traditional staining, labeling steps, and minimizes disruption to the microalgae growth environment.

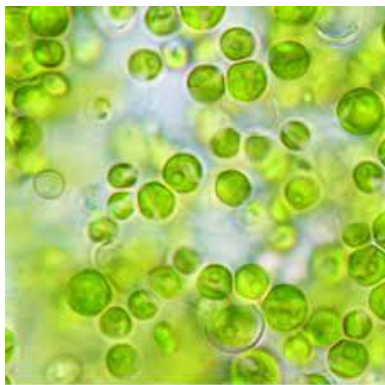


Fig 1.1 *Chlorella vulgaris*

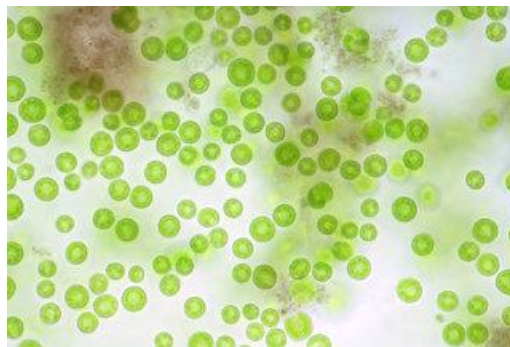


Fig 1.2 *Chlamydomonas reinhardtii*

CONCLUSION:

In conclusion, microalgae are highly diverse microorganisms that require extensive data and information from various fields, including genome analysis, strain-species selection, experimental cultivation, conversion, process design, control, and integration. This work provides a concise review of how AI algorithms and microalgae informatics can enhance current procedures for translating genetic information into desirable microalgae products. AI algorithms play a pivotal role in gene sequencing and editing, extracting critical knowledge, and predicting molecular interactions. Recent advancements in computer vision and ML algorithms have enabled accurate strain species screening and classification, making high-quality microalgae images valuable for further analysis. Various AI algorithms also contribute to improving microalgae cultivation and conversion by reducing the number of experiments and optimizing conditions. Metaheuristics prove particularly useful for system design and process integration, given the typical large-scale nature of the problem. Additionally, reinforcement learning and model predictive control represent the state-of-the-art in system control. As the compilation of microalgae data grows within the research field, the establishment of a commercial-oriented "multi-omics" pipeline becomes feasible for microalgae research. This paves the way for a digitalized and efficient future in microalgae biotechnologies.

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CHAPTER-17

PROPERTIES AND APPLICATIONS OF CERAMICS

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Abstract:

Ceramics is one of the key materials in the development of new technologies. Now a day's scientists have able to design these ceramic materials with new structures and various properties. Ceramic materials design the processes by which these products are manufactured, develop new types of ceramic material, and discover new and enormous applications for ceramic materials in day to day life. Ceramic material has enormous properties physical properties, mechanical properties, electrical properties, optical properties, thermoelectric properties, etc,. Depending upon the properties ceramic materials has various application. Advanced ceramics were used in oil-free bearings, food processing equipment, aerospace turbine blades, nuclear fuel rods, lightweight armour, cutting tools, abrasives, thermal barriers and furnace/kiln furniture.

1. Introduction:

A ceramic is a non-metallic inorganic material composed of metal or non-

metal compounds that have been formed and then hardened at very high temperatures. It is a hard ceramic, corrosion-resistant, and brittle in general [1]. Ceramic material is inorganic, nitride, non-metallic oxide, or carbides. Some of the elements of silicon, carbon, etc., may be considered as a ceramic material. Ceramic materials are strong in compression and weak tension. They are hard or brittle in nature. They can withstand high temperature ranging from 1000°C to 1600°C [2]. The majority of ceramics were excellent insulators. Because of these properties, they are used in almost every aspect of modern life. Ceramic materials can be found as single crystals or as polycrystalline materials (polycrystals). These polycrystals are oriented more or less randomly with respect to one another. They are also known as "grains" [3]. It may be crystalline, glassy or both crystalline and glassy. Ceramics are typically hard and chemically non-reactive and can be formed or densified with heat. Ceramic materials are used in electronics because, depending on their composition, they may be semiconducting, superconducting, ferroelectric, or an insulator. Ceramics are also used to make objects as diverse as spark plugs, fiber optics, artificial joints, space shuttle tiles, cooktops, race car brakes, micro positioners, chemical sensors, self-lubricating bearings and body armour [4].

2. Types of Ceramics:

There are different material categories into which ceramics can be divided. Ceramics are mainly divided into two categories:

- Traditional
- Advanced

These categories can all be evolved into distinctive material features.

2.1 Traditional Ceramics:

Objects made of clay and cement hardened by high-temperature heating are examples of traditional ceramics. Dishes, crockery, flowerpots, roof and wall tiles are all made from traditional ceramics. Earthenware, stoneware, and porcelain pottery are the types of pottery displayed here [3].

- Structure clay product
- Whitewares

2.2 Advanced ceramics:

These ceramics are not clay-based material. Instead, they are either based on oxides or non-oxides or combinations of the both:

- Typical oxides used are Zirconium dioxide (ZrO_2) and Alumina (Al_2O_3).
- Non-oxides are often carbides, silicides, nitrides and borides, for example silicon carbide (SiC), boron carbide (B_4C), and molybdenum disilicide (MoSi_2).

Production processes firstly involves thoroughly a blending to extremely fine constituent material powder. After shaping the material powder into green body, this will be high-temperature fired. This step is often carried out in oxygen-free atmosphere.

This high temperature around 1100-1800°C allows tiny grains of ceramic components to fuse together, tough and corrosion-resistant product. This process is called a sintering [1].

3. Examples of ceramics:

Bismuth strontium calcium copper oxide, Barium titanate, Boron oxide, Boron nitride, Lead Zirconate Titanate, Earthenware, Titanium carbide, Ferrite, Magnesium diboride, Porcelain, Sialon, Silicon carbide, Silicon nitride, Uranium oxide, Zinc oxide, Zirconium dioxide, Yttrium barium copper oxide, Partially stabilized zirconia, etc., [5].

4. Physical Properties:

Physical properties of ceramic material are direct result of its chemical composition and their crystalline structure. Solid - state chemistry reveals fundamental connection between properties and microstructure, such as grain size distribution, localized density variations, second-phase content and type of porosity, which could be correlated with the ceramic properties such as Mechanical Strength (σ) by the Hall-Petch equation, toughness, hardness, the optical properties and dielectric constant exhibited by transparent materials.

4.1 Mechanical properties:

Mechanical properties are the important structural and building materials. In Material Science, fracture mechanics is important to improve mechanical performance of ceramic material [6]. It can apply in physics,

elasticity and plasticity theory in particular stress and strain.

4.2 Electrical properties:

(i) Semiconductors:

Most of these ceramics are transition metal oxides that belong to II-VI (group in periodic table), such as Zinc Oxide. These ceramics are good semiconductors. These ceramics are good semiconductors. One of the most widely used of ceramic is varistor. These devices that exhibit the property that its resistance drops sharply at a threshold voltage. Once the voltage across the device reaches the threshold voltage, there will be a breakdown of the electrical structure in the vicinity of a grain boundaries, which results in their electrical resistance dropping from a several megaohms down to a few hundred ohms. The major advantage of this type of ceramic is that they can dissipate a large amount of energy, they self – reset, after the threshold voltage the device drops below the threshold, and its resistance returns to being a high. This makes them ideal for a surge-protection application, as there was a control over the threshold voltage and the energy tolerance, they can find use in all sorts of applications. One of the best demonstrations of their ability is, it can be found in electrical substations, where they were employed to protect the infrastructure from the lightning strikes. They had rapid response, do not appreciably degrade from use, required low maintenance, and making them virtually ideal devices for this application [7]. Semiconductor ceramics are

employed in gas sensors application. When the various gases were passes through polycrystalline ceramics, its electrical resistance will change. While tuning to the possible gas mixtures inexpensive devices can be produced.

(ii) Ferroelectricity:

Piezoelectricity, link between mechanical and electrical responses, was exhibited by maximum number of ceramics, including the quartz used to measures the time in watch and other electronic devices. Such devices were used both properties of piezo electrics and mechanical properties, using electricity to produce a mechanical motion and then using this type of mechanical motion for produce electricity (generating a signal). The time is measured, the natural interval required for the electricity (electrical energy) to be converted into the mechanical energy and from mechanical into electrical energy [8]. Piezoelectric effect was stronger in ceramic materials, that also exhibit pyro-electricity, and all pyro-electric materials are piezo-electric material [9]. These Ceramic materials can be interconvert between electrical, mechanical or thermal energy. Such materials were used in motion sensors, where tiny rise in temperature from the warm body entering to room is enough to produce a measurable voltage in the crystal.

The pyroelectricity ceramic materials can also display the ferroelectric effect that has the stable electric dipole which could be reversed or oriented by applying the electrostatic field (E). Pyroelectricity is one of the necessary

significance of ferroelectricity [10]. This can be used to store an information in ferroelectric capacitors, elements of ferroelectric (RAM).

The most common materials are Lead Zirconate Titanate and Barium Titanate. Aside from the uses mentioned above, their strong piezoelectric response is exploited in the design of high-frequency loudspeakers, transducers for sonar, actuators for atomic force and scanning tunnelling microscopes.

4.3 Optical properties:

Optically Transparent Materials focussed on the responses to incoming light waves of a wavelength. Selective frequency optical filters could be utilized for enhance or alter the contrast of digital images and the brightness. Guided light waves transmission via selective frequency waveguides involves an emerging field of fiber optic and the ability of an certain glassy composition. As the transmission medium the range of frequencies changes simultaneously (Multi-mode optical fiber) with few or zero interference between frequencies or wavelengths. This resonant mode of energy and data transmission via though low powered, electromagnetic(light) wave propagation, is virtually lossless. Optical waveguides were used as the components in the integrated optical circuits (e.g., light-emitting diodes, LEDs) or the transmission medium in a local and long-haul optical communication systems [11]. Also, the emerging materials is the sensitivity of materials to radiation in a thermal infrared (IR) portion of the electromagnetic spectrum. This heat-seeking ability

is an responsible for such diverse optical phenomena, as Night-vision and IR luminescence.

Thus, there is increasing need in the military sector for the robust materials, high-strength which have capability to transmit light waves (Electromagnetic waves) in a visible region (0.4 - 0.7 micro meters) and mid - infrared regions (1 - 5 micro meters) of the spectrum. These ceramic materials were needed for the applications including pods, requiring transparent armour and next-generation high-speed missiles, as well as protection against the improvised explosive devices (IED) [6,12].

5. Applications:

Ceramic applications bridge the knowledge of ceramic technology, technology development, analytics and product design with needs of its various industrial user segments.

Main target industries are:

- Automotive, aviation, space travel,
- Energy technology, Chassis
- Power generation,
- Friction, Wear protection and corrosion,
- Armour,
- Medical technology,
- Household,

- Food and beverage applications
- and luxury goods [13].

5.1 Boron carbide and body armour:

- The high degree of hardness of some advanced ceramics is put to use in the design of body armour used by soldiers and police officers.
- One type of body armour uses the extremely hard ceramic known as boron carbide (B_4C).
- The ceramic is bonded onto a plate of fibreglass. When a bullet strikes the ceramic plate, the bullet shatters into little pieces.
- The ceramic also shatters near where the bullet hits but the fibreglass backing catches the fragments of bullet and ceramic [14].
- The person wearing the armour may receive bruising, but at least the bullet did not penetrate and potentially kill the wearer.

5.2 Alumina and electronics:

The largest market for advanced ceramics is in the electronics industry. Ceramics can display a range of electrical properties from insulators to resistors to semiconductors.

The large ceramic insulators that hold the high-voltage electrical transmission wires are made of alumina (Al_2O_3) [15].

5.3 Ceramic insulators like alumina are also very good heat conductors:

Ceramic insulators like alumina are also very good heat conductors. They can be used as backing material or mounting brackets to which other electrical components are attached, for example, the electronic systems in a modern car are mounted on alumina [16].

When the electronics unit is working, it generates heat and the alumina backing conducts the heat away. This allows the electronic systems to function efficiently.

5.4 Ceramic high-temperature superconductors:

Researchers based at Industrial Research Limited in Wellington have developed a superconducting ceramic known as BSCCO (pronounced 'bisco') based on the element's bismuth, strontium, calcium, copper and oxygen [17].

6. Advantages of ceramics:

- Most of them have high hardness hence they are used as abrasive powder and cutting tools.
- They have high melting point which makes them excellent refractory material.
- They are good thermal insulators this is another reason to use them as refractory material.
- They are high electric resistivity which makes them suitable to be used as an insulator [18].
- They have low mass density which results in lightweight components.
- They are generally chemically inert which makes them durable.

7. Disadvantages of ceramics:

- They are brittle in nature.
- They have almost zero ductility.
- They have poor tensile strength.
- They show a wide range in the variation of strength, even for the identical specimens.
- They are difficult to shape and machine [5].

8. Methodology:

8.1 Solid state reaction:

The solid-state reaction method is a high-temperature synthesis method for preparing phosphor material. The solid - state reaction is most widely used methods for a preparation of crystalline solids. The solids are not naturally reacting with each other at room temperature and have to be heated at a much higher temperature. The feasibility and rate of the solid-state reaction depend on several factors, which include structural properties of the reactants, reaction conditions, their reactivity, surface area of a solids and thermodynamics free energy [19]. In a typical synthesis procedure, the starting materials used are oxide precursors. The required amount of the chemicals is weighed and ground to a fine powder using an agate mortar and pestle. The

reaction starts spontaneously during the mixing process, accompanied by the release of heat and water vapor. Sometimes, acetone is used as a mixing medium to get a homogeneous mixture. The ground sample is placed in alumina/platinum crucibles and heated at high temperature for a particular time, followed by dry grinding [20]. Figure 1 shows the process of solid-state reaction.

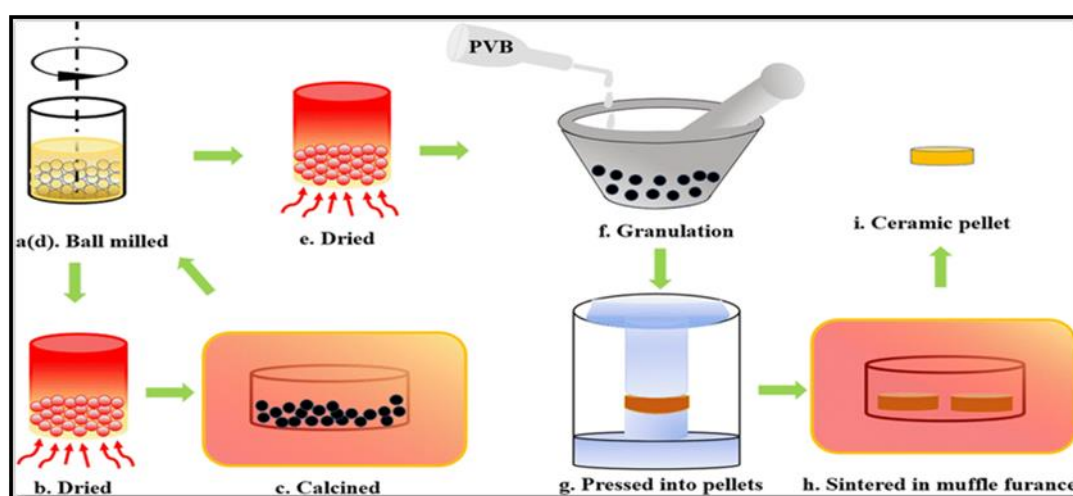


Figure 1: Process of solid-state reaction method

9. Conclusion:

The various types of ceramics can have a wide range of properties. The majority of ceramics are excellent insulators and can withstand high temperatures. Because of these properties, they are used in almost every aspect of modern life. Ceramic materials can be found as single crystals or as polycrystalline materials (polycrystals). These polycrystals are oriented more or less randomly with respect to one another. They are also known as "grains."

When the composition of the grains varies, the ceramic material is multiphase.

The grains in monolithic material are all of the same phases.

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CHAPTER-18

SCREENING AND CHARACTERIZATION OF BACTERIA ASSOCIATED WITH PUFFER FISH *LAGOCEPHALUS SPADICEUS*

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ABSTRACT

Puffer fish, *Lagocephalus spadiceus* collected from Thoothukudi water were screened for the bacteria associated with skin, liver, intestine and body tissue. The associated strains were both Gram positive and Gram negative, motile, short and long rods. On various cultural morphological and biochemical characteristics three groups of bacteria were identified. They are *Klebsiella sp*, *Proteus sp* and *Bacillus sp*. Tetrodotoxin is commonly found in puffer fishes and TTX are produced by a diversity of bacterial species associated with puffer fish. Our results suggest that the three groups of bacterial species may be responsible for the production of toxins. Further the isolation of toxins could lead to the discovery of biological compounds and new drugs for reducing pain in cancer patients.

Key words: Puffer fish,, *Lagocephalus spadiceus*, *Klebsella*, Tetrodotoxin, Gram – positive.

INTRODUCTION

Marine organism are a rich source of structurally novel and biologically active metabolites. Primary and secondary metabolites produced and stored by these organism may be potential bioactive compounds of interest in the pharmaceutical industries. The number of natural products isolated from marine organisms increases rapidly (Faulkner, 2002 and Proksch *et al.*, 2006). The bio resources present in the marine ecosystem have potent biomolecule which includes many natural organic compounds (Rajamanikandan *et al.*, 2011). The porcupine family Diodontidae contains seventeen species in seven genera (Fricke *et al.*, 2018). The family is widely distributed in tropical and temperate marine areas of the Indo-Pacific and Atlantic Oceans (Leis 2006). Puffer will eat all type of food such as shrimp fish, clams, molluscs and crustaceans, etc. It is also important that they consume hard shelled crabs, mussels and shellfish in their diet to wear down their teeth and prevent them from overgrowing. Further more toxicity changes with age, sex, season, and geographical variation (Homaira ,2010).The puffer fishes are commonly known of all type of fish poisoning and has been recognized from ancient times. The bacteria associated with some puffer fish produce powerful neurotoxin in their internal organs making them an un pleasant, possibly and lethal meal for

any predator (Chun-Fai, 2004).

Several TTX – producing bacterial genera have been isolated from the tissues of various puffer fish species such as intestine, skin and tetrodotoxin accumulating organs (ovary, liver) (Yotsu *et al.*, 1987; Noguchi *et al.*, 1987; Matsui *et al.*, 1989; Lee *et al.*, 2000; Yu *et al.*, 2004; Wu *et al.*, 2005, Bragadeeswaran *et al.*, 2010. Yu *et al.*, 2011, Tu Hoang Nguyen *et al.*, 2015)

In India studies on the puffer fish are very limited and it remains unexploited. Therefore, this work has been performed to isolate and characterize the associated bacteria from the skin, liver, intestine and body tissue of puffer fish, *Lagocephalus spadiceus* collected from Thoothukudi coast.

MATERIALS AND METHODS

Collection of specimen

Specimens of puffer fish, *Lagocephalus spadiceus* were collected from fish landing centre at Fishing harbor, Thoothukudi. Then they were washed with seawater and transported to the laboratory in dry and stored in deep freezer at 20°C.

Serial dilution

Specimen of puffer fish was thawed and the liver, intestine, skin and body tissue were incised. One gram of each tissue was homogenized with 10 ml of sterile sea water and then serially diluted to 10^{-1} , 10^{-2} , and 10^{-3} .

Pour plate culture

6 g of Zobell marine agar 2216 was dissolved in 100 ml of sterilized sea water. The medium was autoclaved at 121°C for 15 minutes. 1ml of the diluted solution (10^{-1} to 10^{-3}) was poured into the Petridish, the agar medium was poured and rotated clockwise and anticlockwise direction for thorough mixing. Then the medium was allowed to solidify. All plates were incubated at 37°C for 24 hours.

Isolation of bacterial colonies

Isolated colonies were marked and numbered on the agar plates. The selected colonies were observed under the low power stereomicroscope. The cultural characteristics of isolated colonies were observed. The isolated colonies were sub cultured in the agar plates. Each bacterial colony was collected with an inoculation loop and streaked on the marine agar plate to grow a single species of bacteria. The purified strains were stored at -80 °C in the presence of glycerol

Gram stain morphology for identification of bacterial isolates**Gram staining**

Gram stain is a differential stain that requires primary staining and counter staining. A smeared glass slide was flooded with crystal violet stain and allowed to stand for 5 minutes. The stain was drained and then washed gently with tap water. Then Gram's iodine solution was added and washed after five minutes and the slide was allowed to dry. 95% alcohol caused decolorization.

Finally the counter stain safranin was added and air dried for two minutes. Then the slides were thoroughly rinsed and observed under oil immersion objective.

Motility test

24 hour bacterial cultures were inoculated into the SIM medium tubes by the method of stab inoculation and incubated at 37°C for 24 hours, If the stab remains intact in a single line, it indicates that the bacteria are non – motile. If the stab culture is found disassociated or spread throughout the medium, it indicates that the bacteria are motile.

Biochemical Characterization

. A number of biochemical tests were performed for the identification of bacterial isolates with the help of Bergey's Manual . The principal tests used for this purpose are L Indole Test , Methyl Red Test ,Voges-Proskauer Test, Citrate Utilization Test , Nitrate Reduction Test ,Catalase Test, Hydrogen Sulphide Production and Carbohydrate fermentation test.

RESULTS

Cultural characteristics of isolated bacteria

Eight specific isolates with different characteristics were observed and selected from the Zobell Marine Agar 2216 plates. They were further streaked to obtain pure culture. Two bacterial strains from each tissue were selected and numbered as S₁ and S₂(Skin), T₁ and T₂ (Body tissue), L₁ and L₂(Liver) and

I₁ and I₂ (intestine).

Colony appearance of all the isolates was examined. Characteristics including shape, colour, margin, elevation and opacity were studied (Table 1). It was observed that the forms of the colonies of bacterial isolates were circular, rhizoid, filamentous and irregular. Most of the colonies, which were selected visually based on differences with naked eye, were of whitish and cream colour. Margin of colonies of bacterial isolated were found to be entire and filiform. Opacity of the colonies was observed mostly to be opaque or transparent

Morphological characteristics of isolated bacteria

The isolated strains were both Gram positive and Gram negative. Most of the strains were long rods. All strains were motile (Table 1). Biochemical Characteristics of Isolated Bacteria variety of biochemical assays were carried out to identify the bacterial isolates (Table 2). The isolates differed from each other in substrates utilization in biochemical tests. All bacterial isolates produced catalase and reduced nitrate. The strains were positive for the methyl red, negative for Voges Proskauer tests and positive for the indole tests. The carbohydrate fermentation pattern exhibited by all the isolates. The main variable reactions among the isolates were gelatin liquification, H₂S acid production, citrate test and starch hydrolysis.

Strains	Cultural characters					Morphological characters		
	Shape	Elevation	Marginal	Colour	Opacity	Shape	Motility	Gram staining
S1	Flat	Raised	Entire	White	Opaque	Long rods	+	-ve
S2	Circular	Raised	Entire	White	Transparent	Small rods	+	-ve
T1	Irregular	Raised	Entire	White	Opaque	Long rods	+	-ve
T2	Rhizoid	Raised	Rhizoid	Dull white	Opaque	Small rods	+	+ve
L1	Irregular	Raised	Entire	White	Opaque	Long rods	+	+ve

						rods		
L2	Irregular	Raised	Entire	Whit	Opaque	Lon	+	-ve
				e		g		
						rods		
I1	Filament	Flat	Filifor	Whit	Transpar	Lon	+	-ve
	ous		m	e	ent	g		
						rods		
I2	Filament	Flat	Filifor	Whit	Opaque	Lon	+	+ve
	ous		m	e		g		
						rods		

Table-1**Cultural and Morphological Characteristics of isolated bacteria****Biochemical Characteristics of Isolated Bacteria**

A variety of biochemical assays were carried out to identify the bacterial isolates (Table 2). The isolates differed from each other in substrates utilization in biochemical tests. All bacterial isolates produced catalase and reduced nitrate. The strains were positive for the methyl red , negative for Voges Proskauer tests and positive for the indole tests. The carbohydrate fermentation pattern exhibited by all the isolates.. The main variable reactions among the isolates were gelatin liquification, H₂S acid production, citrate test and starch hydrolysis

Table-2

S.No.	Name of the test	S ₁	S ₂	T ₁	T ₂	L ₁	L ₂	I ₁	I ₂
1.	Catalase Test	+	+	+	+	+	+	+	+
2.	Nitrate Test	+	+	+	+	+	+	+	+
3.	Gelatin Liquification	+	+	+	+	–	+	+	+
4.	H ₂ S Production	+	+	+	+	+	–	+	+
5.	Citrate Test	+	+	+	–	–	–	+	+
6.	Indole Production	+	+	+	+	+	+	+	+
7.	Starch hydrolysis	+	–	–	+	+	+	+	–
8.	Methyl red Test	+	+	+	+	+	+	+	+
9.	Voges- Proskauer Test	–	–	–	–	–	–	–	–
10.	Carbohydrate fermentation test	+	+	+	+	+	+	+	+

Biochemical characteristics of isolated bacteria**Identification of bacterial isolates**

Eight bacterial strains were isolated from skin, liver, intestine and body tissue of puffer fish , *Lagocephalus spadiceus* and identified. They were identified upto genera level by comparing the results with Bergy's Manual of

Determinative Bacterology (1975). They belong to Eight bacterial strains were isolated from skin, liver, intestine and body tissue of puffer fish *Diodon holocanthus* and identified..They were identified upto genera level by comparing the results with Bergy's Manual of Determinative Bacterology (1975). They belong to three genera namely *Klebsilla sp* *Proteus sp* and *Bacillus sp*

DISCUSSION

The analysis presented here aimed to isolate and identify the bacteria associated with the various tissues like skin, intestine, liver and body tissue of puffer fish *L. spadiceus*

The colour of bacterial colonies isolated in the present investigation was white and dull white. Zobell and Feltham (1934) noted that 31.3% of the colonies were yellow, 15.2% orange, 9.9 % brown, 7.4% fluorescent and 5.4% red or pink. Many marine bacteria tend to lose their ability to produce pigment during prolonged laboratory conditions.

The carbohydrate decomposition spectrum determined by the production of acid from substrates is regarded as one of the tools in characterization. Much emphasis is put on the pathways and end-products of glucose metabolism. Oxidation fermentation (OF) medium of Hugh and Leifson (1953) is essential for the determination of type of glucose metabolism. Rapid fermenters produced acid that spread throughout the medium. Weak

fermenters showed delayed acid production, at first at the surface, then along the site of the stab and oxidizers produced acid only at the surface (Lanyi, 1987). In the present observation *Klebseilla sp*, *Proteus sp* and *Bacillus sp*, showed fermentative breakdown of glucose. Yellow colour was produced throughout the medium. Fermentation is characteristics of most obligate anaerobic and facultative anaerobic bacteria (Lanyi, 1987).

The formation of H_2S by bacteria during the decomposition of sulphur containing compounds, was associated with the enzymatic decomposition of proteins or peptones composed of amino acids containing sulphur. Hydrogen sulphide was produced by certain bacteria like *Pseudomonas sp*, *Aeromonas sp* and *Flavobacterium sp* through dissimilation of sulphur containing amino acid eg. cystine, methionine or through reduction of inorganic sulphur compounds such as thiosulphate, sulphate or sulphide.

Under anaerobic conditions cystine was first reduced to two molecules of cysteine, followed by the breakdown of the cysteine to H_2S , NH_3 , acetic acid and formic acid. Under anaerobic conditions, cysteine was said to be dissimilated into H_2S and other products (Salle, 1988). H_2S reacted with heavy metals to produce coloured metal sulphides. Metal salts which yielded dark coloured sulphides were incorporated in solid media, lead was the first metal incorporated in culture media, when cultured in media containing lead acetate, the bacteria turned them black. As here observed *Klebseilla sp*, *Proteus sp*, (L1)

and *Bacillus sp* showed hydrogen sulphide production while *Proteus sp*, (L2) showed negative result.

Lanyi (1987) reported that starch hydrolysis test was applicable for all kinds of microorganisms, based on a colour reaction of non-hydrolysed starch with lugol's iodine. Starch gave a deep blue colour, whereas its break down products, as hydrolysis progresses gradually became violet, brownish red and finally colourless. Our results showed that, *Bacillus sp*, (T2 and L1) and *Proteus sp*. (L2 and I1) were able to hydrolyse starch. During the hydrolysis of starch, deep blue colour gradually changed to violet, brown and finally colourless.

In gelatin hydrolysis, the extracellular proteolytic enzymes of bacteria hydrolysed proteins into polypeptides and amino acids. Production of the enzyme can be demonstrated in classical nutrient broth solidified with gelatin. As the cultures are usually incubated at a temperature above the melting point of gelatin, 2-3 hr prior to reading they should be cooled, the test is positive if the inoculated medium is liquid but the control medium is solid (Lanyi, 1987). All the bacterial isolates associated with different tissues of the pufferfish, *Lagocephalus spadiceus* except *Bacillus sp* (L1) able to secrete gelatinase into the medium.

Testing of nitrate decomposition is of great value in identification. *Acinetobacter*, *Flavobacterium*, *Alcaligenes odorans* and some other aerobes and many anaerobic bacteria do not attack nitrate. Most bacteria including

Enterobacteriaceae produced nitrite whereas *Pseudomonas aeruginosa* and some other *Pseudomonas* and *Alcaligenes denitrificans* produced nitrogen gas (Lanyi, 1987). The enzyme nitrate reductase reduced nitrate to nitrite. In the present results “nitrate reduction” was recorded in all strains associated with muscle, liver, skin and intestine of puffer fish, *L. spadiceus*.

Catalase activity results in the production of molecular oxygen, whereas peroxides decomposes H_2O_2 only in the presence of an organic oxygen acceptor. Cowan (1974) reported that catalase production is of great taxonomic importance: in contrast, detection of peroxidase is not significant in identification. Micrococcaceae produce catalase abundantly, and many other bacteria exhibit a weaker activity. For example *Streptococcus*, *Erysipelothrix*, *Caidiobacterium*, *Kingella* and *Eikenella* are characteristically catalase – negative organisms. Strict anaerobes lack catalase, however most anaerobically growing *Propionibacterium* isolates produce the enzyme. In the present investigation, all the bacterial strains associated with body tissue, skin, liver and intestine of puffer fish, *L. spadiceus* produced catalase enzyme

In 1987, Lanyi reported that methyl red was performed mainly for the intrageneric differentiation of *Enterobacteriaceae*. In glucose phosphate peptone water medium, methyl red positive bacteria produce acid in amounts sufficient to maintain the pH below 4.5 for several days. Methyl red negative bacteria continue to metabolize the acids that were produced into neutral

substances. Our results showed that all strains associated with body tissue, liver, skin and intestine of pufferfish, *L. spadiceus* produced red colour indicating the production of acid.

The Voges-Proskauer (VP) test is based on the detection of acetoin (acetyl methyl carbinol) produced in the course of glucose break down by most isolates of *Klebsiella*, *Enterobacter* and *Serratia* (Lanyi, 1987). If the potassium hydroxide was added in the presence of air to the culture of VP positive organisms, acetoin was oxidized to diacetyl which formed a pink condensation product with guanidine nuclei present in arginine and other peptone constituents (Mac-Faddin, 1980). The colour intensified if creatine, which contains a guanidine nucleus was added. In the present observation, all strains associated with body tissue, liver, intestine and skin showed negative result.

The bacteria *Shewanella* sp. was isolated from the liver of *Lagocephalus wheeleri* while *Exiguobacterium* sp. and *Staphylococcus* sp. were isolated from the liver of *L. scleratus*. Simon *et al.*, (2009). Yu *et al.*, (2011) isolated the TTX-producing bacterial species, *Raoultella terrigena* from the intestine of a local toxic puffer fish *Takifugu niphoble*. Lee *et al.*, (2000) isolated a *Vibrio* strain from the intestine of the puffer fish *Fugu vermicularis radiates*. In the present investigation, *Klebsiella* sp., *Proteus* sp. and *Bacillus* sp., were isolated from the various tissues like body tissue, skin, liver and intestine of puffer fish *L. spadiceus*

CONCLUSION

The present study revealed the presence of bacterial species *Klebsiella* sp., *Proteus* sp. and *Bacillus* sp in the body tissue, liver, skin and intestine of puffer fish *D.holocanthus* according to their cultural, morphological-biochemical characteristics and *Lysinibacillus* was identified. Puffer fish is the most recognizable organism that contains TTX. The puffer fish is a well-known source of TTX. Several species of bacteria were discovered to produce TTX. The occurrence of TTX in puffer fish suggested that the toxin could either be acquired through the food web or is the product of bacterial symbionts. The bacterial strains associated with , *Lagocephalus spadiceus* may be a source of TTX. Tetrodotoxin (TTX) is a powerful sodium channel blocker. It is a very promising substance for the treatment of various types of pain This finding could shed light on the bacterial strains associated with puffer fish which are responsible for the production of TTX.

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CHAPTER-19

UNMASKING THE SILENT DESTROYER: EXPLORING THE WORLD OF CORROSION

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Abstract

Corrosion is the erosion of a material's qualities caused by interactions with its environment, and it is inevitable for most metals to experience corrosion. All forms of material can degrade, but it is most frequently connected with metallic materials. An issue with older aircraft has been the degradation of the wiring's polymeric insulating coatings. By use of selective disintegration, even ceramics can corrode. Similar to death and taxes, corrosion is something we want to avoid, but in the end, we have to learn how to live with it. The reduction in a system's Gibbs energy is the primary reason for all corrosion. The metal is strongly motivated to return to its natural, low-

energy oxide state as a result of this unequal thermodynamic struggle. Corrosion is the term used to describe the process of returning to the original oxide state. Although corrosion is unavoidable, it can be slowed down using corrosion control techniques. Thus is the rate of the approach to equilibrium that is often of interest. This rate is controlled not only by the nature of the metal surface but also by the nature of the environment.

‘Corrosion is the gradual deterioration and degradation of materials, especially metals, due to chemical reactions with their surrounding environment. These reactions typically involve the material's exposure to substances like moisture, oxygen, acids, or other corrosive agents, leading to the formation of corrosion products such as rust or tarnish. Corrosion can weaken materials over time, potentially causing structural damage and reducing their functionality or lifespan. Preventative measures, such as protective coatings and corrosion-resistant materials, are often employed to mitigate or slow down the corrosive process.

- The metal gate had been exposed to years of rain and humidity, leading to extensive corrosion and a weakened structure.
- Industrial equipment needs routine maintenance to avoid corrosion and increase its lifespan.
- Corrosion is a major hazard for ships and offshore constructions because it can be accelerated by exposure to saltwater.

- To shield their pipelines from the corrosive chemicals they provided, the company made an investment in corrosion-resistant coatings.
- Engineers are looking into new materials to reduce corrosion in infrastructure such as bridges and increase their lifetime.
- When toxic substances leak into food containers due to corrosion, the safety of the contents may be affected.
- For the development of successful prevention and mitigation techniques, it is essential to understand the electrochemical processes involved in corrosion.
- Manufacturers can evaluate the long-term lifespan of their products using laboratory corrosion testing.
- Corrosion control measures include regular inspections, coatings, and sacrificial anodes to protect valuable assets from degradation.
- The rusting of iron as a result of its reaction with oxygen and moisture in the air is a common example of corrosion.

When corrosion is discussed, it is important to think of a combination of a material and an environment. Without knowing the environment to which the material will be exposed, the corrosion behavior of the material cannot be defined. Similar to this, it is impossible to characterize how corrosive or hostile an environment is without first knowing what material will be exposed to it. In conclusion, a material's corrosion behavior depends on the environment to which it is exposed, and an environment's corrosivity depends on the material

exposed to it.

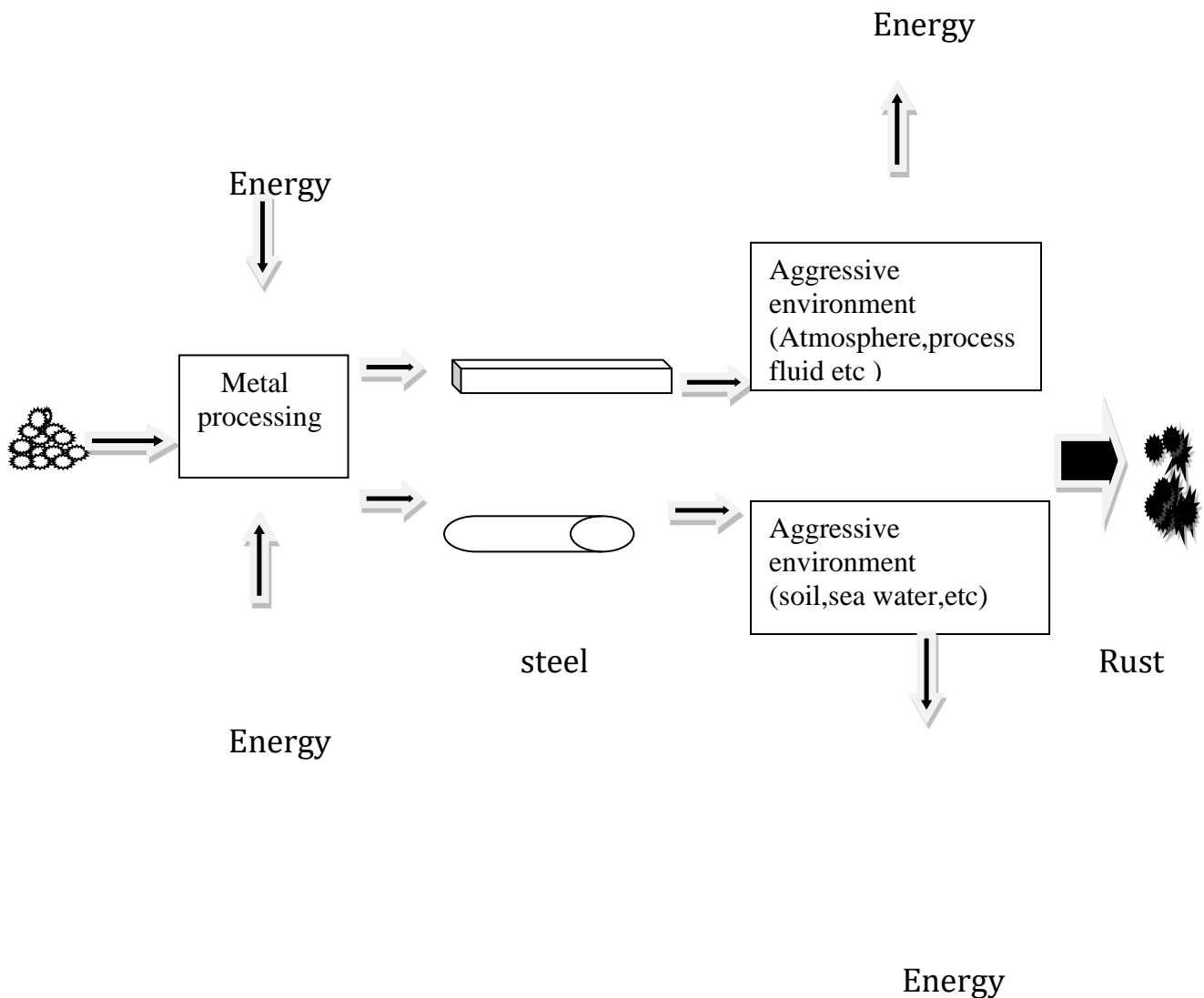


FIG.1 Refining Corrosion Cycle Of Steel Components.

It is useful to identify both natural combinations and unnatural combinations in corrosion. Nickel in corrosive surroundings lead in water, and aluminum in atmospheric exposures are a few examples of natural or desired combinations of substance and environment. In these environments, the

interaction of the metal with the environment typically does not cause harmful or expensive corrosion issues. The combination is a natural one to offer effective service against corrosion. On the other side, unnatural pairings are those that expose the metal to an unfavorable environment and produce severe corrosion damage. Copper in ammonia solutions, stainless steel in chloride-containing environments (like seawater), and lead in wine are a few examples of unnatural combinations.

Corrosion can occur in various forms and settings. Here are some examples of corrosion:

- **Rusting of Iron:** One of the most well-known examples is the rusting of iron when it is exposed to oxygen and moisture in the air. Iron reacts with oxygen to form iron oxide (rust), which weakens the metal over time.
- **Tarnishing of Silver:** Silverware and jewelry made of silver can tarnish when exposed to sulfur compounds in the air. This tarnish is a form of corrosion that affects the surface appearance of the silver.
- **Corrosion of Aluminum:** Aluminum can corrode when exposed to oxygen, and the resulting corrosion product is aluminum oxide. However, unlike iron, aluminum oxide forms a protective layer on the surface, which can actually inhibit further corrosion.

- **Acid Corrosion:** Acidic substances, such as battery acid or strong acids, can corrode metals and other materials they come into contact with. For example, car batteries can leak acid and corrode nearby metal components.
- **Galvanic Corrosion:** This occurs when two dissimilar metals are in contact with each other in the presence of an electrolyte, like saltwater. The less noble (more reactive) metal corrodes more quickly. An example is the corrosion of steel bolts in aluminum structures on boats.
- **Atmospheric Corrosion:** Outdoor structures made of metals, such as bridges, can experience corrosion due to exposure to the atmosphere, including moisture and pollutants. Over time, this can lead to structural integrity issues.
- **Corrosion of Plumbing Pipes:** Old plumbing pipes made of materials like iron or steel can corrode over time, leading to leaks and water quality problems.
- **Corrosion of Pipelines:** Metal pipelines used for transporting liquids or gases can corrode from the inside due to the corrosive nature of the substances they carry or from the outside due to environmental factors.

THEORIES OF CORROSION

1. Acid theory of corrosion:

This theory is particularly applicable to the rusting of iron in the atmosphere. This hypothesis states that the continuous action of oxygen, carbon dioxide, and moisture causes iron to rust by oxidizing the metal to

soluble ferrous bicarbonate, which is then further oxidized to the basic ferric carbonate, and finally transformed into hydrated ferric oxide.

2. Dry theory of Corrosion

Dry corrosion occurs in the absence of moisture or conducting electrolyte medium, due to direct attack of metals by dry gases mainly through chemical reactions. As an example the formation of an oxide layer on the surface of a metal as a result of the attack of dry gases like O₂, Halogen, H₂S, SO₂, NO_x, etc. However, such a process is not common.

Dry corrosion is classified into three types.

- (i) Oxidation corrosion
- (ii) Corrosion by other gases
- (iii) Liquid metal corrosion

3. Wet or electrochemical theory of Corrosion:

Wet corrosion involves reactions in an aqueous medium. The moisture and oxygen in the atmosphere interact electrochemically with the metal's conducting surface. Wet corrosion can be better explained on the basis of electrochemical theory. Due to the presence of anodic and cathodic areas, corrosion happened according to the wet theory and because of the high conductivity of the solution, wet corrosion is best effective in fluids that include salts, such as NaCl(e.g. marine conditions).

FORMS OF CORROSION

1. Uniform form of corrosion

The most common kind of corrosion is also known as general corrosion. Uniform corrosion occurs when a substance deteriorates relatively uniformly across its whole surface. The thickness of the material gradually decreases as a result. When the corrosive components of the environment are evenly distributed, such as when exposed to moisture in the atmosphere, uniform corrosion takes place.

This type of corrosion develops pits of very small diameter. The rate of uniform corrosion can be easily determined by measuring the mass loss or the quantity of released hydrogen.

2. Pitting Corrosion:

It is a type of localized corrosion. On the surface of the material, pitting corrosion frequently manifests as small, deep pits or holes and is isolated. This part becomes anodic and the other remaining parts become cathodic. It happens when a small patch of the metal surface turns out to be more prone to corrosion than the rest of the metal. Pitting corrosion is particularly difficult since it can seriously harm the structure.

Unlike uniform corrosion, the intensity and rate of pitting corrosion can be assessed neither by determining the mass loss nor by measuring released hydrogen.

3. Crevice Corrosion:(deposit attack)

In small cracks, crevices, or joints where oxygen or other elements that promote corrosion cannot reach, crevice corrosion can occur. The constrained materials in these places may deteriorate locally due to the atmosphere created by these cramped confines, which is favorable to corrosion.

Crevice corrosion is a localized corrosion in recesses. Overlapping zones for riveting, bolting, or welding, zones under various deposits. These zones also called crevices, are very tiny and difficult to access for the aqueous liquid that is covering the rest of the readily accessible surfaces.

4. Filiform corrosion

Filiform corrosion is one type of crevice corrosion. When moisture or a corrosive solution leaks through defective coatings, this type of corrosion can occur on coated surfaces. It only happens in specific metals as well. The two metals that are most frequently affected by filiform corrosion are aluminum and steel. Iron and magnesium may be affected as well. It occurs under painted or plated surfaces.

5. Galvanic corrosion

Galvanic corrosion occurs when two metals that are not compatible with one another come into contact with an electrolyte, such as moisture. The more noble (less reactive) metal serves as the cathode and is relatively unaffected while the less noble (less reactive) metal corrodes and serves as the anode.

6. Intergranular Corrosion:

In intergranular corrosion, metal grain borders experience corrosion rather than the actual grains themselves. This type of corrosion is frequently connected to specific metals and alloys, and it can be brought on by sensitization, which modifies the characteristics of grain boundaries.

7. Stress corrosion cracking

It is a type of corrosion that occurs when a material is exposed to a corrosive environment while simultaneously under tensile stress. It can result in the formation of cracks that propagate through the material, potentially leading to catastrophic failure.

8. Erosion Corrosion:

Erosion corrosion is the outcome of the interaction between mechanical wear and corrosion. The corrosion process is accelerated by the abrasive effect of moving fluids in situations with high fluid velocity.

9. Microbial Corrosion (MIC):

It is also referred to as biocorrosion, microbial corrosion is a type of deterioration brought on by the action of microorganisms like bacteria and fungi. These microorganisms have the ability to generate corrosive byproducts or local conditions that encourage corrosion.

10. Dealloying :

Dealloying corrosion, often referred to as selective leaching or parting corrosion, is a type of corrosion that happens when one or more components

of an alloy are removed from the material with preference, leaving behind a porous and weaker structure. This kind of corrosion often occurs in alloys when the various constituents corrode at various rates due to their varied corrosion potentials. Dealloying corrosion can frequently be avoided by choosing the right materials for a given environment, applying corrosion-resistant coatings, or creating alloys with more electrochemically matched constituent metals.

CORROSION INHIBITION STUDIES

Corrosion inhibition studies are essential for understanding and mitigating the corrosion of materials in various environments. These studies typically involve evaluating the effectiveness of corrosion inhibitors, which are chemicals or compounds designed to reduce or prevent corrosion. Here are some characteristic studies and methods commonly employed in corrosion inhibition research:

1. Weight Loss Studies:

In weight loss studies, the corrosion rate is determined by measuring the loss of metal weight over time. Specimens are exposed to a corrosive environment with and without the inhibitor. The inhibitor's effectiveness is assessed by comparing the corrosion rates between the two conditions.

2. Electrochemical Techniques:

Electrochemical methods, such as potentiodynamic polarization,

electrochemical impedance spectroscopy (EIS), and cyclic voltammetry, are used to assess the corrosion behavior of materials in the presence of inhibitors. These techniques provide valuable data on corrosion kinetics, polarization curves, and impedance spectra.

3. Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray Spectroscopy (EDS):

SEM and EDS analysis can be used to examine the surface morphology and composition of corroded samples. This helps identify the types of corrosion products formed and the extent of corrosion inhibition.

4. X-ray Diffraction :

XRD is used to identify and quantify the corrosion products formed on the metal surface in the presence of inhibitors. It provides information about the crystallographic structure of these products.

5. Surface Analysis Techniques:

Techniques like X-ray photoelectron spectroscopy (XPS) and Auger electron spectroscopy (AES) can provide detailed information about the composition and chemical states of the surface layers, including the presence of inhibitor molecules.

6. Electron Microscopy and Atomic Force Microscopy (AFM):

These techniques allow for high-resolution imaging of the surface topography and the detection of microstructural changes caused by corrosion

and inhibition.

7. Corrosion Rate Measurement:

Corrosion rate measurements can be performed using weight loss, electrochemical methods, or direct measurement of corrosion product thickness. These data provide quantitative information about the effectiveness of the inhibitor.

8. Corrosion Product Analysis:

The analysis of corrosion products formed in the presence of inhibitors can provide insights into the mechanisms of corrosion inhibition. It helps determine whether the inhibitor forms a protective film or alters the composition of corrosion products.

9. Long-Term Exposure Testing:

Some corrosion inhibition studies involve extended exposure to corrosive environments with intermittent inhibitor replenishment. These studies simulate real-world conditions and assess the inhibitor's long-term effectiveness.

10. Inhibition Mechanism Studies:

Understanding the mechanism by which an inhibitor works is crucial. This may involve studying the adsorption of inhibitor molecules onto the metal surface, their interaction with corrosion products, or their influence on electrochemical reactions.

11. Statistical Analysis:

Statistical methods can be applied to evaluate the significance of results and determine the reproducibility of corrosion inhibition studies.

12. Corrosion Rate Modeling:

Mathematical modeling can be used to predict corrosion rates in the presence of inhibitors based on experimental data, aiding in the design of effective corrosion protection strategies.

Studies on corrosion inhibition frequently combine several methodologies to develop a thorough understanding of the function and processes of the inhibitor. The methodologies chosen are determined by the precise study objectives, the kind of materials being used, and the surroundings being examined.

The corrosion inhibitive effect of *Derris indica leaves extract (DILE)* on aluminum in 1 M NaOH at different temperatures. For this weight loss studies and electrochemical methods including potentiodynamic polarization (PDP) and electrochemical impedance spectroscopy (EIS) techniques are employed. Both methods confirmed that *DILE* plays a crucial role in the formation of a protective layer over metal surfaces and DILE behaves as a mixed type of corrosion inhibitor. Langmuir adsorption isotherm was found to be the best fit and a physical adsorption mechanism was proposed ^[1]. The inhibition effect of

Capparis Aegyptia extracts on the corrosion of aluminum in 1 M sodium hydroxide (NaOH). Both weight-loss measurements and electrochemical polarization methods were used. The results show that *C. aegyptia* extract is a good corrosion inhibitor. The thermodynamic parameters (ΔH^* , ΔS^* , and E_a) of the adsorption process were calculated and discussed. The electrochemical polarization study showed that *C. aegyptia* extract acts as a mixed-type inhibitor cathodic and anodic. Surface morphology was analyzed by scanning electron microscopy (SEM) technique [2]. Aluminum alloy 1100 (Al-1100) in a 10% NaOH solution was inhibited by both *green tea and Tulsi extract*. Weight-loss technique was used to determine the effectiveness of an inhibitor, with tulsi extract far outperforming green tea with the best efficiency of 83.93% compared to the greatest efficiency of 14.29% for green tea. SEM, FTIR, and EDS analysis were employed. It was observed that greater efficiency was noted while using tulsi extracts than green tea extract in 10% NaOH in Al-1100 [3]. *Sapota leaf extract* controlled the aluminum (Al) corrosion in a 3 M sodium hydroxide (NaOH) medium through gasometric, atomic absorption spectroscopy, electrochemical Tafel diagrams, and impedance spectroscopy techniques. From gasometric data the plant extract inhibits the Al corrosion process and the protection efficiency of the inhibitor varies with the time of the system. From alternating current impedance spectroscopy the plant extract inhibits the corrosion process [4]. The effect of stem extract of *Brahmi and*

Henna on the rate of corrosion of low carbon steel in a solution of 0.5 M NaOH using the methods of weight loss and potentiodynamic polarization. The finding is that stem extract is an effective inhibitor. When using different concentrations of extract of *Brahimi and Henna's* solutions ranging between (0.5–2)% in 0.5 M NaOH, the efficiency IE_p % increased up to 80% which is resulting from polarization while the efficiency IE% increased up to 65% which is resulting from weight loss method [5] and the effect of aqueous extract of leaves of *Morinda tinctoria* on the corrosion inhibition of aluminum in alkaline medium by weight loss and electrochemical impedance spectroscopy and potentiodynamic polarization measurements. An increase in the immersion time, alkaline concentration, and temperature increases the inhibition efficiency. Temperature studies reveal the inhibitor follows chemisorption behavior toward corrosion protection. It proves that the inhibitor works perfectly against the corrosion of metal and is suitable for the corrosion inhibition process [6]. The corrosion inhibition behavior of *Henna leaves* on Tin in 1.0 M HCl and 1.0 M NaOH using weight loss technique. The presence of the compound adsorbed on the tin coupons was verified by spectroscopic measurements. The inhibition efficiency decreased with an increase in temperature but increased with increasing inhibitor concentrations. Lawsonia inermis leaf extract has proved to be more excellent inhibitor for tin in NaOH alkaline [7]. The corrosion inhibition effect of *Saraca ashoka seeds extracts*, on

mild steel corrosion in 0.5M H_2SO_4 by using weight loss measurements, potentiodynamic polarization measurements, and electrochemical impedance spectroscopy techniques. The best inhibition effect of *Saraca ashoka* extract for mild steel in 0.5 M H_2SO_4 was obtained at 100 mg/L. The adsorption on the surface of mild steel was found by AFM, SEM study, and absorption spectroscopic techniques. Due to the existence of hetero atoms in the main components, *Saraca ashoka* extract is considered to be a good inhibitor [8].

The inhibition and adsorption effects of the aqueous extracts of *Musa paradisica* (Banana) peels on mild steel corrosion in 1 M HCl as well as change in inhibition efficiency with ripening of the peels by weight loss measurement, electrochemical impedance spectroscopy, Tafel polarization, and atomic force microscopy techniques. The extracts are characterized by FTIR spectroscopy, UV-visible spectroscopy, and high-performance liquid chromatography techniques^[9] and *Rosa canina fruit extract* was utilized for mild steel corrosion inhibition in 1 M HCl solution by electrochemical impedance spectroscopy (EIS) and potentiodynamic polarisation test. Results revealed that *R.canina* fruit extract acted as a mixed-type inhibitor and remarkably reduced the corrosion current density of mild steel from 110 $\mu\text{A}/\text{cm}^2$ (0 ppm) to 44 $\mu\text{A}/\text{cm}^2$ (800 ppm)^[10]. The mild steel corrosion inhibition in 1M HCl solution was protected with different concentrations of *Lemon Balm* extract.

Electrochemical and theoretical approaches were used. The type of functional groups present in the *Lemon Balm* extract was examined through UV-visible analysis, Fourier Transform Infrared, and Raman spectroscopy. Surface studies by contact angle test, atomic force microscopy, and scanning electron microscopy. Results revealed that the steel surface damage as a result of the HCl solution attack significantly decreased with the addition of 800 ppm LB.E^[11]. The *dried olive leaves extract* as an inhibition in an alkaline chloride solution (pH13). Methanol, ethyl acetate, dichloromethane, and hexane. The anti-corrosive activity was performed using polarization curves, electrochemical impedance spectroscopy, and Mott-Schottky analyses. The polarization studies proved that extract from *olive leaves* is a mixed-type inhibitor in a solution of NaOH (0.1 M) + NaCl (0.5 M). The best inhibition is provided with methanol extract ^[12]. *Terminalia arjuna* is used as a corrosion inhibitor whereas mild steel has been used as a specimen. It shows a maximum of 64.1% efficiency in a 0.2 M HCl medium. Fourier-transform infrared spectroscopy test suggests the reasons behind the inhibitions. Scanning electron microscopy test shows the surface morphology of the corroded samples and confirms less corrosion effect on mild steel in inhibited solution ^[13]. The corrosion behavior of the mild steel in hydrochloric acid 1 M by the aqueous extract of *Artemisia Herba Alba* (AHA), to reduce its corrosive action by weight loss, electrochemical impedance spectroscopy, and potentiodynamic

polarization, SEM-EDX, XPS. Phytochemical screening characterization of different parts of the plant was applied to show the proportions of chemical compounds that exist in the plants. The highest inhibition efficiency obtained is 92% for 0.4 g/L of AHA aqueous extract in 1 M HCl at 303 K. The PDP study confirmed that the AHA extract was a mixed-kind inhibitor ^[14]. The use of corrosion inhibitors is a cost-effective corrosion mitigation strategy for carbon steel. Plant-based extracts were evaluated using electrochemical methods and characterization techniques. Plant extracts appear as promising alternatives for commercially synthesized inhibitor formulations. Therefore, further development of plant extracts as corrosion inhibitors is of significant interest^[15].

Ficus tikoua leaves extract as a corrosion inhibitor for carbon steel in hydrochloric acid. Electrochemical experiments and morphological characterization were carried out. From electrochemical results, the extract inhibitors act as a mixed type with an inhibition efficiency of up to 95.8%. The chemical formulae of these major components are fully optimized in the DFT ^[16]. Through electrochemical measurements the effectiveness of *chamomile flower extract (CFE)* in preventing the corrosion of aluminum in an artificial seawater solution. Atomic force microscopy (AFM), scanning electronic microscopy (SEM), FTIR, and Density functional theory (DFT) were used. According to the electrochemical tests, corrosion inhibition increased as

inhibitor concentration increased and reached a moderate inhibition efficiency of 75.66% at 20 mL/L ^[17]. *Dardagan Fruit* was tested as inhibitor corrosion for mild steel protection in 1 M HCl solution using electrochemical techniques. The surface of mild steel was examined by scanning electron microscopy (SEM) and atomic force microscopy (AFM) and also X-ray spectroscopy (EDX), electrochemical impedance spectroscopy (EIS) are used. From these DF has good corrosion protection ability. The inhibition of corrosion rate reduces when concentration of DF and exposure time are increased ^[18]. Leaves extract of *Arbutus unedo L.* plant was used as a green corrosion inhibitor of mild steel in hydrochloric acid. polarization were used to confirm the anti-corrosion performances of the extract of plant leaves at different temperatures. The addition of extract plant even at low concentration increases significantly the inhibition efficiency with a maximum of 91.72% for 0.5 g/L of leaves extract. Density functional theory and molecular dynamic simulation were also conducted to support the high inhibition efficiency and to propose the adsorption mechanism ^[19] and leaf juice combined with NaOH solution can reduce the corrosion of aluminum alloy. Aluminum alloy was immersed in 100% NaOH, 100% *Syzygium Samarangense* leaf juice, 60% NaOH+40% *Syzygium Samarangense* leaf juice and 40% NaOH+60% *Syzygium Samarangense* leaf juice solution and results showed that *Syzygium Samarangense* leaf juice was behaved as a green inhibitor. FTIR, SEM,

polarization, impedance, surface topography, particle and volume analysis are also done ^[20]. *Eucalyptus leaves extract (ELE)* inhibition impact towards mild steel corrosion in the HCl solution by combined experimental and computational studies. The degree of inhibition was investigated by *EIS* and polarization test. The *EIS* analysis showed that the increase of *ELE* concentration led to the significant increment of charge transfer resistance. Polarization test results indicated the mixed inhibition effects of *ELE* with slight cathodic prevalence. The *ELE* molecules adsorption on the surface of MS followed a Langmuir isotherm ^[21]. Corrosion inhibition property of *Juglone* extracted from walnut green husk for mild steel exposed to an acid electrolyte (1 M HCl) using potentiodynamic polarization as well as *EIS* techniques. In addition, XPS, FT-IR, SEM, AFM, and UV-visible spectroscopy have been used to study the inhibition mechanism of the agricultural waste extract in the corrosive media. The results indicated the efficiency of the inhibitor was enhanced with increasing the concentration of green corrosion inhibitor (GCI). From Tafel extrapolated polarization the extracted GCI functioned as a mixed-type of corrosion inhibitor ^[22].

The corrosion inhibition effect of *Sida cordifolia* extract on mild steel corrosion in 0.5 M H₂SO₄ by using weight loss measurements, potentiodynamic polarization measurements and *EIS* techniques. The adsorption of *Sida cordifolia* extract on the surface of mild steel has been investigated by using

AFM study, SEM study and absorption spectroscopic techniques. Due to the existence of hetero atoms in the main components, *Sida cordifolia* extract is considered to be a good inhibitor ^[23] and the inhibiting action of *Piper longum* seed extracts as the corrosion inhibitors of aluminium in 1 M NaOH solution using potentiodynamic polarization, electrochemical impedance spectroscopy methods and weight loss measurements. The results revealed that *P. longum* extract was an effective inhibitor. Using the potentiodynamic polarization technique, the extract was proving to have a mixed-type character for aluminium in alkaline solution by suppressing both anodic and cathodic reactions on the metal surface ^[24]. The inhibitive action of leaves (LV), root (RT) and seeds (SD) extracts of *Azadirachta indica* on mild steel corrosion in H₂SO₄ solutions using weight loss and gasometric techniques. The results obtained indicate that the extracts functioned as good inhibitors in H₂SO₄ solutions. Inhibition efficiency was found to increase with extracts concentration and temperature, and followed the trend: SD > RT > LV. The experimental data fit into the Freundlich adsorption isotherm ^[25]. Inhibitor effect of the naturally occurring biological molecule caffeic acid on the corrosion of mild steel in 0.1 M H₂SO₄ by weight loss, potentiodynamic polarization, electrochemical impedance and Raman spectroscopy. These confirmed the adsorption of caffeic acid on to the mild steel surface and consequently the inhibition of the corrosion process. Caffeic acid acts by

decreasing the available cathodic reaction area and modifying the activation energy of the anodic reaction [26] and the corrosion inhibition ability of PA and L-cysteine (Cys) on the mild steel in 1 M HCl using potentiodynamic polarization, electrochemical impedance spectroscopy (EIS), and scanning electron microscopy (SEM). Experiments were performed in various concentrations of Cys and PA and different immersion times. The results suggested that both Cys and PA can be used as effective corrosion inhibitors. The adsorption of inhibitors followed the Langmuir adsorption isotherm [27]. Potentiality corrosion inhibition of *Citrullus lanatus* fruit (CLF) extract on corrosion of mild steel in 1 M HCl applying electrochemical (EIS and polarization) and surface morphological (SEM, AFM, contact angle) techniques. The presence of major phytochemicals in CLF extract was explored by FT-IR spectroscopy combined with UV-Visible analyses. Also, the graphical SEM/AFM results disclosed that the interactions of CLF extract molecules with steel surface greatly influenced the prevention of surface damage [28]. Corrosion inhibition of Luffa cylindrica Leaf Extract (LCLE) using gravimetric, depth of attack and surface analysis techniques. Effect of inhibitor concentrations, temperatures and immersion time was studied on the Inhibition Efficiency (IE) of the extract on Mild Steel immersed in a 0.5 M HCl solution. The media solutions and adsorbed film on MS were characterized using FTIR Spectrophotometer. SEM microgram and surface tester were applied for

studying surface morphology and depth of attack profile. Activation energy (28.71 kJ/mol), entropy (-0.15 kJ/mol. K), average enthalpy (-28.00 kJ/mol) and Gibbs free energy (-11.43 kJ/mol) obtained at optimum condition indicate exothermic process and physical adsorption mechanism [29] and the mild steel corrosion inhibition in 1 M HCl solution containing *Mangifera indica* leaves extract by electrochemical and surface studies. The presence of many active components in the extract of *M. indica* was shown by transform infrared spectroscopy and ultraviolet-visible spectrophotometry. Results revealed that with increasing inhibitor concentration and immersion time the inhibition efficiency increased. It was shown that in the presence of *M. indica* extract both iron anodic dissolution rate and cathodic hydrogen evolution reaction rate efficiently decreased reflecting a mixed inhibition action [30].

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CHAPTER-20

An extensive analysis of the factors that led to the increase in GST collections between 2017 and 2023

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Abstract

The goods and services tax (GST), an indirect federal sales tax, is levied on the price of a number of goods and services. After the business has added the GST to the product's cost, the buyer pays the sales price inclusive of the GST when they buy a product. The GST's principal objective was to establish a single federal tax system. While streamlining tax collection across the country, it increased tax revenue. A crucial element of the GST idea is taxing consumable goods and services. Depending on the goods or services, it is separated into a number of slabs. The constantly high GST receipts reflect rising levels of economic activity and consumption. Increased GST receipts signal a growth in domestic demand and greater economic vitality because GST is a consumption-based tax. The author summarizes the causes and impact of rise in GST collections from the year 2017-2018 to 2022-2023.

Keywords: Indirect taxation; Goods and Service Tax, Artificial Intelligence, Government, taxpayer.

1.1 Introduction

All other taxes, including the Value Added Tax and Sales Tax, are eliminated with the establishment of the GST, creating a unified tax structure for goods and services. The GST encourages higher output levels, which fosters growth by reducing producers' tax payments. Due to the GST's broadening of the tax base, government revenue has increased. For the taxes they paid when purchasing goods or services, the GST granted producers input tax credits. The export-specific customs costs were eliminated by GST. In the previous tax structure, the taxation cap for the composition scheme was set at 50 lakhs. The limit has been reduced to Rs. 75 lakh for the North-Eastern states and Himachal Pradesh in light of the GST of Rs. 1.5 crore. A change to the GST regulations stipulates that, as of August 1, 2023, all businesses with annual sales of at least Rs. 5 crore must provide an electronic invoice. According to the GST legislation, companies must generate an electronic invoice if their B2B transaction value exceeds Rs. 5 crore.

Experts assert that state government initiatives to prevent tax evasion have improved compliance, increased GST receipts, and accelerated economic growth and inflation rates.

1.2 Literature Review

Manpreet Arya (2022) in his paper have studied the concepts, objectives, impact and the implications of the Goods and Service Tax in India. As per the author the GST is very crucial tax reform since independence of India, so it must be better handled with utmost care and analysed well before implementing it. And, the government both central and state have to conduct awareness programmes and various literacy programmes about GST to its various stakeholders.

In an article “GST: Good for Business, snag for Federalism”, by G. Sampath published in The Hindu, June 4, 2015, in which the author provides a quick explanation of the GST concept and contrasts it with the current tax system. By quoting Ms. Kavita Rao, who said that when one adopts a GST regime in a federal setting, some restriction of the State's freedom is unavoidable, the article sheds insight on the difficulties and challenges that the states will encounter with the introduction of GST. The paper goes on to analyze the social and economic implications of the GST implementation.

A Jacob, in the writing “The Finance Commission: its role in Adjustment of Union State Financial Relations” (2015) in the book titled „Constitutional Development Since Independence“ concludes that the scheme of distribution of funds in Indian Federation has inclined to give the Union more flexible resources, which as a result has created a gap between needs of State and its resources.

1.3 Objectives of Study

- 1) To examine the elements that contributed to the rise in GST receipts between 2017 and 2023
- 2) To conduct a performance comparison study amongst States.

1.4 Analysis and Interpretation

The chart below shows trends in monthly gross GST revenues during the five year. The table-1 shows the state-wise figures of GST collected in each State during the five years of July 2019 to July 2023.

Jul-19, Jul-20, Jul-21, July'22 and July'23

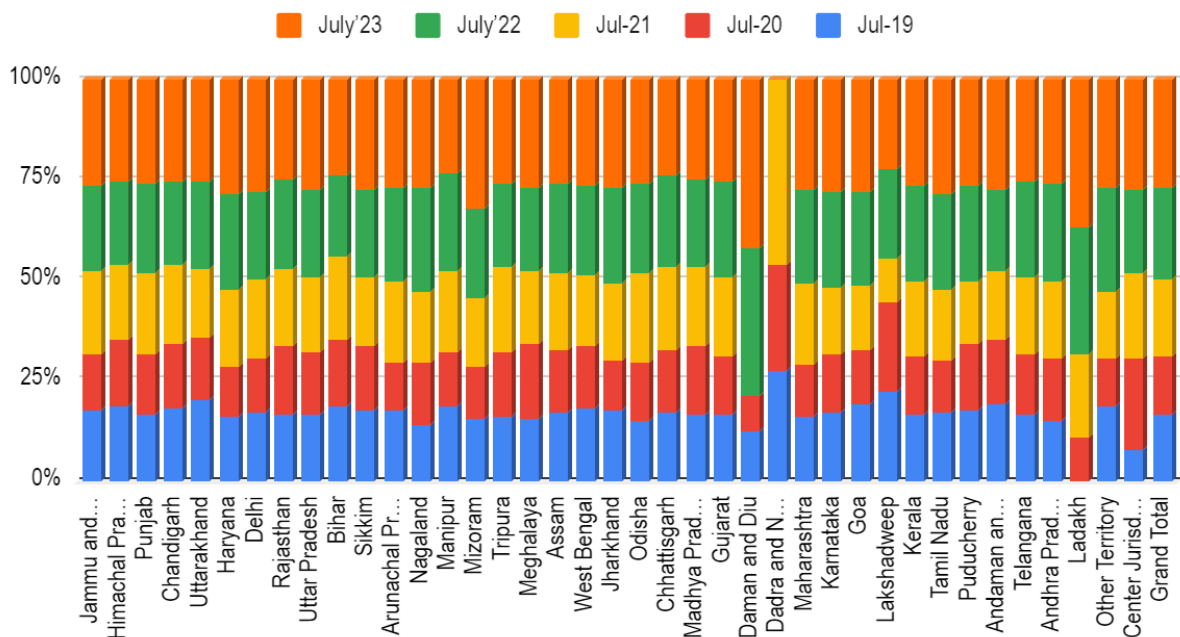


Table: State-wise growth of GST Revenues during July 2019 to July 2023 (Rs. in crore)

SR.NO	State/UT	Jul-19	Jul-20	Jul-21	July'22	July'23
1	Jammu and Kashmir	363	298	432	432	549
2	Himachal Pradesh	677	605	667	746	917
3	Punjab	1271	1188	1533	1733	2000
4	Chandigarh	156	137	169	176	217
5	Uttarakhand	1289	988	1106	1390	1607
6	Haryana	4617	3483	5330	6791	7953

7	Delhi	3406	2629	3815	4327	5405
8	Rajasthan	2699	2797	3129	3671	3988
9	Uttar Pradesh	5422	5099	6011	7074	8802
10	Bihar	1160	1061	1281	1264	1488
11	Sikkim	201	186	197	249	314
12	Arunachal Pradesh	49	33	55	65	74
13	Nagaland	23	25	28	42	43
14	Manipur	34	25	37	45	42
15	Mizoram	19	16	21	27	39
16	Tripura	49	48	65	63	78
17	Meghalaya	104	120	121	138	175
18	Assam	795	723	882	1040	1183
19	West Bengal	3586	3010	3463	4441	5128
20	Jharkhand	1855	1340	2056	2514	2859
21	Odisha	2494	2348	3615	3652	4245
22	Chhattisgarh	2002	1832	2432	2695	2805
23	Madhya Pradesh	2282	2289	2657	2966	3325
24	Gujarat	6411	5621	7629	9183	9787
25	Daman and Diu	105	77	0	313	354
26	Dadra and Nagar	135	130	227		

	Haveli					
27	Maharashtra	15102	12508	18899	22129	26064
28	Karnataka	7088	6014	6737	9795	11505
29	Goa	361	257	303	433	528
30	Lakshadweep	2	2	1	2	2
31	Kerala	1512	1318	1675	2161	2381
32	Tamil Nadu	6084	4635	6302	8449	10022
33	Puducherry	145	136	129	198	216
34	Andaman and Nicobar Islands	22	18	19	23	31
35	Telangana	3163	2876	3610	4547	4849
36	Andhra Pradesh	2138	2138	2730	3409	3593
37	Ladakh	0	7	13	20	23
38	Other Territory	158	97	141	216	226
39	Center Jurisdiction	59	179	161	162	209
	Grand Total	77038	66291	87678	106580	123026
	% increase	100	86.05	113.82	138.34	159.69

[1] Does not include GST on import of goods

Source: <https://pib.gov.in/Pressreleaseshare>.

As per the data given by the Ministry of Finance, it clearly shows that year on year the GST collections in every year went on rising and overall total GST collections showed a rapid growth leaving one year 2020, which was a year of Lockdown, still the GST Collections were adequate enough. And also if we analyse the percentage increase in the total GST collections of all states and territories, it went on increasing from taking base year 2019, as 100%

1.5 Factors that led to the increase in GST collections between 2017 and 2023

On July 1st, 2023, GST will have been in effect for six years. In terms of revenue collected, GST has expanded phenomenally, from Rs. 7.19 lakh crore in FY 2017–18 (as of July 2017) to Rs. 18.10 lakh crore in FY 2022–23. In comparison to FY 2021–22, the revenue for FY 2022–23 was 22% greater.

Since its introduction, the GST has undergone numerous changes in terms of policy, rate rationalization, procedural compliance, and many other things. Additionally, GST survived the Covid epidemic. The success of GST has been attributed to the government's, industries, and tax specialists' constant and persistent commitment. With this, we review the key effects of the GST over the past six years, from 2019 to 2023, as well as the problems and aspirations

Factors responsible and Positive Impact due to raise in GST collections:

The government's "One Nation One Tax" initiative, which aims to ensure frictionless transfers of products and services and bring about taxation consistency, has been successful. Additionally, consistency across all jurisdictions has been maintained through this.

In this fast-paced technological environment, the implementation of a solid and reliable technological infrastructure along with ongoing and timely system adjustments by the government has led to the digitization of records. Additionally, this has enabled information to flow seamlessly between multiple government agencies, like the Customs department and the Income Tax department, among others.

The early detection of tax avoidance by tax evaders and the discovery of fictitious entities thanks to the use of data analytics and AI. The development of technological infrastructure has made it possible to process GST refund requests quickly, and the issuing of several circulars and explanations for refund processing has made it simpler for taxpayers and exporters to manage their working capital.

The base of taxpayers has grown significantly as a result of technology and effective tax administration. As a result, more people are now included in the scope, and GST collections are up year over year.

The GST Council has been convening on a regular basis to evaluate various concerns and work toward finding solutions for taxpayers and stakeholders. Tax policies are continually reviewed and evaluated to ensure that they are current and that corrective actions are done on time.

Conclusion

Rates should be rationalized into fewer and lower tax slabs as a result of the increase in GST collections and the large number of assesses purchased under the scope of GST. A taxpayer must get state-by-state registration because India is a federal country. The idea of centralized registration would be challenging to implement, but in the case of large taxpayers, the government may aim for centralized evaluation. Duplicate assessments and the use of extra resources at the departmental and trade level are results of multistate assessment.

Allocation of common costs is the most frequent problem that taxpayers encounter. Value estimation of such supplies remains a top priority. To ensure uniformity in the estimation of the value of common cost allocation, tax policies and regulations must be put into place.

The credit of the recipient has been limited as a result of recent adjustments to the input tax credit ["ITC"] regulations because of various supplier non-compliance, including failure to file returns, discrepancies between the tax

declared in returns, improper ITC utilization, etc. Regardless of whether the recipient's transactions were sincere, they are subject to such onerous restrictions. As a result, there is a significant blockage of working capital and a high cost of working capital.

The trade is suffering undue hardship as a result of the supplier's additional retrospective revocation of GST registrations.

The GST Appellate Tribunal has not yet been established, despite the fact that the GST has been in effect for six years. This has led to a significant buildup of legal issues. For any tax policy to be successfully implemented, there must be a reliable and impartial adjudicating authority. Without the same, the taxation system collapses. Although the Council is making some progress in this direction, the formation of the Tribunal still seems to be a long way off.

India IS the fifth-largest economy in the world, according to the list of the World GDP Ranking 2023. The foundation of a country's economy is its taxation system, which maintains revenue consistency, controls economic growth, and stimulates its industrial activity. The government is making an effort to dominate the global economy. The GST tax system can be further simplified, and ease of doing business can be attained, with a perfect balance between taxpayer expectations and ongoing government advancement.

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CHAPTER-21

Characterization of enzymes from marine actinomycetes

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Introduction

Marine actinomycetes are a diverse group of bacteria that inhabit various marine environments, from shallow coastal waters to deep-sea trenches. They have adapted to extreme conditions, including high salinity, low temperatures, and high pressures. Their presence in marine sediments, sponges, corals, and other marine organisms highlights their ecological importance.

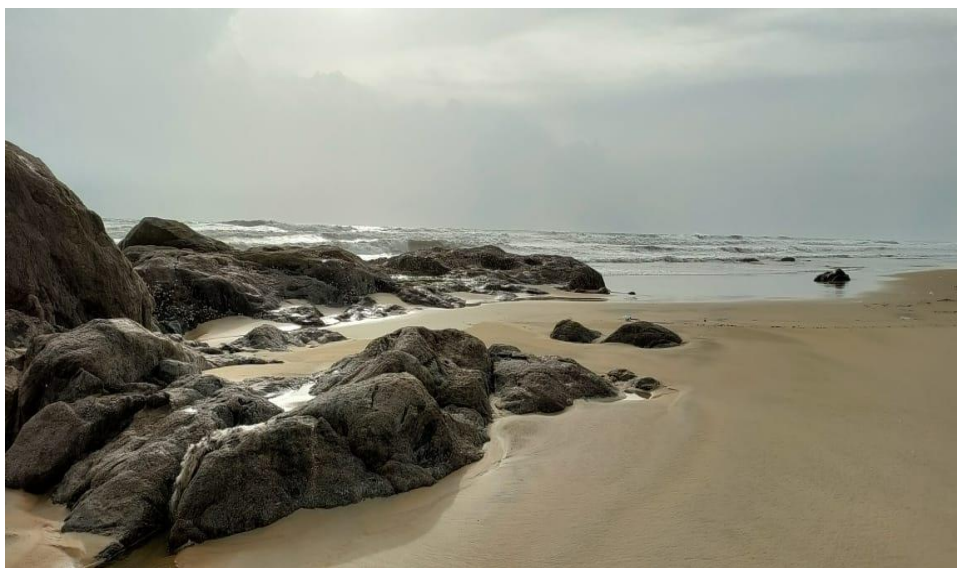
Marine actinomycetes belong to the phylum *Actinobacteria*, which includes well-known genera like *Streptomyces* and *Micromonospora*. They are characterized by their filamentous growth and the formation of spores. Taxonomic classification relies on molecular techniques like 16S rRNA gene

sequencing, revealing a rich diversity of species and strains yet to be fully explored. One of the most intriguing aspects of marine actinomycetes is their ability to produce a wide range of bioactive compounds. These compounds include antibiotics, anticancer agents, enzymes, and more. They have significant potential in pharmaceuticals, agriculture, and biotechnology. Streptomycin, one of the first antibiotics discovered, was produced by a soil-dwelling actinomycete, highlighting their historical importance in medicine and these are valuable resources for bioprospecting and drug discovery. Metagenomics and genome mining techniques are used to identify gene clusters responsible for biosynthesis. The ongoing threat of antibiotic resistance makes the search for new antibiotics from marine actinomycetes particularly critical. Isolating and cultivating marine actinomycetes can be challenging due to their slow growth and specialized requirements.

Marine actinomycetes play roles in nutrient cycling and carbon sequestration in marine ecosystems. Efforts to conserve these unique microbial resources are essential, especially given the increasing threats to marine environments. Marine actinomycetes often form symbiotic relationships with marine organisms like sponges. These associations contribute to the health and defense mechanisms of the host organisms and may influence the microbial diversity of the marine environment.

Beyond drug discovery, marine actinomycetes are used in bioremediation

processes to break down pollutants in marine environments. They have potential applications in various biotechnological processes and products.



(NITK Beach, Mangaluru)



Isolation and Cultivation of Marine Actinomycetes:

The isolation and cultivation of marine actinomycetes are essential steps in studying these microorganisms for research, bioprospecting, and biotechnological applications. Collecting marine samples from the desired environment, such as marine sediments, marine sponges, corals, or other marine organisms. Ensure proper sampling techniques and aseptic conditions to avoid contamination. After sample preparation, aseptically transfer a small portion of the processed sample onto the selective agar medium. Spread the sample evenly over the surface of the agar using a sterile spreader or glass rod. Incubate the agar plates or liquid cultures at the appropriate temperature for marine actinomycetes, which is typically around 25-30°C. Incubation periods

can vary, but it often takes several weeks to months for actinomycetes to grow.

✚ Characterization and Identification:

Preliminary characterization of isolated colonies, such as colony morphology, color, and growth patterns are performed. Fine-tune the growth conditions, including temperature, pH, salinity, and nutrient concentrations, to maximize the yield of marine actinomycetes. It's important to note that the isolation and cultivation of marine actinomycetes can be challenging due to their slow growth and specific requirements. Researchers often use specialized techniques and media to enhance isolation success. Additionally, the choice of isolation method and conditions may vary depending on the source of the marine sample and the specific goals of the research.



✚ Enzyme Extraction from marine actinomycetes:

Extracting enzymes from marine actinomycetes involves breaking down the cell walls and membranes of these microorganisms to release the

intracellular enzymes.

Grow the marine actinomycetes in a suitable liquid culture medium until they reach the desired growth phase. Harvest the cells by centrifugation at a low temperature (4°C) to minimize enzyme degradation. Resuspend the cell pellet in a cold buffer solution (e.g., Tris-HCl or phosphate buffer) to wash away any culture medium or extracellular contaminants. Centrifuge the suspension again to pellet the washed cells, an appropriate cell disruptor method based on your equipment availability and the characteristics of the actinomycetes.

Common methods include:

- **Sonication:** Ultrasonication disrupts cells using high-frequency sound waves. Use an ice bath to maintain low temperatures during sonication.
- **French Press:** High-pressure homogenization can be effective for cell disruption.
- **Bead Beating:** Mechanical disruption using glass or ceramic beads can release enzymes.

Perform the disruption while keeping the samples cold to prevent enzyme denaturation. Centrifuge the disrupted cell suspension to separate the cell debris, unbroken cells, and intracellular content (containing enzymes). Collect the supernatant, which contains the intracellular enzymes. If the enzymes are sensitive to proteolytic degradation, consider adding protease inhibitors to the

supernatant, further concentrate and purify the enzyme extract using techniques like ultrafiltration, dialysis, or chromatography, Purification can help obtain a more concentrated and homogeneous enzyme preparation.

Enzyme Assays:

The enzyme activity in the extracted solution using appropriate enzyme assays. The choice of assay depends on the type of enzyme you are working with. Assess enzyme activity under various conditions (pH, temperature, substrate concentration) to characterize its properties. Store the enzyme extract at an appropriate temperature and conditions based on the enzyme's stability. Some enzymes may require storage at -20°C or -80°C, while others may be stable at 4°C.

The extraction of enzymes from marine actinomycetes is a crucial step in studying their properties and potential applications. It's important to handle the cells and enzymes carefully to avoid denaturation or degradation during the extraction process.

Protein Purification:

Purification of enzyme of interest using techniques like chromatography (e.g., ion exchange, size exclusion, affinity chromatography). Purification helps obtain a homogeneous enzyme preparation for further characterization.

Molecular Characterization:

Enzyme identification at the molecular level through techniques like SDS-PAGE (Sodium Dodecyl Sulfate-Polyacrylamide Gel Electrophoresis) to determine its molecular weight. Perform Western blotting or enzyme-linked immunosorbent assays (ELISA) to detect and quantify the enzyme.

pH and Temperature Optima:

Determine the optimal pH and temperature for enzyme activity by conducting assays at various pH levels and temperatures. This information is crucial for industrial applications and biotechnological processes.

Stability Studies:

Assess the enzyme's stability under different conditions, including pH, temperature, and the presence of ions or organic solvents.

Substrate Specificity:

The substrate specificity of the enzyme by testing its activity with different substrates. Structural data provide insights into the enzyme's mechanism of action and may guide enzyme engineering efforts.

Bioinformatics and Genomic Analysis:

Analyse the genome of the marine actinomycete to identify other potential enzymes and enzyme-related genes.

Applications and Biotechnological Potential:

Assess the enzyme's potential applications in various industries, such as

pharmaceuticals, biofuels, agriculture, and environmental remediation.

Characterizing enzymes from marine actinomycetes is a multidisciplinary process that combines microbiology, biochemistry, molecular biology, and biotechnology. The results of these studies can lead to the development of new biotechnological products and processes with practical applications.

Applications of enzymes from marine actinomycetes:

Enzymes derived from marine actinomycetes have a wide range of applications across various industries due to their unique properties and potential for functioning in extreme marine environments. Here are some notable applications of enzymes from marine actinomycetes:

❖ **Pharmaceuticals:**

- **Antibiotic Production:** Marine actinomycetes have been a rich source of novel antibiotics, offering potential solutions to combat antibiotic-resistant pathogens.
- **Enzymes for Drug Synthesis:** Enzymes from marine actinomycetes can be used in the synthesis of pharmaceutical compounds and prodrugs.

❖ **Bioremediation:**

- **Biodegradation of Pollutants:** Enzymes produced by marine actinomycetes can break down organic pollutants, such as hydrocarbons and pesticides, in contaminated marine environments.

- **Oil Spill Cleanup:** Certain enzymes can be used to enhance the bioremediation of oil spills in coastal and offshore areas.

❖ **Biotechnology:**

- **Enzyme Production:** Marine actinomycetes can serve as hosts for the production of enzymes used in various biotechnological processes, including DNA amplification (PCR) and protein expression.
- **Industrial Enzymes:** Enzymes with unique properties from marine actinomycetes can be employed in industries like food, textile, and detergents for processes such as starch processing and stain removal.

❖ **Agriculture:**

- **Plant Growth Promotion:** Some enzymes produced by marine actinomycetes can enhance plant growth by facilitating nutrient uptake and protecting plants from pathogens.
- **Biocontrol Agents:** Actinomycetes-derived enzymes can be used as biocontrol agents to manage plant diseases.

❖ **Biofuels:**

- **Enzymatic Hydrolysis:** Enzymes from marine actinomycetes can play a role in the conversion of lignocellulosic biomass into biofuels, such as ethanol and biogas.

- **Algae Biofuels:** Marine actinomycetes can assist in the breakdown of complex compounds in marine algae, potentially contributing to the development of marine-based biofuels.
- ❖ **Food and Beverage Industry:**
 - **Food Processing:** Enzymes like proteases and lipases from marine actinomycetes can be used for cheese production, meat tenderization, and flavor enhancement.
 - **Brewing and Winemaking:** Enzymes can be employed in the brewing and winemaking processes to improve fermentation and clarify beverages.
- ❖ **Textile Industry:**
 - **Enzyme-Based Finishing:** Enzymes can be used in the textile industry for processes like biopolishing and desizing, reducing the environmental impact of textile manufacturing.
- ❖ **Diagnostics:**
 - **Diagnostic Enzymes:** Enzymes from marine actinomycetes can be used in diagnostic assays and biosensors for detecting specific biomarkers and pathogens.
- **Cosmetics and Personal Care: Enzyme-Enhanced Formulations:** Enzymes are used in cosmetics and personal care products for exfoliation, skin rejuvenation, and hair care.
- ❖ **Environmental Monitoring:**

- **Enzyme-Based Sensors:** Enzymes can be integrated into biosensors for monitoring environmental parameters, such as water quality and marine pollution.
- ❖ **Wastewater Treatment:**
- **Enzyme-Assisted Treatment:** Enzymes can be applied to enhance the breakdown of organic matter and improve the efficiency of wastewater treatment processes.
- ❖ **Biocatalysis:**
- **Enzyme-Catalyzed Reactions:** Enzymes from marine actinomycetes are valuable biocatalysts for various chemical reactions, offering advantages like specificity and mild reaction conditions.

The diverse range of applications for enzymes from marine actinomycetes highlights their significance in various industries and their potential to address environmental and industrial challenges. Continued research in this field may uncover novel enzymes with unique properties, expanding their practical utility even further.

Conclusion:

The characterization of enzymes from marine actinomycetes is a multifaceted and essential process that provides valuable insights into the properties, functions, and potential applications of these biologically active

molecules. This characterization involves a series of experiments and analyses aimed at understanding the enzymes at both biochemical and molecular levels.

Characterizing enzymes from marine actinomycetes contributes to our understanding of these microorganisms' unique adaptations to marine environments and their potential biotechnological significance. It also aids in the development of novel enzymes for a wide range of applications, including healthcare, agriculture, and environmental sustainability. Continued research in this field holds promise for discovering new bioactive compounds and unlocking innovative biotechnological solutions.

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CHAPTER-22

CORROSION STUDIES

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Corrosion is the term used to describe the process of material degradation caused by chemical interactions with the environment. The word corrosion is sometimes used to describe the deterioration of plastics, concrete, and wood, it is generally associated with metals. Corrosion is the degradation of the quality of materials by chemical reactions with other elements present in the natural environment (both dry and wet)¹. This process is commonly referred to as corrosion, and the rate of degradation is largely dependent on the time, temperature and reactant concentration².

Corrosion has a significant impact on an object's beauty, value and structural integrity^{3,4}. According to a survey conducted by NACE in 2011, corrosion costs amounted to \$2.2 billion. In India, corrosion costs are

estimated to be over \$100 billion, while corrosion costs in South Africa are expected to be more than \$9 billion³. Because of these huge material and economic losses, researchers have invested a lot of time and money in researching ways to reduce corrosion and its harmful effects. According to NACE, current corrosion prevention efforts may reduce corrosion costs by as much as 35% ⁵.

Losses due to corrosion could be direct or indirect. Direct losses may include,

- Replacement of corroded equipment
- Overdesign to allow for corrosion
- Preventive maintenance, for example, painting
- Inability to use otherwise desirable materials

Indirect losses may be either economic or social. These may include

- Contamination of a product
- Loss of valuable product, for example, from a container that has corroded
- Safety, for example, sudden failure can cause fire, explosion, release of toxic product
- Appearance as when corroded material is unpleasing to the eye.

Some of the major harmful effects of corrosion can be summarized as follows:

- Reduction of metal thickness leading to loss of mechanical strength and structural failure or breakdown.

- Hazards or injuries to people arising from structural failure or breakdown (e.g. bridges, cars, aircraft).
- Loss of time in availability of profile-making industrial equipment.
- Reduced value of goods due to deterioration of appearance.
- Contamination of fluids in vessels and pipes (e.g. beer goes cloudy when small quantities of heavy metals are released by corrosion).
- Perforation of vessels and pipes allowing escape of their contents and possible harm to the surroundings.
- Loss of technically important surface properties of a metallic component.
- Mechanical damage to valves, pumps, etc, or blockage of pipes by solid corrosion products.

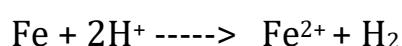
Principles of corrosion

Thermodynamic Principles: Thermodynamic and electrochemical principles have maximum importance in determining the corrosion behavior of materials. Thermodynamic principles can indicate the spontaneity of a chemical reaction. They are used to determine whether corrosion theoretically possible.

Electrochemical Principles: They are extensively used to determine the corrosion behavior of the material. Hence the corrosion reaction can be represented by partial reactions such as metal oxidation and reduction species of the environment both occurring simultaneously at equal rates at the mixed

potential of the reaction. Corrosion reactions mainly occur at the metal-environment interface. The electrochemical nature of corrosion can be illustrated by their attack of iron in hydrochloric acid. When the iron is dipped in acid, a vigorous action occurs. As a result, hydrogen gas is evolved and iron gets dissolved.

Hence the reaction is



The above reaction can be divided into two partial reactions.



Metallurgical Principles: Metallurgical principles help to understand corrosion behavior of a metal. In many cases the metallurgical structure of an alloy can be changed much as to improve its corrosion resistance.

Physical and Chemical Principles: Physical chemistry and its various disciplines are most useful for studying the mechanism of corrosion reactions, the surface conditions of metals and other surface conditions of metals and other basic properties.

Corrosion mechanism

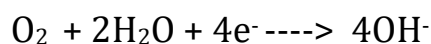
When iron is immersed in water, or when humidity from the air condenses on an iron surface, the oxygen dissolved reacts with iron causing the formation of iron oxides.

There are always two distinct chemical reactions in a corrosion process:

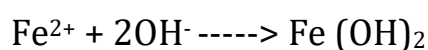
1) Anodic Dissolution of Iron that goes into solution (water)



2) Cathodic Reduction of Oxygen dissolved into water



The final reaction is:



$\text{Fe}(\text{OH})_2$ will then react with oxygen to give iron oxides: Fe_2O_3 (red) and Fe_3O_4 (black). The final product (when dry) has the reddish-brown flaky character we associate with rust. On a metal surface in contact with water an infinite number of cathodic and anodic sites are established uniformly distributed over the metallic surface. The result is a uniform attack on the metal surface. The rate of attack, corrosion rate, is a function of different factors like temperature, fluid velocity, pH. Low pH, acid solution, is more corrosive than neutral solution.

Forms of corrosion

Almost all corrosion problems and failures encountered in service can be associated with one or more of the eight basic forms of corrosion: general corrosion, galvanic corrosion, concentration-cell (crevice) corrosion, pitting corrosion, intergranular corrosion, stress corrosion cracking, dealloying and

erosion corrosion^{6,7,8}.

General Attack (Uniform) Corrosion: It occurs when a chemical or electrochemical attack occurs over a large area in a uniform manner. This is often referred to as a general wall loss or thinning.

Galvanic Corrosion: Galvanic corrosion can be defined simply as being the effect resulting from the contact between two different materials in a conducting corrosive environment.

Crevice corrosion: Crevice corrosion is a highly localized attack occurring in a crevice or an otherwise shielded area when a material is exposed to a stagnant corrosive media.

Pitting corrosion: A highly localized corrosion attack that results in holes is referred to as pitting. Pits may be isolated or localized and of virtually any configuration. They occur at defects or imperfections in a protective or passive film.

Intergranular Corrosion: Intergranular corrosion occurs when the grain boundaries are attacked in preference to the material matrix.

Stress Corrosion Cracking: Stress corrosion occurs when a material is exposed to a corrosive media while a force (stress) or pressure is applied. The material usually remains undamaged with the exception of cracks that grow through the material matrix.

Dealloying (Selective Leaching): Dealloying occurs when one of the elements is removed from the metal matrix, leaving an altered residual structure. It is commonly identifiable by a color change or a drastic change in mechanical strength.

Erosion: Erosion occurs when the velocity of the fluid is sufficient to remove protective films from the metal surface. It is often a combination of erosion (mechanical damage) with corrosion (electrochemical damage).

Fretting Corrosion: Fretting occurs when motion between surfaces either removes protective films or mechanically removes material from surfaces in relative motion.

Biological Corrosion: Corrosion caused by microorganisms is usually indistinguishable from other sources; it is often determined by sampling the process condition for evidence of microbiological activity.

Corrosion control methods

Corrosion can be mitigated by five basic methods: coatings, cathodic protection, materials selection, chemical inhibitors and environmental change. A basic understanding of corrosion will enable USACE personnel to comprehend how these methods help to prevent corrosion and it will establish an overall introduction to the purpose for the entire engineer manual.

Corrosion can be prevented by the following ways,

Change of metal: Alloying and surface modifications are common techniques used to prepare metal with improved corrosion resistance properties.

Change of environment: It is possible to decrease the corrosivity by the addition of organic and inorganic substances, which inhibit or significantly reduce the corrosion. These substances are known as inhibitors. They may be either anodic or cathodic inhibitors. Anodic inhibitors function by reacting with the anodic sites on the metal surface to form a compound that is sparingly soluble or even insoluble, thereby preventing or retarding corrosion of the metal.

Change of metal/ electrode potential: Corrosion can be prevented by changing the electrode potential of the metal. This can be achieved by lowering of potential of the metal in the negative direction (anode) in the domain of immunity (cathodic protection) and increasing the potential of the metal in the positive direction in the domain of passivity (anodic protection).

Cathodic protection: Cathodic protection is defined as the reduction or prevention of corrosion by making the steady of corrosion electrical potential of the metal sufficiently more electronegative.

Anodic Protection: In this method the structure to be promoted is made anode and potential is set in the passive region.

Protective Coatings: Protective coatings are the most widely used corrosion control technique. Essentially, protective coatings are a means for separating

the surfaces that are susceptible to corrosion from the factors in the environment which cause corrosion to occur. Both metallic and non-metallic coatings are being used widely on the industrial and domestic fields. Metallic coatings may function as sacrificial coatings and protect the substrate metal by cathodic protection. Alternatively, the noble metallic coatings may have a greater corrosion resistance than the substrate metal.

Inhibitors: Among many anti-corrosion technologies, corrosion inhibitors are known for their low dosage, immediate effect, low cost, and ease of use [9]. Corrosion inhibitor is also an indispensable additive in the pickling process because they can effectively slow down the corrosion of metals. Based on different components, corrosion inhibitors can be divided into inorganic corrosion inhibitors and organic corrosion inhibitors. As the name suggests, inorganic corrosion inhibitors are mainly based on inorganic substances, such as chromate, nitrite, and phosphate. Once people's awareness of environmental protection was weak, inorganic corrosion inhibitors were widely used. Organic corrosion inhibitors are mainly composed of organic substances, such as imidazoles, thiazoles, and triazoles. Organic corrosion inhibitors all have a common feature, that is, they have N atom, O atom, S atom, P atom, benzene rings, and non-polar covalent bonds [10,11]. Organic corrosion inhibitors can be adsorbed on the metal surface through chemical or

physical acting force under the gain and loss of electrons or electrostatic forces [12].

The inhibitors can be classified as,

Cathodic corrosion inhibitors reduce the corrosion rate due to retarding cathodic reactions. A cathodic inhibitor causes formation of insoluble compounds precipitating on the cathodic sites in form of a barrier film. The effective cathode area is one of the factors of galvanic corrosion therefore its reduction results in decrease of corrosion rate.

Anodic corrosion inhibitors reduce the corrosion rate due to retarding anodic reactions. An anodic inhibitor shifts the equilibrium of the corrosion process to the passivation zone (Pourbaix diagrams) causing formation of a thin invisible passivation oxide film on the anodic sites, which increases the anode potential and depresses the oxidation process. Reduction of the effective anode area results in decrease of corrosion rate.

Adsorption corrosion inhibitors reduce the corrosion rate due to polarization of the metal by extremely thin layer of their molecules adsorbed on the surface. Decrease of the effective surface area results in reduction of the corrosion rate. Adsorption inhibitors are substances (mainly organic) capable to form chemisorbed bonds with surface metal atoms.

Volatile corrosion inhibitors (VCI) reduce corrosion in closed spaces (package bags). VCI compound is emitted (vaporized) by the material enclosing

the space. The vapors condense on the metal surface in form of microscopic crystals, which dissolve in the moisture film present on the surface. The ions of the dissolved VCI displace water molecules from the metal surface and form monomolecular invisible protection film reducing the corrosion rate.

Theories of inhibitors

Adsorption theory: According to adsorption theory, inhibitors are adsorbed on the metal surface forming a protective layer. The mode of adsorption leads to its classification as physical adsorption and chemical adsorption. It is the result of electrostatic attractive forces between inhibiting organic ions or dipoles and the electricity charged surface of the metal. The surface charge of the metal is due to the electric field at the outer Helmholtz plane of the electrical double layer existing at the metal /solution interface. The surface coverage can be obtained from the potential of the metal (E_{corr}) Vs its zero charge potential ($E_{\text{q}}=0$). When the difference $E_{\text{corr}} - E_{\text{q}}=0 = \emptyset$ is negative, cation adsorption is favoured. Adsorption is favoured if \emptyset is positive.

Chemisorption: This process involves charge sharing or charge transfer from the inhibitors molecules to the metal surface in order to form a coordinate type of bond. The chemisorption process takes place more slowly than electrostatic adsorption and with higher activation energy. It depends on the temperature and higher degree of inhibition should be expected at higher temperature. The

bonding occurring with electron transfer is typical for transition metals having vacant low energy orbitals. Most of the organic compounds are substances with at least one functional group regarded as the reaction site for chemisorption process. In this case, the strength of the adsorption bond is related to the heteroatom electron density and to the functional group polarizability. For example, the inhibition efficiency of homologous series of organic compounds differing only in heteroatom is usually in the following orders: >Se>S>N>O .

Corrosion Monitoring Techniques

The field of corrosion measurement, control and prevention covers a very broad spectrum of technical activities. Corrosion measurement employs a variety of techniques to determine how corrosive the environment is and at what rate metal loss is being experienced. Corrosion measurement is the quantitative method by which the effectiveness of corrosion control and prevention techniques can be evaluated and provides the feedback to enable corrosion control and prevention methods to be optimized.

Weight Loss Method: The Weight Loss technique is the best known and simplest of all corrosion monitoring techniques. The method involves exposing a specimen of material (the coupon) to a process environment for a given duration, then removing the specimen for analysis. The basic measurement which is determined from corrosion coupons is weight loss; the weight loss

taking place over the period of exposure being expressed as corrosion rate.

The simplicity of the measurement offered by the corrosion coupon is such that the coupon technique forms the baseline method of measurement in many corrosion monitoring programs. The technique is extremely versatile, since weight loss coupons can be fabricated from any commercially available alloy. The percentage of inhibition efficiency (IE) is calculated by, Inhibition Efficiency (%) = $\frac{W_o - W}{W_o}$

Where, W_o and W are the weight loss in absence and presence of inhibitors.

Gasometric Method: This method is reliable and accurate. The volume of gas is measured directly at constant temperature and atmospheric pressure and the metal loss is calculated. Several authors have used this technique and designed gasometric apparatus operating under controlled conditions of temperature and pressure. The main disadvantage is that this cannot be applied to strong oxidizing medium.

Electrochemical Methods: The mechanism of corrosion taking place in aqueous phase is electrochemical. Therefore, a broad range of electrochemical techniques has been developed. The main advantages of electrochemical techniques include sensitivity to low corrosion rates, short experimental duration and well-established theoretical understanding. During electrochemical experiments specimens are polarized to accelerate the

corrosion measurement process and the measurements are made within minutes or hours. Electrochemical measurements are used in both the laboratory and the field.

Potentiostatic method: In the potentiostatic method, the potential of the specimen is changed in steps (manually or automatically) and the current flowing in the external circuit is recorded as a function of time. Polarization studies were carried out for mild steel specimen of the same composition, both in the presence and absence of inhibitors. Polarization measurements were performed to evaluate the corrosion kinetics parameters such as I_{corr} , E_{corr} and Tafel slopes b_a and b_c .

Electrochemical impedance spectroscopy (EIS) : Impedance technique has been widely used for the measurement of corrosion rate, due to the main advantage that the double layer capacitance (C_{dl}) and charge transfer resistance (R_{ct}) can be determined. The term resistance and impedance both imply a restriction to the current flow. When dealing with DC, only resistors produce this effect. But in the case of AC both inductors and capacitors influence electron flow.

$$\text{Inhibition Efficiency (\%)} = \frac{R_{\text{ct}}^* - R_{\text{ct}}}{R_{\text{ct}}^*} \times 100$$

where R_{ct}^* - charge transfer resistance with inhibitor, R_{ct} - charge transfer resistance without inhibitor

Linear Polarization Resistance (LPR) Monitoring: The LPR technique is based on complex electro-chemical theory. For purposes of industrial measurement applications, it is simplified to a very basic concept. In fundamental terms, a small voltage (or polarization potential) is applied to an electrode in solution. The current needed to maintain a specific voltage shift (typically 10 mV) is directly related to the corrosion on the surface of the electrode in the solution. By measuring the current, a corrosion rate can be derived.

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CHAPTER-23

Detection of mycotoxins by advanced and emerging analytical methods

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Introduction:

Mycotoxins are toxic compounds produced by certain molds (fungi) that can contaminate various agricultural products, including crops, grains, and animal feed, posing a significant risk to human and animal health. These naturally occurring toxins have been a concern in the food and agricultural industries for decades, as they can lead to food safety issues, economic losses, and public health problems.



Mycotoxins are primarily produced by molds belonging to genera such as *Aspergillus*, *Penicillium*, and *Fusarium*. These molds can grow on crops both in the field and during storage, depending on factors like temperature, humidity, and substrate composition. As they grow, they may produce mycotoxins, which can persist even after the molds are killed or removed.

The presence of mycotoxins in food and feed can have various adverse effects:

- **Health Risks:** Mycotoxins can cause a range of health problems in humans and animals when ingested, inhaled, or absorbed through the skin. These effects can include acute poisoning, chronic health issues, and even carcinogenicity.
- **Economic Impact:** Mycotoxin contamination can lead to significant economic losses in the agriculture and food industries. Infected crops and products may be discarded, leading to decreased yields and financial setbacks.
- **Trade Barriers:** Many countries have established strict regulations regarding mycotoxin levels in imported and domestically produced food and feed. Non-compliance with these regulations can result in trade barriers and product rejections.
- **Food Quality:** Mycotoxins can affect the sensory qualities of food products, including taste, odor, and appearance, making them less appealing to consumers.

Common mycotoxins include aflatoxins, ochratoxin A, fumonisins, deoxynivalenol (DON), and zearalenone, among others. Each of these mycotoxins is associated with specific mold species and conditions, and they vary in their toxicity and health effects.

To mitigate the risks associated with mycotoxin contamination, various strategies are employed, including good agricultural practices (GAPs), good manufacturing practices (GMPs), and mycotoxin management throughout the supply chain. Additionally, advanced analytical methods and regulations have been established to monitor and control mycotoxin levels in food and feed products, contributing to improved food safety and public health. Understanding mycotoxins and their impact is essential for ensuring the safety and quality of the global food supply.

Mycotoxins are produced by various fungal species, and the type of mycotoxin produced can vary depending on the specific fungal strain and the environmental conditions in which it grows. Here are some common fungal genera known for producing mycotoxins:

Aspergillus:

- **Aflatoxins:** *Aspergillus flavus* and *Aspergillus parasiticus* are well-known producers of aflatoxins, which are highly toxic and carcinogenic mycotoxins. Aflatoxins are primarily found in nuts, grains, and legumes.

- Ochratoxin A: *Aspergillus ochraceus* is a major producer of ochratoxin A, which can contaminate a variety of food products, including cereals, coffee, and wine.
- Sterigmatocystin: This mycotoxin is a precursor of aflatoxins and is produced by several *Aspergillus* species, including *Aspergillus versicolor*.

Penicillium:

Patulin: *Penicillium expansum* is known to produce patulin, which is commonly found in decaying apples and apple-based products like apple juice and cider.

Penicillic Acid: *Penicillium verrucosum* produces penicillic acid, which is associated with moldy grains and wheat products.

Fusarium:

- Deoxynivalenol (DON): *Fusarium graminearum* and *Fusarium culmorum* produce DON, also known as vomitoxin, which contaminates wheat, barley, and corn.
- Zearalenone: *Fusarium* species produce zearalenone, a mycotoxin that can be found in grains like maize, wheat, and barley. It has estrogenic effects and affects animals and humans.
- Fumonisins: *Fusarium verticillioides* and related species produce fumonisins, which contaminate maize and maize-based products.

- T-2 Toxin and HT-2 Toxin: These mycotoxins are produced by various *Fusarium* species and can be found in grains like oats, wheat, and barley.

Claviceps:

- Ergot Alkaloids: The *Claviceps* genus produces ergot alkaloids, which can infect cereal grains and grasses. Consumption of contaminated grains can lead to ergotism, characterized by symptoms like hallucinations and convulsions.

Alternaria:

- Alternariol (AOH) and Alternariol Monomethyl Ether (AME): These mycotoxins are produced by *Alternaria* species and can contaminate a variety of fruits, vegetables, and grains.

Trichothecium:

- T-2 Toxin and HT-2 Toxin: These mycotoxins are produced by several *Trichothecium* species and can contaminate grains like wheat, barley, and oats.

Pencillium (Blue Mold):

- Roisin: This mycotoxin is produced by *Pencillium roqueforti* and *Pencillium glaucum* and is commonly associated with blue cheese.

It's important to note that the specific mycotoxin produced by a fungus can depend on factors such as the fungal species, the substrate it grows on, environmental conditions (temperature, humidity), and other factors. These

mycotoxins can have significant health implications when present in food and feed, which is why monitoring and control measures are essential in the agricultural and food processing industries.

Detection methods of mycotoxins:

The detection of mycotoxins by advanced and emerging analytical methods is a crucial aspect of food safety and quality control. Traditional methods like high-performance liquid chromatography (HPLC) and enzyme-linked immunosorbent assays (ELISA) have been widely used for mycotoxin analysis. However, advanced and emerging analytical techniques offer several advantages in terms of sensitivity, speed, and precision. Here are some of these methods:

- **Liquid Chromatography-Mass Spectrometry (LC-MS/MS):**

LC-MS/MS is a powerful technique for mycotoxin detection due to its high sensitivity and specificity. It allows for simultaneous quantification of multiple mycotoxins in a single analysis, reducing the time and cost of testing.

- **Gas Chromatography-Mass Spectrometry (GC-MS):**

GC-MS is used for mycotoxins that can be derivatized into volatile compounds. It offers excellent separation and quantification capabilities and is commonly used for analyzing aflatoxins and some other mycotoxins.

- High-Resolution Mass Spectrometry (HRMS):

HRMS provides superior mass accuracy and resolution, enabling the identification and quantification of mycotoxins and their metabolites with high confidence. It is valuable for identifying unknown or emerging mycotoxins.

- Ultra-High-Performance Liquid Chromatography (UHPLC):

UHPLC systems provide faster separations and higher resolution compared to traditional HPLC, reducing analysis time and solvent consumption.

- Imaging Mass Spectrometry (IMS):

IMS allows for the spatial distribution analysis of mycotoxins on food surfaces. It is valuable for understanding how mycotoxins are distributed within food matrices.

- Biosensors and Immunosensors:

Biosensors and immunosensors use antibodies or aptamers to detect mycotoxins selectively. They offer rapid and on-site testing capabilities, making them suitable for field applications.

- Nanotechnology-Based Methods:

Nanomaterials can enhance the sensitivity and selectivity of mycotoxin detection methods. Nanosensors and nanoparticles are used in various techniques, including electrochemical sensors and surface-enhanced Raman

spectroscopy (SERS).

- Microfluidic Devices:

Microfluidic platforms enable miniaturized and high-throughput mycotoxin analysis. They are particularly useful for point-of-care testing and remote monitoring.

- Nuclear Magnetic Resonance (NMR) Spectroscopy:

NMR spectroscopy can be employed for quantitative and qualitative mycotoxin analysis, It is non-destructive and can provide valuable structural information.

- Machine Learning and Data Analytics:

Advanced data analysis techniques, including machine learning algorithms, can help in the interpretation of complex analytical data. They can improve the accuracy of mycotoxin quantification and pattern recognition.

- Spectroscopic Techniques:

Techniques like Fourier-transform infrared spectroscopy (FTIR) and near-infrared spectroscopy (NIRS) are explored for their potential in rapid mycotoxin analysis.

These advanced and emerging analytical methods offer improved sensitivity, specificity, and efficiency in mycotoxin detection, helping to ensure food safety and regulatory compliance in the food industry. Researchers and food safety professionals continue to explore and develop these techniques to address the

challenges associated with mycotoxin contamination in food products.

Controlling methods of Mycotoxins:

Controlling mycotoxins in food and feed is crucial to ensure food safety and protect human and animal health. Mycotoxins are produced by molds and can contaminate various agricultural commodities both in the field and during storage. Here are some key control measures and strategies to mitigate mycotoxin contamination:

- Good Agricultural Practices (GAPs):

Properly manage and maintain crops in the field to prevent fungal infection and mycotoxin production. Implement crop rotation to reduce the risk of mycotoxin buildup in soil. Use disease-resistant crop varieties when available.

- Pre-Harvest Monitoring:

Regularly monitor crops for signs of mold growth and mycotoxin contamination. Harvest crops at the appropriate maturity to minimize the risk of mycotoxin development.

- Post-Harvest Handling:

Dry harvested crops promptly to reduce moisture levels to safe levels. Use appropriate storage conditions, such as temperature and humidity control, to prevent mold growth and mycotoxin production. Store grains and other commodities in clean, well-ventilated, and pest-free facilities. Implement

proper cleaning and maintenance of storage facilities to prevent mold contamination.

- **Sorting and Cleaning:**

Use equipment such as air screen cleaners, gravity separators, and color sorters to remove contaminated grains or seeds from batches. Visually inspect and sort grains to remove moldy or damaged kernels.

- **Mycotoxin Testing:**

Regularly test agricultural commodities for mycotoxin contamination using reliable analytical methods, such as HPLC, LC-MS/MS, or ELISA. Implement a sampling plan to ensure representative testing.

- **Processing and Milling:**

Properly process and mill grains to remove mycotoxin-contaminated outer layers. Some mycotoxins can be reduced through thermal processes like cooking and baking.

- **Biocontrol Agents:**

Explore the use of biocontrol agents, such as competitive non-toxigenic strains of fungi, to outcompete mycotoxin-producing molds.

- **Chemical Control:**

Use approved mycotoxin binders or sequestering agents in animal feed to

reduce mycotoxin absorption in the digestive tract of animals. Consider the application of safe fungicides or preservatives during storage, ensuring compliance with regulations.

- **Education and Training:**

Educate farmers, food handlers, and consumers about mycotoxin risks and safe handling practices. Train personnel involved in the production and processing of food and feed on mycotoxin prevention and control.

- **Regulations and Standards:**

Adhere to mycotoxin regulations and standards set by national and international authorities. Establish and enforce maximum allowable limits for mycotoxins in food and feed products.

- **Integrated Pest Management (IPM):**

Implement IPM strategies to control pests that may damage crops and increase the risk of mycotoxin contamination.

- **Monitoring and Surveillance:**

Establish monitoring and surveillance systems to track mycotoxin contamination trends and respond promptly to outbreaks.

- **Research and Innovation:**

Support ongoing research to develop new and innovative methods for

mycotoxin control and mitigation. Effective mycotoxin control requires a multi-faceted approach involving collaboration across the entire food supply chain, from agricultural production to food processing and distribution. By implementing these control measures, the food industry can reduce the risk of mycotoxin contamination and ensure the safety of food and feed products.

Conclusion:

The detection and control of mycotoxins in food and agricultural products. Mycotoxins are toxic compounds produced by molds that can contaminate crops and pose a risk to human and animal health. Advanced and emerging analytical methods, such as NMR spectroscopy, machine learning, and spectroscopic techniques, are being explored for mycotoxin analysis. These methods offer improved sensitivity, specificity, and efficiency in detecting mycotoxins, ensuring food safety and regulatory compliance. Controlling mycotoxins requires implementing good agricultural practices, pre-harvest monitoring, and post-harvest strategies to prevent fungal infection and mycotoxin production. Overall, the article emphasizes the importance of addressing mycotoxin contamination to protect public health and ensure food safety.

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CHAPTER-24

ARTIFICIAL INTELLIGENCE ROLE IN CHARACTERIZING BACTERIAL AND FUNGAL COLONY MORPHOLOGY

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Artificial intelligence (AI) is a promising tool that can improve the field of microbiology in many ways by providing new ways to explore and understand the diversity and complexity of microorganisms with higher accuracy, speed, and efficiency than ever before. It will be helpful in improving microbiological techniques and their interaction with the environment, discovering new insights and knowledge about microorganisms and their roles in health, disease, and ecology. One of the most common applications of AI in microbiology is image analysis. Microscopes enhanced with AI have the potential to aid microbiologists' examination of organisms and use the collected data for identification and differentiation, improving diagnosis or root cause analysis.

KEYWORDS: Artificial Intelligence(AI), Colony morphology, Detection, Analysis of morphology.

1. INTRODUCTION:

AI's applications extend to pathogen detection in the healthcare domain, where machine learning algorithms, neural networks, and deep learning techniques are commonly employed. These algorithms are adept at processing extensive datasets and discerning patterns that enable the detection of pathogenic organisms. Additionally, AI plays a vital role in advancing drug and therapy development for infectious diseases through the analysis of data from clinical trials and drug development research.

Artificial intelligence (AI) holds significant promise as a tool for enhancing the field of microbiology, offering unprecedented levels of accuracy, speed, and efficiency in the exploration and comprehension of microorganisms' diversity and intricacies. This technology is poised to advance microbiological techniques, shed new light on microorganisms' interactions with their environments, and facilitate the discovery of fresh insights regarding their roles in health, disease, and ecological systems.

AI's widespread application in microbiology often centers on image analysis, where AI-augmented microscopes hold the potential to assist microbiologists in scrutinizing organisms. This collected data can be leveraged for enhanced identification, differentiation, and ultimately, improved diagnostic and root cause analysis capabilities. Notably, in the past year, a multinational team made significant strides by introducing a novel AI tool capable of evaluating the

image quality of environmental microorganisms, encompassing denoising, segmentation, feature extraction, classification, and object detection. Another valuable application of AI in microbiology involves the creation of predictive models to study how microbial communities interact with their environment and respond to different environmental factors. AI is ushering in a transformative era for microbiology, equipping researchers with innovative tools and methodologies to investigate microorganisms across various levels of complexity and detail. This advancement promises to elevate the speed, precision, dependability, and replicability of research outcomes while also opening doors to fresh insights and opportunities within microbiological data through enhanced analysis, interpretation, and data integration. Ultimately, AI stands poised to enhance the microbiology field by deepening our comprehension of microbial life and its profound implications for both human health and the environment. As a microbiologist, I firmly believe that AI will serve as an invaluable partner for those seeking to propel their research and make meaningful contributions to society.

2.COLONY MORPHOLOGY

In microbiology, colonial morphology involves the visual evaluation of bacterial or fungal colonies grown on agar plates, serving as the initial stage in identifying unfamiliar microorganisms. By meticulously analyzing factors such as size, shape, color, transparency, and texture of these colonies, valuable hints

about the organism's identity emerge, enabling microbiologists to choose relevant tests.

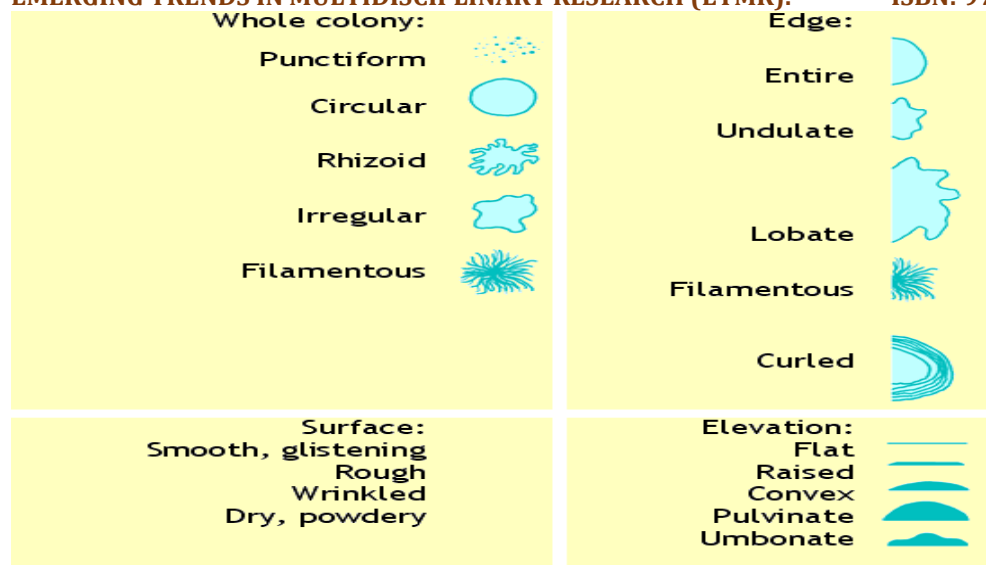


Fig 1: Morphology of bacteria and fungi

2.1 BACTERIA:

When it comes to identifying bacteria and fungi, the growth patterns of these microorganisms in or on various media are of paramount significance. This exercise focuses on discerning a bacterium's cultural traits on an agar plate, known as colony morphology. Diverse bacterial species can yield colonies with markedly different characteristics.

- ❑ Colonial characteristics to be observed include the overall shape (ranging from round to irregular to filamentous and rhizoid),
- ❑ colony size (which can range from large to punctiform, less than 1mm in size),
- ❑ edge or margin shape (best viewed under a dissecting microscope),
- ❑ and chromogenesis, which pertains to the color and pigmentation of the colonies, which

may vary from white and buff to red or purple, with certain pigments being water-soluble while others are not.

- ⑦ Additional colony characteristics include opacity, which can be categorized as transparent, opaque, translucent, or iridescent based on how the colony appears when viewed.
- ⑦ Elevation refers to how much the colony protrudes above the agar (determined by turning the plate on its side), while the surface texture may be described as smooth, glistening, rough, dull, or rugose (wrinkled). Furthermore, the consistency or texture can range from buttery (butyrous) to sticky and mucus-like (mucoid), or even brittle and friable (dry, breaking apart).

2.2 FUNGI:

Colony morphology is a method that scientists use to describe the characteristics of an individual colony of fungi growing on agar in a Petri dish. Fungi, being eukaryotic organisms, exhibit a dual nature with unicellular yeast-like and multicellular hyphae or mold forms, with some capable of switching between the two. When observing fungal colonies, it's essential to take note of characteristics like colony surface and reverse color, surface texture (ranging from powdery to velvety), topographical features (elevation, folding, margin), and growth rate.

Different types of fungi will produce different-looking colonies, some colonies may be

coloured, some colonies are circular in shape, and others are irregular. A specific terminology is used to describe common colony types. These are:

- Form - circular, filamentous, etc.
- Size – The diameter of the colony. Tiny colonies are referred to as punctiform.
- Elevation - This describes the side view of a colony. Turn the Petri dish on end.
- Margin/border – The edge of a colony.
- Surface - smooth, glistening, rough, wrinkled, or dull.
- Opacity - transparent (clear), opaque, translucent (like looking through frosted glass), etc.
- Colour - white, buff, red, purple, etc.

Yeast colonies are very similar to bacterial colonies. Yeasts are typically cultured aerobically on Sabouraud Dextrose Agar (SDA), forming distinctive pasty colonies that emit a characteristic yeasty odor. These yeast colonies exhibit varying morphology, but in general, they have a smooth texture and tend to be larger than bacterial colonies grown on SDA medium.

Moulds often have fuzzy edges. They usually turn into a different colour, from the centre outwards. The genus *Mucor* is known for its rapid growth and can display a range of colors, typically starting as white and transitioning to brown or grey as the colonies age, a transformation attributed to spore development.

3. AI can aid in the detection and analysis of colony morphology in bacteria and fungi in several ways:

Automated Image Recognition: AI algorithms, particularly those based on computer vision and deep learning, can be trained to recognize and classify colony morphology based on images captured from agar plates. These algorithms can distinguish various characteristics like shape, size, color, opacity, texture, and edge morphology.

1. **Speed and Efficiency:** AI-powered systems can process a large number of agar plates quickly and consistently, reducing the time and effort required for manual observation and analysis. This increased efficiency is especially beneficial in high-throughput laboratory settings.
2. **Accuracy and Consistency:** AI systems can provide more accurate and consistent results in identifying and categorizing colony morphology, reducing the potential for human error or subjectivity in interpretation.
3. **Pattern Recognition:** AI can identify subtle patterns and variations in colony morphology that may not be easily discernible by the human eye. This can lead to the discovery of important features for microbial identification.
4. **Data Management:** AI systems can integrate with databases and laboratory information management systems (LIMS) to organize and store data related to colony morphology. This makes it easier to track and retrieve information for research and reference.

5. **Quality Control:** AI can serve as a tool for quality control, ensuring that the culture conditions and agar plates are consistent and suitable for accurate colony morphology assessment.
6. **Machine Learning for Pattern Analysis:** By training machine learning models on a diverse dataset of colony morphologies, AI systems can learn to recognize and classify a wide range of microbial characteristics, aiding in the identification of unknown microorganisms.
7. **Advanced Imaging Techniques:** AI can be used in conjunction with advanced imaging techniques, such as fluorescence microscopy, to enhance the detection and analysis of colony morphology with higher specificity and resolution.
8. **Real-Time Monitoring:** AI systems can be employed to continuously monitor microbial growth and colony development, allowing for early detection of unusual or potentially harmful changes in colony morphology.

Overall, AI has the potential to significantly improve the accuracy, speed, and comprehensiveness of colony morphology detection in bacteria and fungi, contributing to more effective microbiological research, diagnostics, and quality control in various industries, including healthcare and biotechnology.

CONCLUSION:

While significant progress has been made in the past decade in leveraging deep learning

for microbiology, particularly in the realm of microorganism imaging and detection, numerous challenges persist. In summary, AI offers the capability to automate colony morphology recognition from agar plate images, ensuring rapid, precise, and consistent analysis with the potential to identify subtle patterns, enhance data management, aid in quality control, and support real-time monitoring, ultimately advancing microbiological research, diagnostics, and quality assurance across various sectors, including healthcare.

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CHAPTER-25

Study on Designing a Star Topology Based on Differential Equation

with Application

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ABSTRACT

Reducing the network latency is the first important research direction for topology design. Topological Design is concerned with the functionality of an object or device derived from its shape. All the applications of topological design are done effectively because of its flexibility. Moreover, it is geometrically in nature thus the faults or corrections are made in these applications easily. Furthermore, the faults in conventional topology are little bit difficult to recover the normal process but in mathematically it is easy to rebuild the function. Hence in this paper a star node-based topology is created based on the differential equations. The stability of the star topology is also discussed

and application on data transmission is also established.

Keywords: Differential Equation, Eigenvectors, Eigen values, Star Topology.

1. INTRODUCTION

The differential function is a subfield of calculus that concerned with the education of quantities and rate change also it is one of the twofold traditional partitions of calculus. In addition, the derivative of a function is the primary study in differential calculus. The procedure for identifying a derivative is termed as differentiation. Furthermore, the differentiation has applications which are evaluated by measureable disciplines. On the other hand, derivatives are often utilized to determine the minima and maxima of a process function, equations relating derivatives are represented as differential equations. Spinoffs and their simplifications appear in several areas of mathematics, such as functional analysis, complex analysis, abstract algebra, differential geometry and measure theory .

Further, the network nodes are formed on the basis of differential topology and result with better outcome . Topology is a geometric analysis and mathematically it is flexible in nature, topology is concerned with the geometric objects which are properties of conserved under incessant deformations, such as twisting , stretching bending and crumpling. A topological gap is a set endowed structure, termed as topology that allows

all kinds of continuity program in all applications. Construction of mathematical topology for network channel brings more advantages because of their flexibility.

Network virtualization is a network scheme that enables to design and implement an innovative network service process with increased agility, lower cost and faster time-to-value. Some matrix decomposition-based procedures have proved their effectiveness to identifying the existence of wide anomalies in network layer. However, in some case the detection of multiple anomalies is difficult so Jing chen et al (2019) proposed matrix decomposition with differential based false localization and detection scheme for NFV networks. Initially the developed algorithm is used to investigate network functions subsequent it could find the anomalies which are in the network layer.

In recent decade Laizhong Cui et al (2018) proposed localization mechanism based on enhanced (Differential Evaluation) DE and DV-Hop is termed as DECHDV-Hop also the differential equations are used for global minimization Here the considerable experiments evaluated the efficiency of DECHDV-Hop thus the results defined that proposed strategy achieved higher localization accuracy measure.

The topology framework model is utilized in many applications, furthermore, the rapid topology optimization mechanism for rotating machines which are based on deep learning model. From this reason Shuhei Doi et al (2019) developed two approaches such as convolution neural scheme with Genetic heuristic mechanism, here the neural

network is utilized to screen the performance of torque and optimization is to evaluate motor efficiency.

The key contribution of this research is summarized below:

- Initially, develop a differential derivation and design a star node structure.
- After that, The stability of the proposed star topology formation is estimated.
- Consequently, the data transmission is established as an outcome.

2. METHOD AND DISCUSSION

For uncomplicated differential equation, it is probable to discover closed type solutions. The general function g of the simplest equation is expressed in eqn. (1) as,

$$x'(t) = g(t) \quad (2)$$

$$x(t) = \int g(m)dm + b \quad (3)$$

Where the random integration constant is termed as b and $\int g(m)dm$ is refers any fixed antiderivative of g . Then the indicating the value of $x(t)$ at some known point is

$$x(t_0) = x_0 \quad (4)$$

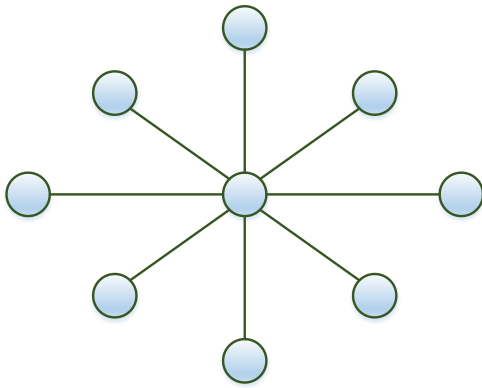


Fig.1 Systematic diagram of differential star topology

The differential equation is also termed as the linear differential equation, which is executed by a linear polynomial in the indefinite function with its derivatives. This can be expressed in the form of eqn. (5) as,

$$c_0(x)y + c_1(x)y' + c_2(x)y'' + \dots + c_n(x)y^{(m)} + d(x) = 0 \quad (5)$$

Where the random differential functions are denoted as $c_0(x), \dots, c_n(x)$ and $d(x)$, the consecutive derivatives of the indefinite function y of the changeable x is termed as $y', \dots, y^{(m)}$. The central node of the star is defined by the group of nodes enclosing the equal. Based on the Taylor series expression the eqn. (6) obtained as

$$V_i = V_0 + e_i \frac{\partial V_0}{\partial x} + f_i \frac{\partial V_0}{\partial y} + \frac{1}{2} \left(e_i^2 \frac{\partial^2 V_0}{\partial x^2} + f_i^2 \frac{\partial^2 V_0}{\partial y^2} + 2e_i f_i \frac{\partial^2 V_0}{\partial x^2} \right) \quad (6)$$

Where the function value at the star node central is termed as V_0 and the function value at nodes rest is termed as V_i , the central node coordinates is denoted as (x_0, y_0) and the i star nodes coordinates is denoted as (x_i, y_i) . Consider the function V_i as v_i then the

equation can be rewritten as

$$X(v) = \sum_{i=1}^n \left[\left(v_0 - v_i + e_i \frac{\partial v_0}{\partial x} + f_i \frac{\partial v_0}{\partial y} + \frac{e_i^2}{2} \frac{\partial^2 v_0}{\partial x^2} + \frac{f_i^2}{2} \frac{\partial^2 v_0}{\partial y^2} + e_i f_i \frac{\partial^2 v_0}{\partial x \partial y} \right) z(e_i, f_i) \right]^2 \quad (7)$$

Where the weight function is denoted as $z(e_i, f_i)$ and the twice differentiable in Ω function is denoted as $v(x, y)$. The star node is termed as a set of recognized nodes associated to one which is termed as central node. The systematic diagram of the differential star topology is shown in Fig.1. Therefore the every node in the area is generally allocated as connected star. Moreover from the differential eqn. (5) to eqn. (6) the function values in the star nodes are required to estimate. Consequently the $X(v)$

norm from eqn. (7) is diminished with respect to $\frac{\partial V_0}{\partial x}, \frac{\partial v_0}{\partial y}, \frac{\partial^2 v_0}{\partial x^2}, \frac{\partial^2 v_0}{\partial y^2}, \frac{\partial^2 v_0}{\partial x \partial y}$ and these derivatives are considered as $\delta, \gamma, \beta, \eta, \psi$ respectively, then

$$\frac{\partial X(v)}{\partial \delta} = 2 \sum_{i=1}^n (\phi z(e_i, f_i)) e_i z(e_i, f_i) = 0 \quad (8)$$

$$\frac{\partial X(v)}{\partial \gamma} = 2 \sum_{i=1}^n (\phi z(e_i, f_i)) f_i z(e_i, f_i) = 0 \quad (9)$$

$$\frac{\partial X(v)}{\partial \beta} = 2 \sum_{i=1}^n (\phi z(e_i, f_i)) \frac{e_i^2 z(e_i, f_i)}{2} = 0 \quad (10)$$

$$\frac{\partial X(v)}{\partial \eta} = 2 \sum_{i=1}^n (\phi z(e_i, f_i)) \frac{f_i^2 z(e_i, f_i)}{2} = 0 \quad (11)$$

$$\frac{\partial X(v)}{\partial \psi} = 2 \sum_{i=1}^n (\phi z(e_i, f_i)) e_i f_i z(e_i, f_i) = 0 \quad (12)$$

Where $\phi = v_0 - v_i + e_i \frac{\partial v_0}{\partial x} + f_i \frac{\partial v_0}{\partial y} + \frac{e_i^2}{2} \frac{\partial^2 v_0}{\partial x^2} + \frac{f_i^2}{2} \frac{\partial^2 v_0}{\partial y^2} + e_i f_i \frac{\partial^2 v_0}{\partial x \partial y}$. These expressions are solved given the open equations of the indefinites in terms of the function value v of each star nodes, the $e_i f_i$ of the values and z is the weight function. Therefore the system equation is taken by the abovementioned equations, which can be expressed by

$$x' = Rx \quad (13)$$

Where R is taken for the eigenanalysis of the matrix. Furthermore in the computational case the $n \times n$ of R matrix is considered and the eigenvectors are independent n , the eigenvalues are $\alpha_1, \dots, \alpha_n$ different but it can real or complex. The eigenpairs are expressed by the following expansions in terms in eqn. (14) as.

$$(\alpha_1, x_1), (\alpha_2, x_2), \dots, (\alpha_n, x_n) \quad (14)$$

From $n \times n$ matrix, x_1, \dots, x_n are self-governing, the eigenvalues $\alpha_1, \alpha_2, \dots, \alpha_n$ are real and the conjugate pairs of complex terms are $\alpha_1 = \bar{\alpha}_2 = p + iq$ with $q > 0$. Therefore the general eqn. (13) can articulate by this eqn. (15)

$$x(t) = c_1 x^{(p)} e^{\alpha t} + c_2 x^{(q)} e^{\alpha t} + \dots + c_N x^{(n)} e^{\alpha t} \quad (15)$$

Where the independent eigenvectors are represented as $x^{(p)}$ and $x^{(q)}$. Consequently, the ratio $\frac{y_2}{y_1}$ is autonomous of t , yet it based on the elements of $x^{(p)}$ and $x^{(q)}$, the random constants are c_1 and c_2 . Therefore the entire trajectory places on a straight line via the origin. Furthermore the vector-matrix type of common solution is termed as

$$x(t) = \text{aug}(x_1, \dots, x_n) \text{diag}(e^{\alpha_1 t}, \dots, e^{\alpha_n t}) \begin{pmatrix} c_1 \\ \vdots \\ c_n \end{pmatrix} \quad (16)$$

The real values are provided by the eqn. (154), hence the eigenvalues are real. Moreover the eigenvalues of complex pairs are in terms as $\alpha_1, \bar{\alpha}_1, \dots, \alpha_a, \bar{\alpha}_a$, then the real eigen values are listed as $2a+b=n$, which is defined by the eqn. (17) as,

$$A = \text{aug}(\text{Re}(x_1), \text{Im}(x_1), \dots, \text{Re}(x_{2a-1}), \text{Im}(x_{2a-1}), x_{2a-1}, \dots, x_n) \quad (17)$$

$$S_\alpha(t) = e^{pt} \begin{pmatrix} \cos qt & \sin qt \\ -\sin qt & \cos qt \end{pmatrix} \quad (18)$$

Where $\alpha = p + iq$ with $q > 0$. Afterwards the vector matrix of real form common solution is termed as in the eqn. (19) and eqn. (20) as,

$$x(t) = A \text{diag}(S_{\alpha_1}(t), \dots, S_{\alpha_{p1}}(t), e^{\alpha_1 t}, \dots, e^{\alpha_{b1} t}) \begin{pmatrix} c_1 \\ \vdots \\ c_n \end{pmatrix} \quad (19)$$

$$e^{Bt} = A \text{diag}(S_{\alpha_1}(t), \dots, S_{\alpha_{p1}}(t), e^{\alpha_1 t}, \dots, e^{\alpha_{b1} t}) A^{-1} \quad (20)$$

3. STABILITY OF THE DIFFERENTIAL STAR TOPOLOGY

A node can be improper or proper based upon the amount of tangent lines that the trajectories only two or infinitely. The stability of the differential equation in the star topology is in case:

The critical point (p, q) is termed as stable if for each $\lambda > 0$ there exists $\beta > 0$ such that if

$|x_0 - p| < \beta$ and $|y_0 - q| < \beta$, then the solution of the differential equation information

$$|x - p| < \lambda \text{ and } |y - q| < \lambda.$$

In common the nodal falls are stable in critical points; if the points are not stable then it is termed as unstable. Moreover, if the critical point is stable bounded by uncomplicated closed trajectories denoting intermittent solutions then such a critical point is referred as center.

A critical point is termed as asymptotically stable, consequently if the point is stable for some $\beta > 0$ if $|x_0 - p| < \beta$ and $|y_0 - q| < \beta$ then the condition is $\lim_{t \rightarrow \infty} x(t) = p$ and $\lim_{t \rightarrow \infty} y(t) = q$. The star node is a point of equilibrium \hat{P}_0 at which all trajectory has a exact restrictive direction and for some known direction D at \hat{P}_0 , there is a D trajectory as its restrictive direction. Moreover in the case of star node is stable if the values are positive and asymptotically stable if the values are negative.

4. APPLICATION

The star network topology needs the utilized of a top level of central node to which each other nodes are linked. Moreover, the top level of node may be a computation or an easy switch or a common connection point immediately. The information received by the node of top level either be broadcast to all subordinate nodes or if the device of top level is high enough fidelity, transmit only to the targeted subordinate node.

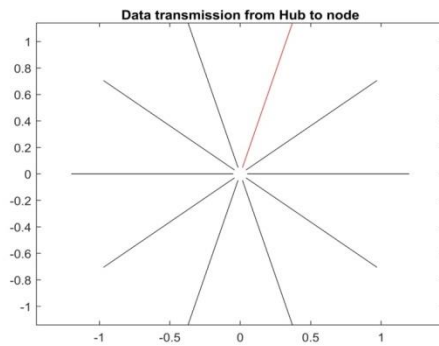


Fig.3 the data transmission from the Hub to node by the proposed differential star topology

The data transmission from the Hub to node by the proposed differential star topology is shown in Fig.3. Moreover the configurations are minimized by the inter node delays of messaging. The star network topology is a better effective, which is takes from the cabling failure localization in this configuration. The connection failure may occur in the top level node and secondary node or failure in the secondary node will not reflect the all network. Furthermore the star network topologies are generally utilized in local area networks spanning a huge region than the other topologies.

5. CONCLUSION

The main aim of this research is to develop a star topology using differential equation. Based on this the proposed differential star topology is developed by the matrix of eigenvalues. The data transmission was shown in the outcome of the research.

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CHAPTER-26

EMERGING TRENDS IN CRUDE OIL TRADE: A STUDY ON DE-DOLLARISATION

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ABSTRACT

The paper aims to understand the total value of oil imports made by India in U.S. dollars in the last two decades thereby signifying the value of petro dollars in the Indian economy. It also attempts to point out the excessive dependency on crude oil imports and the ever increasing demand for it in India. The total amount of foreign exchange reserves held by India in terms of U.S. dollars also explains the complete dominance of USD as a reserve currency and the most sought after medium of exchange in the international market. The paper attempts to explore the possibility of moving away from

oil import payment in U.S. dollars and shifting to Indian Rupees. In this regard, it is significant to study the feasibility of de-dollarisation in the Indian context with respect to petro dollar and forex reserves. The study aims to analyse the reasons which have led to the extreme dependence on USD and offers suggestions to reduce this dependency by exploring possibilities of finding alternate methods like de-dollarisation.

Keywords: De-dollarisation, petro dollar, foreign exchange reserves

Introduction

De-dollarisation refers to reducing the influence of the U.S. dollar directly on the individual economies of the world. Since the end of the Second World War, the U.S. dollar has had the exclusive privilege of being the world's top reserve currency and is held by the central banks across the world as a storage of value. The USD continues to be the most sought-after medium of exchange in international trade and is favoured by most nations to settle financial accounts in international business. Hence most of the countries of the world are over dependent on the USD at the cost of being detrimental to national economic control and policies.

U.S. dollar is also the most widely held foreign reserve currency across nations of the world. A recent data from the International Monetary Fund related to the first quarter of 2023 says that while the USD accounted for 59% of allocated currency reserves of the world, the euro was at just under 20% and the Japanese yen was at

around 5%. This clearly shows the supremacy of the USD compared to all the other international currencies. However, it must be noted that in 2001, the IMF report showed a 70 % dependence on USD as the chief foreign exchange reserve. Undoubtedly, the Greenback still remains the most preferred currency reserve of the world even though the past few decades have seen a reducing reliance of the USD. In view of these recent developments, the pertinent question arises whether the world is moving towards de-dollarisation thereby reducing the over dependence on the USD and if such a possibility is even feasible in the present Indian scenario.

In order to reduce the over bearing influence of the USD, economies of the world have to switch over to alternate reserve currencies which gives them the financial power to engage in local as well as international trade. In this regard, the most vital task is to find out which are the other international currencies which can take up the place of the USD. The traditional alternatives to the dollar include the euro, the yen, and the British pound sterling. However, as the IMF notes, these currencies haven't increased their share of reserve allocations in proportion with the dollar's decline.

Objectives and Methodology:

The main objectives of the study are:

1. To understand the total value of oil imports paid by India in U.S. dollars.

2. To analyse the total amount of foreign exchange reserves held by India in terms of U.S. dollars.
3. To explore the possibility of moving away from import payment in U.S. dollars and shifting to Indian Rupees.
4. To study the feasibility of de-dollarisation in the Indian context with respect to petrodollar and forex reserves.

De-dollarisation in the Indian scenario:

De-dollarization refers to shrinking the influence that the U.S. dollar has on the economies of other countries. Even as countries aim to reduce their dependency, the dollar is still by far the most widely held reserve currency and remains essential for conducting international business. Backlash against the dollar has intensified as the U.S. flexes its economic muscle in response to the war in Ukraine.

The US dollar has long been the dominant currency in global trade, accounting for nearly 60 per cent of all foreign exchange (Forex) reserves and more than 80 per cent of global foreign exchange trading. India accounts for around 2 % of world trade BRICS nations account for 26 % of world's GDP and 43% of world's population. Countries may seek to decrease their dependency on the dollar in several ways. Central banks can hold reserves in gold or other currencies rather than in dollars, while countries may also enter agreements to avoid using the dollar when settling international transactions.

Table 1: Import of Crude Oil and Liquefied Natural Gas (LNG) by India from 2000 - April 2023

Import of Crude Oil and Liquefied Natural Gas (LNG) by India

(from 2000-2001 to April 2023)

Year	Crude Oil			Petroleum Products			Liquefied Natural Gas (LNG)		Total		
	Quantity (In T MT)	Value Rs. in Cror e	Value US\$ in Milli on	Quantity (In T MT)	Value Rs. in Cror e	Value US\$ in Milli on	Quantity (In T MT)	Value	Quantity (In T MT)	Value Rs. in Cror e	Value US\$ in Milli on
2000-2001	7409	6593	144	9267	120	264	-	-	8336	7802	170
	7	2	03		93	2			4	5	45
2001											
2001-2002	7870	6039	126	7009	724	151	-	-	8571	6764	141
	6	7	35		9	1			5	6	46
2002											

2

200	8198	7619	157	7228	884	182	-	-	8921	8504	175
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2-	9	5	59		7	2			7	2	81
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200

3

200	9043	8352	182	8001	972	211	-	-	9843	9325	203
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3-	4	8	68		3	4			5	1	82
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200

4

200	9586	1170	259	8828	148	327	2500	169	1046	1318	292
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4-	1	03	90		87	8		6	89	90	68
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200

5

200	9940	1717	387	1344	279	630	-	336	1128	1996	450
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5-	9	02	76	1	70	2		6	50	72	78
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200

6

200	1115	2190	483	1766	411	906	-	565	1291	2601	574
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6-	02	29	89	0	60	8		0	62	89	57
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200

7

200	1216	2726	679	2246	609	151	-	719	1441	3336	831
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7-	72	99	88	2	99	26		7	34	98	14
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200

8

200	1327	3483	768	1858	611	135	8060	954	1513	4094	904
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8-	75	04	76	5	56	57		8	60	60	33
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200

9

200	1592	3752	795	1466	338	708	9148	106	1739	4090	866
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9-	59	77	53	5	00	8		95	24	77	41
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201

0

/20	1635	4552	100	1737	559	120	9931	143	1809	5112	112
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10-	95	76	080	9	98	68		62	74	75	148
-----	----	----	-----	---	----	----	--	----	----	----	-----

201

1

201	1717	6722	139	1584	680	141	13214	317	1875	7403	153
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1-	29	20	690	9	91	89	18	79	11	879
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201

2

201	1847	7846	144	1635	688	125	13136	419	2011	8535	156
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2-	95	52	293	4	52	90	02	49	04	883
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201

3

201	1892	8648	142	1669	758	124	12995	531	2059	9407	155
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3-	38	75	962	7	96	66	23	35	71	427
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201

4

201	1894	6874	112	2130	746	121	14092	573	2107	7620	124
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4-	35	16	744	1	44	38	84	36	60	882
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201

5

201	2028	4165	639	2945	653	995	16142	450	2323	4819	739
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5-	50	79	72	6	61	2	38	06	40	24
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201

6

201	2139	4701	701	3628	715	106	18631	408	2502	5417	808
6-	32	59	96	7	66	14		04	19	25	10
201											
7											
201	2204	5664	878	3546	883	136	19870	499	2558	6548	101
7-	33	50	03	1	74	37		41	94	24	440
201											
8											
201	2264	7831	111	3334	113	163	21050	698	2598	8968	128
8-	98	83	915	8	665	41		48	46	48	255
201											
9											
201	2269	7170	101	4378	125	176	-	-	2707	8427	119
9-	55	01	376	8	742	89			42	43	065
202											
0											
202	1964	4597	622	4324	109	147	-	-	2397	5692	770
0-	61	79	48	8	430	70			09	08	18
202											

1												
202	2119	8993	120	4053	182	245	-	-	2525	1082	144	
1-	80	12	445	8	971	33			18	283	978	
202												
2												
(P)												
202	2325	1260	157	4383	213	267	-	-	2763	1473	184	
2-	61	173	507	3	793	40			94	966	247	
202												
3												
(P)												
202	1983	8838	107	2995	120	147	-	-	2283	1003	122	
3-	7	7	83		07	3			1	94	56	
202												
4-												
upto												
Apri												
l												
202												

(P)

Abbr: TMT- Thousand Metric Tons

Source: Ministry of Petroleum and Natural Gas

The above Table 1 shows the total value of the imports of crude oil, petroleum products and LNG paid in USD from 2000-23 by India. While 14403 USD was the payment made towards crude oil imports in 2000-01, this value increased to 62248 USD in 2020-21, showing a whopping 332 percent jump in the crude oil imports. This also explains the stupendous increase of 137883 TMT of crude oil imported in the two decades from 2000 to 2020. The projected estimate of crude oil imports in 2020-21 is 196461 TMT as compared to the total crude import value in 2019-20 which is 226955 TMT as the COVID-19 pandemic slowed down businesses across the globe with India being badly affected too due to reduced demand for crude. The period 2012-2015 and 2017-2020 saw a steady crude oil import requirement with no sudden variations while 2022-23 showed the highest import of crude oil at 157507 USD being paid.

Table 2: Petroleum Imports and Exports from 2020-2022

Petroleum Imports	2020-21	2021-22
and Exports		
Petroleum imports	19.5	23.6

as percentage of

India's gross imports

(in value terms)

Petroleum exports as	7.3	10.6
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percentage of India's

gross exports (in

value terms)

Import dependency	84.4	85.5
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of crude oil

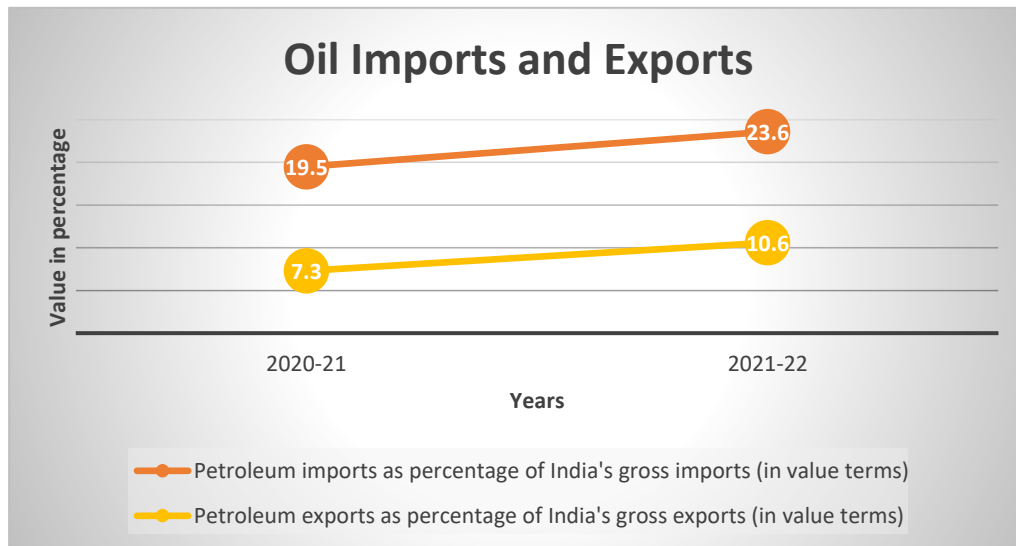
(on POL

consumption basis)

Source: India's Oil & Gas data, Govt of India

From Table 2, it can be noted that the export of petroleum products as a percentage of India's gross exports in value terms rose significantly by 3.3 % within a year from 2020-21 to 2021-22 thereby signalling the recovery path of the Indian economy, post COVID-19 setback. It can be observed that while 19.5 % in value terms was the total import of Petroleum products in 2020-21, only 7.3 % was exported in the international market. This shows that the substantial amount of crude oil refined within the country was consumed domestically.

Chart 1: Petroleum Imports and Exports from 2020-2022



Source: India's Oil & Gas data, Govt of India

Chart 1 shows that India still has an import dependency of crude oil at 85.5% in 2021-22 up from 84.4% in 2020-21 and this increase should be a cause of worry to the policy makers. These imports are being paid in dollars and hence any further diversification in imports will lead to India paying more petro dollars. This is a vicious cycle because as the economy grows, the demand for crude oil increases, payment through petrodollars increases, thereby putting further pressure on the Balance of Payments situation.

Table 3.1: Foreign Exchange Reserves from 2001-2022

End	Foreign	Gold	Reserve	SDRs	Total
of	Currency		Tranch		

Finan	Assets	Position									
cial	RupeesC	USD	Rup	USD	Rup	USD	SDR	Rup	USD	Rupe	USD
Year	rores	Milli	ees	Milli	ees	Milli	s	ees	Milli	es	Milli
		on	Cror	on	Cror	on	Milli	Cror	on	Cror	on
			es		es		on	es		es	
2021-	4094565	540	322	425	389	514	136	143	188	4598	607
22		724	213	51	88	3	57	052	91	819	309
2020-	3924168	536	247	338	361	492	104	108	148	4218	576
21		693	723	80	98	5	9	64	6	953	984
2019-	3333815	442	230	305	270	358	104	108	143	3602	477
20		213	527	78	13	3	5	00	3	155	807
2018-	2665564	385	159	230	206	298	104	100	145	2855	412
19		357	585	71	57	6	9	76	7	882	871
2017-	2597570	399	139	214	135	207	105	100	154	2760	424
18		442	740	84	20	9	9	20	0	850	545
2016-	2244940	346	128	198	150	232	106	938	144	2398	369
17		319	830	69	50	1	6	0	7	200	955
2015-	2219060	336	133	201	162	245	106	996	150	2378	360
16		104	430	15	90	6	6	0	2	740	176

2014-	1985460	317	119	190	808	129	288	249	398	2137	341
15		324	160	38	0	2	9	40	5	640	638
2013-	1660910	276	129	215	110	183	288	268	446	1828	304
14		359	620	67	20	4	8	30	4	380	223
2012-	1412630	259	139	256	125	230	288	235	432	1588	292
13		726	740	92	10	1	7	40	8	420	046
2011-	1330511	260	138	270	145	283	-	228	446	1506	294
12		069	250	23	11	6		60	9	130	398
2010-	1224883	274	102	229	131	294	-	204	456	1361	304
11		330	572	72	58	7		01	9	013	818
2009-	1149650	254	811	179	623	138	-	225	500	1259	279
10		685	88	86	1	0		96	6	665	057
2008-	1230066	241	487	957	500	981	-	6	1	1283	251
09		426	93	7	0					865	985
2007-	1196023	299	401	100	174	436	-	74	18	1237	309
08		230	24	39	4					965	723
2006-	836597	191	295	678	204	469	-	8	2	8682	199
07		924	73	4	4					22	179
2005-	647327	145	256	575	337	756	-	12	3	6763	151

06		108	74	5	4					87	622
2004-	593121	135	196	450	628	143	-	20	5	6191	141
05		571	86	0	9	8				16	514
2003-	466215	107	182	419	568	131	-	10	2	4901	112
04		448	16	8	8	1				29	959
2002-	341476	718	167	353	319	672	-	19	4	3614	761
03		90	85	4	0					70	00
2001-	249118	510	148	304		.	-	50	10	2640	541
02		49	68	7						36	06

Source: Reserve Bank of India

Table 3.1 shows that the total foreign exchange reserves in India in 2021-22 was \$607.3 billion USD crossing the 600 billion mark for the first time ever. This is a historic achievement for India undoubtedly. The table shows that the forex reserves were USD 294398 in 2011-22 while it has risen to a significant USD 607309 within a period of ten years in 2021-22.

It is interesting to note that out of the \$607.3 billion as the total forex reserves in 2021-22, \$540.7 billion is valued as foreign Currency Assets. A recent IMF Report states that over 60% of international reserves across all countries of the world and not just India is held in the form of dollar dominated assets. This means that the USD has an exorbitant

privilege as a currency reserve.

The dollar hegemony is a real threat as it can weaponize it and use it in its favour, the point in case being Russia in the ongoing Ukraine-Russia war. Such an excessive dependency on the USD makes all the economies of the world to watch and monitor USD very closely so that adverse changes in the USD rates should not have a negative impact on their economies.

Table 3.2 Movement in Foreign Exchange Reserves

Movement in Foreign Exchange Reserves					
(USD Million)					
Month End	FCA	Gold	SDR	RTP	Forex Reserves
September-22	472807	37605	17427	4826	532664
October-22	474131	37496	17557	4839	534022
November-22	490282	39877	17955	5056	55317
December-22	498022	41291	18248	5159	562721
January-23	506886	43837	18467	5227	574416

February-23	497863	41631	18127	5102	562723
March-23	509691	45200	18392	5165	578449
Mean	492811.71	40991	18024.71	5053.429	485758.9
Standard Deviation	14669.78	2922.21	402.43	160.10	190660.2
Kurtosis	-1.33	-1.16	-1.23	-1.15	6.79
Skewness	-0.49	0.14	-0.60	-0.78	-2.59

Abbr: i)FCA (Foreign Currency Assets): FCA are maintained as a multi-currency portfolio

comprising major currencies, such as, US dollar, Euro, Pound sterling, Japanese yen, etc.
and are valued in terms of US dollars.

ii)SDR refers to Special Drawing Rights

iii)RTP refers to the Reserve Tranche Position in the International Monetary Fund
(IMF).

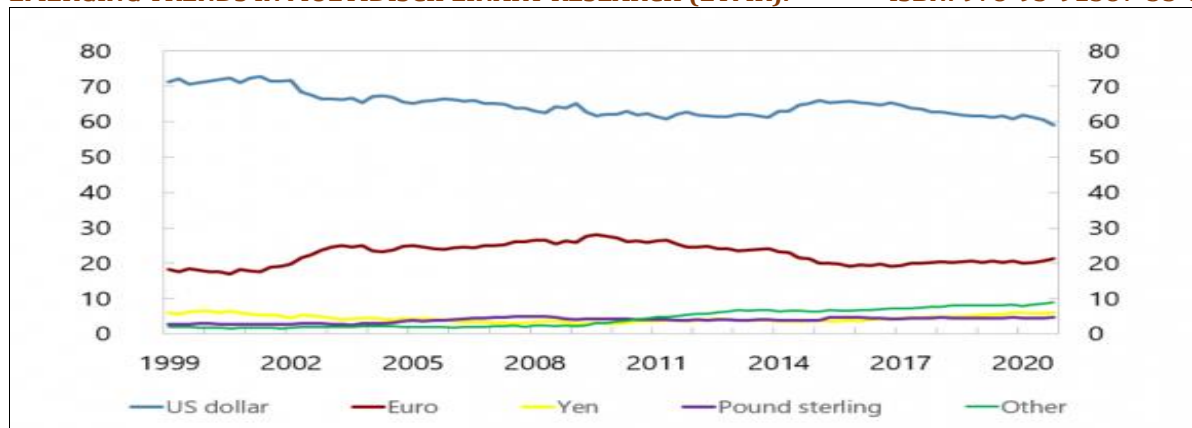
Source: Author's interpretation from the Reserve Bank of India

The Table 3.2 shows the Movement in Foreign Exchange Reserves in the seven months between September 2022 and March 2023.

Foreign Currency Assets stood the highest in March 2023 at USD 509691 and the least in September 2022 at USD 472807 with the mean at USD 492812. The only positive skewness is for gold reserves at 0.14. India's total foreign exchange reserves were at \$578.4 billion as of March 2023.

When compared to march 2022 figures, there has been a reduction of over \$28 billion out of which, \$19.7 billion is said to be due to valuation changes, as per the RBI. The US Fed hiked interest rates and this made the dollar appreciate. Subsequently, India's balance of payment witnessed lower net capital inflows. When the dollar index reached its peak last October as expectations of further Fed interest rate hikes reduced, this trend reversed. Thus, it can be concluded that India's Foreign Exchange reserves jumped this year primarily due to revaluation gains as the dollar weakened and capital flows rose. Also, oil imports from Russia are not settled in dollar, which has also added reserves.

Table 6: Demand for dollars by Central Banks



Source: International Monetary Fund

Table 6 shows that even though the USD continues to be the most sought-after international currency held in central banks, the demand for the same is seeing a downward trend. However, it is tough to spell out what a more sustained shift away from the dollar might mean for the global financial system. Currency. If the dollar were to lose its status at the top of the currency heap, the effects on the U.S. economy would likely be dramatic. Borrowing costs in the U.S. might move higher, making it more difficult to gain access to capital and more expensive to do business in the country.

Around three-quarters of the shift in reserves away from the U.S. dollar has gone toward non-traditional reserve currencies, including the Australian dollar, Canadian dollar, Swedish krona, and South Korean won.

Another alternative is for central banks to hold their reserves in gold, and countries around the world have been doing just that. According to the World Gold Council, central bank demand for gold in 2022 soared to 1,136 metric tons, up 152%

year over year and hitting the highest level since 1950.

Summary of Findings

Despite the decline in its share of overall central bank holdings, the U.S. dollar remains the preeminent reserve. In a situation where the dollar is no longer king, the U.S. stock market may also experience a drain in value. Perhaps more significantly, the U.S. has long depended on the dollar's role as a reserve currency to support running large deficits on government spending and international trade. If central banks around the world no longer felt the need to stuff their coffers with dollars, then the U.S. would likely lose this flexibility. At least for now, the U.S. dollar retains its central role in the global financial system, but the trend of de-dollarization appears to be gathering steam.

De-dollarization could help level the playing field for economies outside the U.S. However, countries also depend on having a stable currency to hold in reserve and conduct international business. At least in the near term, there appears to be no viable replacement for the dollar at the heart of the global financial system.

De-dollarization describes a process of moving away from the world's reliance on the U.S. dollar (USD) as the chief reserve currency. The dollar has remained the primary reserve currency and conduit for international business ever since the United States emerged as the world's top economic power following World War II. But

questions often emerge about whether the dollar can sustain its leadership. Although the greenback is unlikely to lose its relevance in the near term, it's worth looking at the potential trend of de-dollarization and consider what a decline in the dollar's dominance might mean for the global financial system.

De-dollarization could be viewed as a backlash against the hegemony of the U.S. currency. The U.S. has used the dominance of the dollar as a tool to promote and enforce its economic interests around the world, causing economic turmoil amongst other countries of the world.

Beyond shifting their reserves to gold or other currencies, countries are reducing their dollar dependency by sidestepping the U.S. currency in their international transactions. For instance, China has been paying for its massive commodities purchases from Russia using the renminbi rather than the dollar, and it also has signed deals to use its own currency in trade with Saudi Arabia and Brazil. Speculation has emerged that the BRICS countries might even create a currency that could rival the dollar for world dominance, although it appears that the group has no immediate plans for a common currency. Even so, the approach of de-dollarization could be growing as more countries question their dependence on the U.S. currency.

Suggestions

The following are the suggestions laid down in this study:

1. De-dollarization, which involves reducing the control that the dollar holds over the global economy, has found great support in countries like China and Brazil. Although the dollar continues to dominate as the world's top reserve currency, de-dollarisation is also a reality. Just like the sterling pound which lost its dominance eventually, the USD might also face the same plight. Hence over dependence on The USD has to reduce.
2. Discussion of de-dollarization has intensified because of the war in Ukraine. The U.S. in its efforts to curb Russian trade, has imposed several economic sanctions and has frozen Russia's currency reserves thereby showing the world the true power of the dollar. Hence, countries like India have to be wary of the extreme dependence on USD.
3. If India pays its oil imports using Indian rupee, then it would reduce its dependency on the petro dollars too. India recently signed a deal with the UAE to pay in Indian rupees for oil imports from UAE. This is a right move towards de-dollarisation.

Conclusion

De-dollarization involves moving away from the U.S. dollar as a reserve currency or seeking ways to sidestep the dollar when conducting international business. Examples include a central bank shifting its reserves to other currencies or countries conducting international trade in their own currency rather than relying on the dollar

as an intermediary.

Despite the backlash against it, the dollar remains the world's most widely held reserve currency. Thus, it is difficult to speculate about the potential consequences of a more substantially de-dollarized world economy. For one thing, the U.S. would lose the advantages that have come with having the dollar as the world's reserve currency.

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CHAPTER-27

EMERGING TRENDS IN THE LUXURY BRAND OF ROYAL ENFIELD

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ABSTRACT

The purpose of this paper is to study the development of a worldwide luxury brand business and discusses previous conceptualisations of luxury brands. In this endeavour, the study explains the unique context of luxury consumption, to highlight several changes in extant works, and to advocate for the improvement of consumer-centric example of luxury branding. Design/methodology/approach –The study reviews the rise of a global luxury brand industry, discusses macro-environmental trends that have influenced luxury brand consumption, critically evaluates the existing literature on luxury brands, and offers directions for future research. Results –The study highlights that luxury brands have developed as a special form of branding that carries the unique sociocultural and specific meanings to their adherents. Moreover, it was created that

these senses have been shaped by a number of vital cultural, social, and external trends, which call researchers and experts to consider the consumer-centric paradigm of luxury branding. Originality/value –The study calls for a shift in the attention from the features of luxury brands and towards phenomenological practices and socio-cultural impacts, in the searches to understand what brand luxury carries in the broader context of post-modern consumer culture. The study offers two distinct areas for upcoming research to address these developments. the emergence of a global luxury brand industry and discusses earlier conceptualisations of luxury brands. In this endeavour, the study shows the unique context of luxury consumption, to highlight several expansions in extant literature, and to advocate for the progress of the consumer-centric standard of luxury branding.

Keywords: Theory growth, Brands, Cultural trends, Luxury, motor bikes, socio culture.

INTRODUCTION

Luxury branding is a commercial strategy that motivations on creating a supposed difference between a luxury product and its participants. This perceived difference can take many procedures, with superior quality, unique design, modified service, or individuality.

It is all about producing a sense of individuality and luxury for a product or service. It can make a merchandise or service look more expensive and good-looking to consumers, which can help initiative sales. Luxury branding also helps businesses stand out from

their entrants and create a more unforgettable consumer experience. Luxury brands often charge additional for their goods than those of lower-quality or less-exclusive products. Because luxury customers are mostly wealthier than normal consumers, luxury brands often enjoy developed profit limits than other categories of brands. Luxury branding is a promotion plan working by companies to generate a unique image or individuality for their high-end products and services. There are several keys to a successful luxury branding policy, including rising a unique positioning statement, generating a motivated brand image, and using high-quality resources and skill in the product design.

Moreover, it is significant to aim the right consumers and interconnect the brand values in a clear and reliable manner across all marketing channels.

The most significant element of forming luxury brands is the product's ability to create and communicate symbolic value for its customers. Brands generally offer two types of value – functional value and symbolic value. Functional value comes from the structures and the possible uses of the brand.

A luxury item is not essential to live, but it is considered highly necessary within a culture or society. Demand for luxury goods rises when a person's capital or revenue increases. Typically, the more the percentage growth in income, the more the percentage growth in luxury item purchases. A luxury item is not essential to live, but it is deemed highly required within a culture or society. Demand for luxury goods rises when a person's

wealth or income increases. Typically, the greater the ratio increase in income, the more the ratio increase in luxury item buying.

Digital Marketing Presence

Royal Enfield, a motorcycle producer, has executed digital events to engage customers during the COVID-19 lockdown. Offline initiations for client contact and skills have long been a staple of the two-wheeler industry. Brands are forced to go to the computer-generated realm because physical actions are not viable.

According to the firm, the vast range of initiatives has caused in putting a diverse yet complete Royal Enfield community, extending from enthusiastic riders and hopefuls to custom builders and motorcycling groups, under one banner and attachment over their common desire—Pure Motorcycling.

Over the last few months, Royal Enfield has run numerous digital campaigns. The Trip Story campaign is one of several intentional social meeting activities to keep riders concerned during these unique times. The ad is based on the observation that digital engagement and content consumption are at an all-time high throughout the lockdown.

Advertising Strategy of Royal Enfield

Royal Enfield has continuously ranked a comprehensive marketing strategy. Royal Enfield has opted to attention more on the requirements of the consumer rather than production to boost the number of bikes sold. They launch what customers wanted to make their items more visible to a greater audience. Because its main customers are

middle-aged men who like digital knowledge, Royal Enfield focuses more on digital marketing, such as launching numerous online campaigns on social media sites such as Facebook, Twitter, and Instagram. It also takes part in many shows or deals with different TV series to expand product visibility.

SWOT (strengths, weaknesses, opportunities, and threats) study is a plan for finding and evaluating internal and external strengths and weaknesses, as well as opportunities and threats, that impact current and future actions and aid in the growth of strategic goals.

1. Strengths of Royal Enfield

Royal Enfield has recognized a strong brand uniqueness in the market and has gained customer trust. The high-quality values of Royal Enfield are one of the key motives for its well-known brand identity.

Royal Enfield has an in-house R&D centre that is responsible for advancing the company's product range while also ensuring the consumer's reliability.

In the last five years, Royal Enfield's global sales have improved by more than 50%.

Royal Enfield motorcycles are being distributed to more than 30 nations across the world, and the establishment has spent greatly in developing up business facilities in the United Kingdom in response to enlarged demand.

2. Weaknesses of Royal Enfield

For a few clients, the weight of the motorcycle may be a problem. The mileage of high-cc motorcycles is a problematic.

3. Opportunities of Royal Enfield

One of the fastest-growing manufacturing is two-wheelers. Bicycle export is limited, implying that there are unexplored overseas markets.

4. Threats of Royal Enfield

In the cruiser segment, Royal Enfield participates with several other motorcycle producers around the world. It also strives in the market with high-utility bikes. Market share is condensed as a result of enlarged competition.

As formerly stated, Royal Enfield motorcycles have nominal mileage, thus a rise in fuel prices will have an influence on sales. Better public transport will mark Royal Enfield.

Which are 3 major characteristics of a luxury brand?

There are several features that are often associated with luxury brands, including individuality, high quality, and exceptional customer service. Other common characteristics of luxury brands consist of a strong brand uniqueness and image, a best price point, and a focus on expertise and attention to detail.

Building an admired and sophisticated reputation: Luxury customers often associate luxury brands with status and complexity, and are drawn to brands that have a strong reputation in their industry. Companies can target luxury consumers by structure a strong, positive status through word-of-mouth marketing, industry accolades, and enterprises with other important brands or establishments.

Offering exclusive, limited-edition products and experiences: Luxury consumers often

worth exclusivity and rarity, and may be willing to pay a premium for products or skills that are not generally available. Companies can attract luxury consumers by current exclusive, limited-edition products or experiences, such as special collections, one-of-a-kind items, or access to different events or experiences.

What are the 7 pillars of luxury?

Marketing strategy in the luxury business is created around the dream value, the segmenting-targeting-positioning model and 7 pillars that most experts know: product, price, promotion, place, packaging, positioning and people.

REVIEW OF LITERATURE

1. **Jitong Li and Karen K Leonas (2019):** The luxury sector is a well-established global industry worth almost US\$200 billion a year; while successful, the luxury market is gently being re-framed to align with key and developing trends in the industry. The concept of sustainability is gaining increased courtesy by the industry and consumers. Many corporations with H&M, Levi's, and Nike have already combined sustainable development and supply chain partner that focus on sustainability into their corporate models.

2. **Glyn Atwal and Douglas Bryson (2014)** This book is a priceless repository of information that conveys clarity to key issues and trends for practitioners, academics and students of luxury brands. It sets out to decode the luxury markets in the primary

developing markets (BRICs) and offer a rich resume of the key factors that impact the efficiency of luxury brand policies.

3.Glyn Atwal and Douglas Bryson (2017) This book provides a study of the luxury business in two of the world's major and growing markets, and recognizes and deliberates the key issues and dynamics in changing their luxury sets. By discussing the basics that are most likely to control boardroom agendas, the pragmatic suggestions for both premeditated and marketing forecasting are made clear. Special importance is placed upon well-contemplated answers to luxury brand marketing tasks that executives are likely to face as they push their brands to adapt and thrive in these fluctuating markets.

4: Serena Rovai (2018): The connection between luxury and digitalisation, has been and still is difficult. Literature evidenced the challenging condition for luxury goods and online acquisition with respect to individuality and uniqueness. China has shown remarkable alignment towards the digitalise world and a stable rise in Internet use in every commercial sector. Chinese market has its own socio-cultural standards and its luxury and fashion gaining habits apparently in constant evolution. The situation in China has directed that luxury fashion brands and digitalisation have not fully exposed its development in relation to its "Chineseness" – or the specificity of the Chinese luxury and fashion marketplace.

5. Prashant Chaudhary (2021): By the turn of the 21st century, Siddhartha Lal gained

the opportunity to revive Royal Enfield (RE), the declining iconic motorcycle brand of Eicher Motors. The task was to turn around the motorcycle division of Eicher Motors and accomplish sustainable development in sales and market share, while sustaining profitability. Eicher Motors worked on improving the brand performance and awareness by modernising the RE bikes, in terms of technological developments, superior functionality and overall driving experience and feel. With this RE re-emerged as a major player in the mid-size motorcycle sector.

6. Muthu Ajay et al, (2019): India is one of the biggest automobile producers in the world. The automobile manufacturing in India financial records for 7.1% of country's gross domestic product (GDP). The two-wheeler sector with 81% market share is the leader of the Indian automobile industry. Indian automobile history began from 1897–1898. Now we can see nearly all world brand vehicles in Indian market laterally with its own products. But major share of customers still loves the oldest models specially two-wheelers like Yamaha RX 100, Yezdi Roadking, Samurai, Bajaj Chetak, Rajadoot, etc.

7. S Poorani and LRK Krishn (2021): Technology upgradation has meaningfully contributed to the research and development of traveller and commercial automobiles. The speedy trends in skill are causing various disruptions in the value chain. This paper presents the visions on skill development in the context of the disruption produced by technology and its impact on employee retention in the automobile sector in the city of Chennai, Tamil Nadu, India. The aim companies involved in the study are the top

automobile brands such as Ashok Leyland, Daimler Chrysler, Ford, Royal Enfield, TVS, Yamaha, involving a total population of 3 lakhs (approx.)

Objectives of the study

1. To upgrade and development of latest technology in royal enfield.
2. To maintain the brand's exclusivity.
3. To obtain a better grasp of the company's product, price, advertising and distribution strategies.
4. To know the latest trends in automobile industry.

RESEARCH METHODOLOGY

The methodology was created on the study and analysis of the relevant literature. Methods such as study, synthetic, critical thinking generalization where are use. The secondary data source includes websites, research articles, literature reviews and books. This study based on combinations reviews from various articles and research papers. The basic source of secondary data on the latest scenario of the royal enfield.

FINDINGS

The article then goes through a development and technology advancement that have changed in recent years and various distributions also changes. Improving brand performance and perception by increasing marketing strategies and new techniques.

STATEMENT OF THE PROBLEM

The main reason for these changes in technology and distribution strategies towards

Royal Enfield. They study this product as enhance changes while compared with other motor bikes. This study efforts on these reasons how luxury brand of Royal Enfield developed.

CONCLUSION

It is controlled from the study that if these ideas are useful on Royal Enfield can place a main position in the market as well as in the minds of customers. Technology advancement of “Royal Enfield” is the most inducing factor in the automobile industry.

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CHAPTER-28

FIN TECH AND FINANCIAL INCLUSION – ISSUES AND CHALLENGES TO FARMERS IN INDIA

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Abstract:

The financial inclusion is usage of financial products and services such as payment, savings, credit and insurance by the individuals and businesses. The Financial technology has dominant role in digital payments and transactions by the people. This paper tests the issues and challenges faced by the Indian farmers while using the digital transactions. The financial technology has developed rapidly recent days in financial inclusion. The

challenges of financial inclusion are the awareness and understanding of the technologies in financial inclusion. In India, the farmers have some difficulties to access the financial services. They have to be rectified by the fintech services.

Introduction:

The livelihood of a majority of India's population directly depends on agriculture. Still, it remains one of the most unorganized and disjointed sectors in the country. Despite the challenges of fragmentation, risks related to lack of trust and enforceability, broken supply chains, limited access to finance and storage, and challenges within policy frameworks, digitization and tech-driven innovation has helped Agritechs outperform other industries in the last two years. Technology has helped transform the otherwise conventional agri-value chain and it is important to extend this tech-led transformation to address the financial or liquidity needs of the farming community at large and small and marginal farmers more specifically.

Fintech holds the potential to solve several grass root problems farmers' face. Administering financial inclusion – equal opportunity and access to financial services and products like loans, banking, and insurance when needed – in the agricultural setup will revolutionize this sector.

The trouble

Financial inclusion has historically been a challenge for the small and marginal farmer. Constraints related to institutional design and delivery mechanisms largely

contribute to the absence of sustainable rural financial markets and institutions. Financial literacy is another issue plaguing the agri-economy. This is fundamentally due to a gap between institutionalized banks, farmers and people engaged in the ecosystem, especially in rural India.

According to the Reserve Bank of India, public and private sector banks cover only 41 percent of small and marginal farmers. Over 100 Mn farmers are therefore dependent on informal channels, exposing them to exorbitant interest rates as they fulfill their credit needs each cropping season and open to exploitation.

The ones that can store the produce to pursue better prices make profits in this value chain. A majority of farmers cannot afford storage without credit. Even the end-use of agricultural credit is an area of concern as 30-40 percent of the farmers diverts the cash flow to healthcare needs, marriages, and education costs, leaving lesser scope for investing in the right technology to achieve productivity.

This disconnect is coupled with weather-related production challenges, unavailability of technology, and lack of trusted networks for commerce. Lack of information such as availability of storage spaces, market prices and quality parameters add to the challenges of small holder farmers.

Fintech to save the day

The growth of the cashless economy and financial technology is generating new ways to target and collateralize credit, appropriate pricing, and manage risks. The

blockchain-backed mobile money, better user interface, and ease of accessing financial products are injecting much-needed financial inclusion into the country, even though it is a nascent stage.

The aim for Fintech startups is to connect the disintegrated agri-ecosystem, especially the marginalized and small-holder farmers, with the whole ecosystem, from supply chains to credits, to storage and easier accessibility to financial products. They can bring much-needed transparency to the value chain. In this context, association of fintech companies with Farmer Produce Organizations becomes critical too considering that more than 84% of the land holdings are with small and marginal famers.

Improved Financing

For starters, warehouse financing has enormous potential to eradicate the complexities in the agriculture value chain and solve one of the most critical issues of Indian agriculture by bringing better price realisation for farmers. Warehouse receipt financing has been a game-changer in this space.

Due to lack of liquidity, farmers are compelled to sell their produce post-harvest, sometimes within days of harvest. In such a scenario, the farmer cannot realise the best price for her produce and has to sell it at whatever price the market offers. With WRF, instead of selling her produce, the farmer will deposit her commodity and be issued an warehouse receipt or an electronic balance against the specific quantity and quality parameters assigned at the warehouse. This receipt or electronic balance can be used to

get access to immediate credit to tide over their cash flow needs.

Fintechs like of Arya.ag, this issue is being addressed with a network of more than 10,000 warehouses on the platform and connects farmers with large buyers of agriculture commodities. Also by bringing the agri stakeholders on a single digital platform, disbursing loans against farmer produce, providing vast information on Mandi prices and ensuring market linkages, Fintechs are bridging a major divide in the Indian agriculture sector.

With satellite imaging and the ability to monitor the crop will transform the method of lending, which will enable easy access to finance, for a stage led disbursement can be planned well in advance at each stage of the crop, this will not only mitigate the risk of unwanted lending but also enable easy access and adequate funding reducing the diversion risk.

Credit Profiling

Fintechs are using digital tools to profile farmers and their farm data. The digital footprints that these tools create can help in developing the economic identities of smallholder farmers.

Digitization of farms with an integrated plan to create electronic balances for commodities will enable the creation of Agri Stacks, building the much-needed transparency in value chains. Not only will this ensure seamless facilitation of credit, but

also help de-link farmers from non-institutional sources where they are compelled to borrow at steep interest rates.

Through this credit profiling, fintech companies can segment farmer credit risk to enable faster loan disbursement and a higher chance of repayment, a win-win for all stakeholders.

Better Insurance

Insuring of animals, crops and equipment can be made more efficient for farmers through Fintech companies as they can bring in easily available and affordable insurance covers than traditional insurers.

Apart from this, insurance products can help overcome uncertain agricultural risks like climate and weather change that can sabotage the produce. Technology-driven insurers ensure better pricing and ease of availability. Expediting the pay out of claims by directly tracking weather is making the process effective and efficient.

Linking farmers directly to markets

For decades, farmers especially smallholders, hugely depended on intermediaries to sell their products. This made it difficult for them to get the best pay they deserved. By providing a digital platform which offers the right pricing, crop yield estimation and ease of exchange, Fintech is bridging the gap between farmers, retailers, and manufacturers. Disruption in agriculture will require eliminating inefficiencies in the supply chain, helping farmers access credit and crop insurance, engaging in predictive analytics to

improve farm productivity and creating an unhindered path towards precision farming.

The emergence of self-decisioning fintech platforms with embedded financing and technology will enable further transparency in processes and the shift of power into the hands of the agricultural borrower as in other personal finance industries.

Conclusion:

Fintech is undoubtedly playing a pivotal role in Indian agriculture by helping farmers increase productivity and operations. Agri fintech players also play a key role in imparting financial literacy for the marginalised. This is especially relevant for women in agriculture as they face unique challenges: limited control and ownership over assets such as land and their inability to post hard collateral for loans. The Indian government rightly identifies financial inclusion as the economic progress of the country. Mobile money, biometric identification, and blockchains — can also help in generating financial inclusion.

Beyond financial inclusion, the Fintech revolution can benefit the Agri-sector with better transparency and affordability and strengthen the rural digital finance ecosystem.

CHAPTER-29

Functional peptide - Crustins studies in *Fiddler* crab species

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Introduction

The ocean is a special resource that offers a wide variety of natural items. Brachyuran crabs are one of the most significant taxa among the macro fauna usually found in mangrove forests in terms of both number of species, density, and total biomass [1-7]. Most fiddler crabs and sesarmid crabs are members of the families Grapsidae and Sesarminae, respectively [8]. Fiddler crabs are crucial to numerous processes. In addition to being crucial producers and decomposers of cord grass-derived organisms (bacteria and fungi), they also play a crucial role in the food chain as they are consumed by numerous large carnivores, including blue crabs, rails, egrets, herons, and raccoons. Burrowers are being avoided by fiddler crabs as well. They can cause marsh banks to deteriorate or collapse. Their feeding and burrowing alter the aeration, which impacts the growth of marsh plants. They encourage the mineralization and cycling of crucial

nutrients. They are also effective environmental indicators and sensitive to pollutants in the environment, particularly pesticides.

Antimicrobial host-defense peptides (AMPs) play a significant role in metazoan immunity and are found in abundance in nature, especially in invertebrates without an adaptive immune system [39]. These natural antibiotics may have multiple functions in host-pathogen interactions in addition to their quick and effective neutralizing action against invading microorganisms (such as Gram-positive and Gram-negative bacteria, yeasts, filamentous fungi, and enveloped viruses), by regulating crucial aspects of immunity after infections. The versatility of AMPs as immunological effectors and/or regulatory components highlights their significance in animal physiology and makes them strong biotechnological prospects for the development of novel drugs [13]. Due to their broad antibacterial spectrum, great efficacy, and little toxicity to eukaryotic cells, AMPs have emerged as attractive compounds in the ongoing situation of the emergence of microbial resistance to numerous medications.

Less than 50 hydrophobic and cationic amino acid residues make up the majority of AMPs, which are short-chain peptides. This fundamental structure often bestows amphiphilic characteristics, enabling AMPs to equally permeate in lipidic and aqueous environments [47]. The presence of hydrophobic residues permits their partition in non-polar hydrocarbon environments through hydrophobic interactions, whereas the presence of cationic residues provides a net positive charge at physiological pH.

However, due to an excess of negatively charged residues, some AMPs do not conform to this canonical structure and exhibit an anionic nature ^[16]. It's interesting to note that some AMPs are very small fragments created by the proteolytic cleavage of bigger proteins with potential immune system-unrelated functions. The respiratory protein hemocyanin from the Pacific white shrimp *Litopenaeus vannamei* was cleaved at its C-terminus, and the resulting short fragment, PvHCt, is an antifungal ^[18]. Due to AMPs' exceptional antibacterial characteristics and the fact that they are primarily composed of the common 20 amino acids found in both single-celled and multicellular animals, substantial research has been conducted to understand the molecular mechanisms underlying their biological activity.

According to functional investigations, AMPs generally act at the membrane level by inserting into and destabilizing the microbial membrane, which causes the release of cytoplasmic contents. Their fundamental physicochemical characteristics and the chemical make-up of microbial surfaces combine to give them this ability. While cells from multicellular creatures reveal zwitterionic phospholipids on that face and separate those with a negative nature on the internal leaflet, many bacteria' membranes exhibit negatively charged phospholipid headgroups on the outside face ^[46]. The classic AMPs mechanism is based on this significant difference between the surfaces of these two types of cells: the negatively charged surface of bacteria attracts AMPs through difference between the surfaces of these two types of cells: the negatively charged surface of

bacteria attracts AMPs through electrostatic forces, which is followed by AMP insertion into lipid bilayers via hydrophobic portions, ultimately irreversibly compromising functions. Other methods of action, such as activity on intracellular targets, have also been hypothesized, despite the fact that it represents a typical way of microbial killing. In this instance, AMPs are translocated through the microbial membrane and act on certain targets, boosting the suppression of vital metabolic processes, such the creation of cell walls or the synthesis of proteins and nucleic acids ^[1]

Since alterations in amino acid residues can change an AMP's antimicrobial range without significantly altering its overall physicochemical properties, AMPs are revealed to be functionally malleable molecules. The way that AMPs work provides another significant evolutionary benefit: Most microbes are less able to evade these molecules' onslaught. Since AMPs primarily affect the cell membrane, developing resistance becomes more expensive because it necessitates a variety of mutations linked to the structural remodeling of the microbial cell membrane. Additionally, the development of microbial proteases that selectively target AMP molecules is inhibited by the lack of clear AMP chemical fingerprints ^[81].

AMPs from various families have currently been found in crustaceans ^[44]. Because they are more readily available, cultured species like marine decapods (such penaeid shrimp, lobsters, and crabs) provide the best-characterized AMPs. Crustins, penaeidins, and anti-lipopolysaccharide factors (ALFs) are the AMP families in decapods with the

best descriptions ^[17]. The biggest family of crustaceans, Malacostraca, which includes around 30,000 live species, contains a huge number of crustins, the most representative of which have been proven to play a variety of roles in host immunology and physiology.

Crustins

Crustins are disulfide-rich antimicrobial peptides/polypeptides that are released and range in size from 6 to 22 kDa. At their C-terminal end, they carry a conserved Whey Acidic Protein (WAP) domain. One of the earliest groups of gene-encoded AMPs discovered in crustaceans was the crustins. The discovery of a cationic 11.5-kDa peptide from the granular hemocytes of the shore crab *Carcinus maenas* marks the beginning of its history ^[56]. Although only a partial characterisation of this peptide had been carried out at the time, these molecules had an antibacterial activity against salt-tolerant marine Gram-positive bacteria and displayed a primary structure distinct from any immune-related protein identified in crustaceans ^[56].

The '11.5-kDa peptide' was conveniently dubbed 'carcinin' by Smith and Chisholm [63] after the genus *Carcinus* and demonstrated activity even after boiling. The term "crustins" was first used to refer to homologous sequences in two penaeid shrimp species (*L. vannamei* and *Litopenaeus setiferus*) in 2002 by Bartlett and colleagues ^[7]. This nomenclature is now consistently used to refer to related molecules in other crustaceans. In fact, later research found crustin-like sequences in other shrimp species over the years ^[55,59,70,82], and as of now, more than 200 sequences have been published in

the literature or added to open-access databases.

The largest and most varied family of AMPs found in crustaceans is the crustin family ^[44]. With members in the Pleocyemata and Dendrobranchiata suborders, they have been largely regarded as belonging to the Decapoda order ^[44,64]. As of the time of writing, the NCBI database (<https://www.ncbi.nlm.nih.gov/search/all/?term=crustin>) has 215 amino acid sequences and 245 nucleotide sequences from 36 species of invertebrates. Decapod crustaceans such as penaeid shrimp, freshwater prawns, lobsters, crayfish, and crabs were used to identify and classify the vast majority of sequences. Crustin sequences, however, have also been found in non-decapod crustaceans, particularly those from the Amphipoda and Isopoda orders. Crustin-coding transcripts have recently been found in transcriptome databases of 21 species of isopods from six different families by Becking and associates ^[8].

Lai and Aboobaker ^[40] identified crustin transcripts in 55 crustaceans, including 37 non-decapod taxa, using similar methods. Additionally, based on comparative genomics investigations, crustin homologues were also discovered in ants (hymenopteran insects), demonstrating that this AMP family is prevalent in several taxa within Pancrustacea.

Crustins are distinct from other AMPs in that their C-terminal end retains a conserved Whey Acidic Protein (WAP) domain. The WAP domain is a 50 amino acid protein motif that comprises eight conserved cysteine residues engaged in four intramolecular disulfide linkages (<https://pfam.xfam.org/family/PF00095>). Internal

disulfide bonds make a compact structure that is firmly packed to form the typical three-dimensional configuration known as the "four-disulfide core" or 4DSC ^[65] on PROSITE.

The WAP domain is not unique to this AMP family, despite the fact that all crustins have this protein motif. In actuality, Piletz and colleagues ^[51] first used the term "WAP" to refer to a novel major whey protein found in mouse milk. When the transcripts for the WAP proteins in murine models were cloned and analyzed, it was shown that their deduced amino acid sequences displayed conventional 4DSC motifs that had previously been seen in non-milk proteins such wheat germ agglutinins and snake venom neurotoxins ^[28]. The 4DSC protein superfamily is found in almost all kinds of life, yet oddly, the most prevalent species on the world, arthropods, account for a disproportionately tiny number of its members. Around 12% (646 sequences) of the more than 5500 WAP protein sequences stored in the PFAM database (ID: PF00095) are from this class of metazoans. Pearlwapins, a tiny subset of mollusk-derived proteins, are among the WAP proteins found in invertebrates. These proteins, which are made up of three WAP domains, have been linked to the development of the shell via controlling the abalones' calcite crystal deposition ^[75].

The presence of a conserved WAP domain at the C-terminal end distinguishes crustins from other multiple domain cysteine-rich AMP families found in the crustacean kingdom, including arasins, hyastatins, penaeidins, and stylicins ^[58]. Noteworthy, as crustins lacking the WAP-type four-disulfide core domain exhibit poor biological

capabilities, the WAP domain of crustins is regarded to be a crucial motif for their activity. since the biological functions of crustins lacking the WAP-type four-disulfide core domain are compromised. From the hemocytes of the Chinese shrimp *Fenneropenaeus chinensis*, full-length cDNA sequences coding for a naturally occurring crustin with an incomplete WAP domain were extracted, and the corresponding recombinant peptides were demonstrated to have no antibacterial action. A WAP-complete crustin, on the other hand, that was unique in having 30 extra amino acid residues at the N-terminal end of the WAP motif, was demonstrated to have a definite antibacterial effect [82]. These findings underline the functional significance of structural alterations in the WAP domain and the significance of the amino acid content of this domain in the biological function of crustins.

There are misunderstandings about what constitutes a true member of the crustin family due to the widespread publication of crustin-related sequences from various crustaceans throughout the 2000s and the lack of functional characterizations. When Smith and colleagues established a precise approach for crustin classification in 2008, this growing complexity was systematically organised for the first time. The three "Types" (Types I to III) of crustins in this system are distinguished by the presence or absence of structural domains at the N-terminal end of the mature peptide or polypeptide.

The 'cysteine-rich domain', which has four conserved cysteine residues and is

positioned specifically upstream of the WAP domain, is what distinguishes type I crustins from other types. It is composed of a signal peptide, which is followed by a variable-sized domain. Despite the fact that Type I crustins always contain these cysteine residues, there is no proof that they are involved in disulfide bonding. Crabs, lobsters, freshwater prawns, and crayfish are just a few examples of the crustaceans from the suborder Pleocyemata that are known to contain type I crustins, which are characterised by sequences that are comparable to the *C. maenas* carcinin (11.5-kDa peptide). Decapods from the suborder Dendrobranchiata, penaeid prawns, have also been mentioned in a few publications as having them [19,33].

The cysteine-rich domain also present in Type I crustins is preceded by a highly polymorphic hydrophobic region in Type II crustins. This N-terminal region, known as the "glycine-rich domain," typically consists of between 20 and 160 residues. Glycine residues typically occur in blocks of four to five amino acids (tetra- or pentapeptides, such VGGGLG), which are tandemly repeated. The amount of glycine residues can vary significantly between different species [65]. Despite being a prominent feature, this structural domain has not yet been given a purpose. Type II crustins have been observed in a variety of crustaceans from the suborder Pleocyemata as well as penaeid prawns (suborder Dendrobranchiata) [36, 66]. Type II crustins are by far the most varied members of the family and represent the best-characterized crustin group. Additionally, they can be further subdivided into Type IIa crustins, also known as "Crustins," and Type IIb

crustins, also known as "Crustin-like peptides," based on distinct amino acids profiles [6].

The third class of crustins, commonly referred to as SWDs (single WAP domain-containing peptides), has peptides with only one C-terminal WAP domain. The usual glycine-rich domain of Type II crustins and the cysteine-rich domain present in both Type I and Type II crustins are noticeably absent from Type III crustins, albeit they may include brief N-terminal regions richer in proline/arginine residues [3,31,35].

It is frequently assumed that the presence of crustin transcripts in numerous tissues is proof that the organ or tissue is largely in charge of crustin production. The open circulatory system of crustaceans, which allows hemolymph to fill hemocoele, and the hemocytes' capacity to infiltrate highly vascularized tissues, which results in hemocytic infiltration, should be taken into consideration. In certain circumstances, hemocytes that express crustin would produce a positive signal in tissues that do not express crustin, leading to a misunderstanding of the spatial distribution of crustin. In order to precisely identify the potential areas in which crustins are expressed, localization techniques (such as immunohistochemistry and/or in situ hybridization) are essential.

Suleiman and colleagues [68] used immune histochemical staining to look for putative carcinin-producing sites in a variety of tissues and organs removed from *C. maenas* in order to answer this question. Curiously, although a significant signal was seen in the ovaries due to high expression levels in oocytes, the positive signals of carcinins

across the analysed tissues were the result of invading hemocytes. This is the sole experimental example of crustins outside of hemocytes to date. The astonishing molecular variety of this particular AMP family is explored in this review, along with the classification schemes that are currently in use and their biological implications.

Conclusion

Studies focusing on the exploitation of molecules with potential for use in prawn farming and mitigation of the severe impacts generated in the productive sector are important given the necessity for new techniques to combat and control infectious illnesses. Due to the lack of effective alternatives, antibiotics have been utilized to control and prevent disease epidemics. However, because to (i) its negative effects on the environment, (ii) the selection of germs that are resistant to antibiotics, and (iii) the contamination of the animals, which renders them unfit for human consumption, this practise has become highly prohibited. Due to these factors, the identification of eco-friendly chemicals made by living things that may kill harmful germs without causing resistance is highly valuable for use in marine biotechnology and aquaculture around the world. Studies on the diversity of immunological effectors in crustaceans, particularly crustins, are crucial in this context to learn more about their molecular defence mechanisms and to increase the pool of potential immune effectors that can be used in various therapies. Understanding the diversity of these multifunctional molecules can also open up new research avenues with applications in human and animal health, which

is important given the biotechnological potential of AMPs.

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CHAPTER-30

A STUDY CHALLENGES OF HIGHER EDUCATION IN INDIA

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Abstract

India's education system is often cited as one of the main contributors to the economic rise of India. The size of India's higher education market is about \$40 billion per year. This paper presents the development and present scenario of higher education in India by analyzing the various data and also identifies the key challenges that India's higher education sector is facing. This paper also presents the key initiatives by the government and recommendations to meet these challenges.

Keywords: Higher Education, Knowledge Economy, Technical Education.

Introduction

Knowledge Economy

Knowledge is the driving force in the rapidly changing globalized economy and society.

Education general and higher education in particular, is a highly nation-specific activity, determined by national culture and priorities. The emergence of India as a knowledge-based service driven economy has made its human capital its major strength and opportunity for growth. Unlike China or other Asian economic giants, India's growth has not been led by manufacturing. Instead, the nation's pool of skilled workers has allowed India to move quickly up the economic value chain in several knowledge based industries. According to a report by ICRIER, New Delhi, India is home to the world's largest pool of scientific and knowledge workers and produces 400,000 engineers per year while the US produces 60,000. According to the same report, in August 2006 India filed 1312 patent applications second only to the United States. This indicates that on the science and technology side, India has built up the largest stock of scientists, engineers and technician. In order to sustain these positive trends and an economic growth rate of 7%, a venture Intelligence calculates that India's higher education gross enrollment ratio (GER) would need to increase from 12 to 20 percent by 2014.

Structure and Statistics of Higher Education in India

In India the institutional framework consists of *Universities* established by an Act of Parliament (Central Universities) or of a State Legislature (State Universities), *Deemed Universities* (institutions which have been accorded the status of a university with authority to award their own degrees through central government notification),

Institutes of National Importance (prestigious institutions awarded the said status by Parliament), and *Institutions established by State Legislative Act* and *colleges affiliated with the University* (both government-aided and unaided) [4].

In India technical education is treated as a separate sector. There are 65 centrally funded institutions like IITs, IIMs, NITs, IISc, etc. Additionally, State Governments have also set up technical institutions. AICTE and equivalent sectoral regulators (like the Medical Council of India) both approve and regulate technical institutions in engineering/technology, pharmacy, architecture, hotel management & catering technology, management studies, computer applications and applied arts & crafts. Vocational Education is another stream of higher education in India. For this a network of public and private polytechnics and vocational institutions exists, controlled and supervised by the Councils specializing in each discipline. India has also developed an Open University system to encourage distance learning. Indira Gandhi National Open University (IGNOU) was the pioneer and now there are 14 open universities in India [5]. The open universities in India are regulated by the Distance Education Council of India (DEC), New Delhi which maintains the standards, encourages and organizes the activities of Open and Distance learning in India (ODL). Distance education with new information and communication technology (ICT) promises to expand the frontiers of Higher Education as never before. This is because it costs 66 per cent less and the students need

not leave their homes or profession. The internet and satellite technology are being put to use to further the cause of distance education.

The Higher Education sector ensures the quality of the educational process with the help of accreditation agencies established for the purpose. The main agency which accredits universities and colleges in general education is the National Assessment and Accreditation Council (NAAC) established by the UGC in 1994, whereas a similar function is done for technical education by the National Board of Accreditation (NBA) set up by AICTE in 1994, and for agricultural education by the Accreditation Board (AB) set up by ICAR in 1996. NAAC proposes to introduce the India Education Index (IEI) for ranking institutes based on academic, research performance and other parameters. The outcome will help in the international comparison of institutes. NAAC has entered into an MOU with higher learning institutes of the United States, Taiwan, Norway, Kuwait and with the Commonwealth of Learning (COL) to facilitate collaborative work on quality assurance in higher education institutions (HEIs).

Universities in India, both private and public, are spread across the length and breadth of the nation. The number of universities in India increased from 20 in 1947 to 504 in 2010, a 25 times increase (See table 1). The growth of universities and colleges from 1947 to 2010 is shown in figure 1. It is clear from the figure that growth during 2004-05 is remarkable. However during 2005 to 2007 the growth rate is low but again

it increased and attained to a good number.

According to MHRD Annual report 2009-2010 ^[6], as of March 2009, the country had 26455 institutes of higher education; 504 universities and university level institutions and 25,951 colleges. At the commencement of the academic year 2009-2010 the overall formal system enrollment in the various universities and colleges was reported at 13.6 million, while the total number of faculty members has been reported at 0.59 million.

Challenges in Higher Education

In present scenario the challenges in higher education are:

Research and Development: Research and higher education are complementary to each other. According to the available official statistics ^[9] the expenditure on R&D in the field of Science & Technology as a percentage of gross domestic product (GDP) was 0.8 percent during the year 2005-06 in India. For perspective, countries spending the most on S&T as a percent of their GDP were Israel (5.11 percent), Sweden (4.27 percent), Japan (3.11 percent), South Korea (2.95 percent), the United States (2.77 percent), Germany (2.74 percent) and France (2.27 percent). Among other countries, China (1.54 percent), Russia (1.74 percent), U.K. (1.88 percent) and Brazil (1.04 percent) have spent more than India.

Moreover, India's higher education institutions are poorly connected to research centers. So this is another area of challenge to the higher education in India.

Faculty Shortage: According to a recent report of HRD Ministry premier educational institutes like the Indian Institute of Technology (IITs) and the Indian Institute of Management (IIMs) are facing a faculty crunch with nearly one-third of the posts vacant. According to a report published in IANS ^[10] around 35 percent posts are vacant in the central universities, 25 percent in the IIMs, 33.33 percent in the National Institute of Technology (NITs) and 35.1 percent in other central education institutions coming up under the Human Resource Development (HRD) Ministry. However in order to overcome this, government is planning to have short-term measures like raising the retirement age in teaching posts from 62 to 65 years and enhancement in salaries and other benefits for teachers. Also some long-term measures have also been initiated for attracting young people to opt for this (teaching) career. These include enhancement in fellowships and attractive start-up grants in various disciplines.

Key Initiatives

The key initiatives of the government to improve the quality and further development of higher education in India are as follows:

A proposal for establishment of an autonomous overarching National Commission for Higher Education and Research (NCHER) for prescribed standards of academic quality and defining policies for advancement of knowledge in higher educational institutions. The said proposal is based on the recommendations of Yash Pal Committee and National

- A proposal to prevent, prohibit and punish educational malpractices.
- Law for mandatory assessment and accreditation in higher education through an independent regulatory authority.
- Establishment of a national database of academic qualifications created and maintained in an electronic format which would provide immense benefit to institutions, students and employers.
- A proposal to establish 14 innovation universities aiming at world class standards.
- Setting up 10 new National Institutes of Technology (NITs).
- Launching of a new scheme of interest subsidy on educational loans taken by professional courses by the economically weaker students.
- Setting up of 374 Model degree colleges in districts having GER for education less than the National GER.
- As part of reforms in All India Council for Technical Education (AICTE) norms, the HRD ministry announced an increase of almost 200,000 seats in engineering courses, additional 80,000 seats in management and 2,200 seats in architecture courses. The ministry also made it mandatory for technical institutions to reserve 5 percent seats for the weaker sections of society.

- HRD ministry has liberalized the norms for land requirement for engineering colleges. Now lesser space will be needed for establishing technical institutes. While an engineering college in rural India will need 10 acres of land, just 2.5 acres of land will be needed in urban areas.
- Conduction of special evening in the areas of Engineering, Technology, Architecture, Town Planning, Hospitality and Pharmacy by AICTE-approved institutes.
- Introduction of Section 25 of Company's Act to allow good corporate to set up Technical Institutions.
- Review of the functioning of existing Deemed Universities.
- Passing of the Right of Children to Free and Compulsory Education Bill.

Recommendation

As per the present scenario of the higher education in India we recommend following in order to further meet the challenges:

1. Government should offer tax concessions/fiscal incentives for setting up campuses of higher education by private/corporate sectors.
2. Open Universities need to be encouraged to offer quality programmes at the least cost.
3. Government should encourage foreign universities to come to India to set up independent operations or collaborate with existing Indian Institutions.

4. A regulatory set up is required to ensure that there is no cheating or hoax and , fixation of fees should not be in state control.
5. There is great need for providing broad band connectivity to all students along with low priced computer accessibility.
6. Good salary packages and benefits to the faculty so that good brains can be attracted to this profession.
7. Private sector should run universities not for a profit-basis through charitable trusts/societies but as a part of a corporate social responsibility (CSR).
8. Possibilities for foreign collaboration and participation as 100% foreign direct investment (FDI). The government can encourage this initiative to improve the quality of formal education, particularly, in government run institutions.

Conclusion

In this paper we have presented the development and present scenario of higher education in India by analyzing the various data and also identify the key challenges like demand-supply gap, quality education, research and development and faculty shortage in India's higher education sector. In this paper also identified the key initiatives from the government side which include the establishment of NCHER, independent regulatory authority for accreditation and national database of academic qualification, increase in

number of universities including IITs, IIMs, NITs and SPAs during 11th five year plan and increase in the number of seats in existing institutions, and passing of the Right of Children to Free and Compulsory Education. Looking to the present scenario of the higher education in India we recommended some points in order to further meet the challenges.

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CHAPTER-31

IMPACT OF GST ON INDIAN ECONOMY- ONE NATION ONE GST

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ABSTRACT

GST, which was treated as India's most significant reform in the sector of Tax, is also known as Goods and Services Tax. GST is a form of indirect taxes imposed at the State and Centre levels. The GST outlawed the old tax system, which consisted of VAT, Excise duty, Service Tax and other such taxes. As the name suggests, it charged on both services and goods. This tax was brought forward with the intention of One Tax One System, although it failed to live up to that expectation with several tax slabs. GST was first brought forward in the 2006 Annual Budget Speech on 28th February. The main intention was to rebuild the Nation's indirect taxation system. Later, the Goods and Services Tax was approved by the Indian Parliament on 29th March 2017, which came into effect on 1st July 2017. GST will have widespread ramification on the economy, be it manufacturing sector or service sector. All the players of the commercial sphere be it

trades, manufactures or service providers are equally being affected by the introduction of GST.

Keywords: GST needs Indian economy, awareness, GST.

Introduction

Goods and offerings Tax (GST) are a proposed gadget of oblique taxation in India merging most of the exiting taxes into single machine of taxation. It used to be delivered with the aid of the charter (One Hundred and First Amendment) Act 2016. GST would be a complete oblique tax on manufacture, sale and consumption of items and offerings for the duration of India. To change taxes lived with the aid of the central and kingdom governments. Goods and offerings tax would be furious and accrued at every stage of sale or purchase of items or offerings based totally on the enter tax savings method. This approach permits GST- registered commercial enterprise to declare tax credit score to the fee of GST they paid on buy of items and offerings as section of their ordinary industrial activity. Taxable items and offerings are no longer unusual from one some other and are taxed at single charge in a provide chain until the items or services attain the consumer. Introduction of an built-in items and offerings tax (GST) to change the current more than one tax buildings of central and country taxes is now not solely acceptable however necessary in the rising monetary environment. The implementation of GST would make sure that India affords a tax regime that is nearly comparable to the relaxation of the world. It will additionally enhance the global fee competitiveness of

native items and services. The GST at the central and at the nation degree will in this way supply greater alleviation to enterprise trade, and agri-business also, clients thru a extra thorough and extra vast scope of insurance of enter tax set-off and offerings tax setoff.

Objectives of the study

1. To find out about the GST.
2. To learn about the execs and cons of GST.
3. To find out about the advantageous and terrible have an impact on of GST on Indian economy.

What is GST?

GST was once first delivered ahead in the 2006 Annual Budget Speech on twenty eighth February. The major intention was once to rebuild the Nation's oblique taxation system. Later, the Goods and Services Tax used to be authorized via the Indian Parliament on twenty ninth March 2017, which got here into impact on 1st July 2017. It used to be introduced ahead with the thought of a single complete tax that would be levied on all offerings and goods. It has four slabs – 5%, 12%, 18% and 28% for all sorts of items and services. The different two slabs are 1.5% and 3% for jewelry; reduce diamonds, treasured metals, and some chosen automobiles. So, there are 6 slabs in total.

Needs for GST

1. VAT quotes and rules fluctuate from kingdom to state. And it has been located that states frequently hotel to slashing these quotes for attracting investors. This outcomes in

loss for both the central as properly as country government.

2. As enterprise methods have evolved, the taxing strains between the nation listing and central listing have began to blur main to double taxation and giant litigation

3. The central and kingdom taxes are no longer fungible towards every different nor are the nation taxes fungible inter-state, main to a cascading effect.

4. The disparity in the price of taxes as levied by means of respective kingdom has led to business

Structuring their transactions solely to attain a tax advantage.

Advantages of GST

As cited above, the GST comes with a few advantages, such as one tax gadget and boosting the unique elements of the Indian economy, such as:-

1. One Tax System

One of the important intentions of bringing GST was once to dispose of special sorts in the Indian tax system. Before the implementation of GST, there have been special taxes such as VAT, provider tax, etc. All such taxes have been eliminated with GST coming into play. Now, solely one tax is charged. Although there are distinctive slabs, GST fees are one of a kind for distinct gadgets which frequently creates confusion.

2. Common National Market Creation

GST brings up a tax shape that is built-in into nature. This helps do away with all sorts of monetary barriers, allowing the GST to create frequent country wide markets. Again, the

use of enter tax credit score can every so often end up difficult.

3. The Make In India Initiative

One of the primary motives for bringing Goods and Services Tax was once to assist in boosting the 'Make in India' products. The GST helps in manufacturing the merchandise at competitive rates. Although the relaxation is but to be defined via the Government as to how GST helps in this campaign.

4. Cascading Effect Removal

A massive gain of GST is the elimination of the cascading impact of GST. Cascading impact capacity the tax levied on tax. So, if a product has 10% tax on Rs 1000, every other 10% of tax will be charged on 1100. So double tax is charged. In GST, if 28% tax is charged on Rs 1000, then Rs 1280 is charged, and on the subsequent level, again 28% will be charged on Rs one thousand So, the Tax on Tax machine is removed.

5. Litigation Reduction

GST helps in lowering litigation cost, which was once improved due to a couple of taxation systems. As GST is supposed to supply readability in the tax evaluation ability. One can use the revised shape of GST to exhibit the distinct credit score float in distinctive businesses. But the savings following is no longer very easy and now and again leads to errors, so one should be careful.

6. Composition Scheme

Through the GST, many small organizations with an annual turnover of much less than

and equal to INR 1.5 Crore can decide for the composition scheme. They can decrease their compliance without problems the use of this scheme. The GST is charged at decrease quotes of 1%, 5% and 6% by using corporations that come beneath this scheme.

7. Simple Access

The GST portal can be accessed by way of everyone sitting somewhere at any time. This makes submitting of returns easy. This is very excellent for all sorts of businesses.

8. Automated methods

These procedures are computerized and simplified for a range of approaches such as return, tax payment, registration, etc.; all interplay is finished thru a frequent GSTN portal.

Disadvantages of GST

1. Very High Tax Burden on SMEs

As per the shape of the preceding tax system, solely these corporations whose every year income had been greater than Rs.1.5 core have been required to pay excise duty. But as per the new tax structure, it is obligatory for all organizations whose annual income are extra than Rs.40 lakh to pay GST.

2. Compliance Burden

GST compliance is pretty excessive due to the submitting of three tax returns each single month. Besides, now it is obligatory for the organizations to register for the GST in all states anywhere they operate business. The total manner of registering with the

regulatory body, producing GST-compliant invoices, preserving digital records, and submitting returns have put a large stress burden on SMEs and others.

3. Increased Costs

It is viewed that GST compels groups to convert their existing accounting software program to ERP or GST-compliant software program with a view to retaining their operations running. But one additionally has to understand that the groups might also incur extensive fees for buying, installing, and then education personnel to use GST-compliant software. In addition to this, the fees of doing enterprise have elevated appreciably no longer solely for large corporations however additionally for small ones when you consider that they have to employ tax gurus in order to grow to be GST-compliant.

4. IT Software Expenditure

Keeping in view the GST regime, all agencies both have to replace their present day accounting software program or ERP software program to make it GST compliant or buy new GST software program to prop up their businesses. This effects in an expand in IT fees of the companies in phrases of buying the GST software program and coaching the personnel to use the software program efficiently. However, Masters India, a association that is one of the main GST Suvidha Providers (GSP) has effectively developed personalized GST software program and APIs in order to ease the compliance approaches for exclusive enterprise users.

Positive have an impact on of GST on Indian economy

There are following superb affects of GST on Indian Economy

- Reduce the burden of tax on manufactures and producers thru greater production.
- Single tax gadget eliminates the distinct tax barriers.
- Government Revenue improved after the implementation of GST.
- Some sectors like Auto Commercial Vehicle, customer goods, footwear, cigarettes, constructing cloth and logistics make develop due to discount of tax on special objects below GST.

Negative have an impact on of GST on Indian economy

There are following tremendous influences of GST on Indian Economy

- Some sectors like Hotels, Restaurant and Branded Apparels go down due to expand in tax quotes on one-of-a-kind objects underneath GST.
- GST tax fee varies from 0%,5%,12%,18% and 28% which is restricted for the complete taxation machine formerly separate tax price existed for special items and services.
- Growth in inflation would possibly be impact due to GST.

Conclusion

The introduction of items and offerings tax (GST) would be a tremendous step in the reform of oblique taxation India. Amalgamating quite a few central and kingdom taxes into a single tax would mitigate cascading or double taxation, facilitating a frequent

countrywide market. The simplicity of the tax need to lead to simpler administration and enforcement. In India implementation of GST would additionally appreciably assist in disposing of monetary distortion brought on via current complicated tax shape and will assist in improvement of a frequent country wide market.

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CHAPTER-32

INVITRO ANALYSIS OF ANTIBACTERIAL & ANTIOXIDANT PROPERTY OF MANGO SEED KERNEL & GREEN TEA AGAINST BACTERIAL UROPATHOGENS

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ABSTRACT

Urinary tract infection (UTI) is the most prevailing disease threatening millions of people worldwide. Women are highly prone to it. People instantly switch to antibiotic

treatment for this case, but frequent usage of synthetic drugs results in causing

resistant microbes, causes side effects and damages the normal flora. Ethanol extract of mango seed kernel and green tea extract was tested against the isolated uropathogens at various concentration. At 200 μ l E.Coli exhibited highest zone of inhibition 12mm.

Minimum inhibitory & bactericidal concentration were tested. The antioxidant property of MSK & GT extract was 68.26 ± 0.24 mg and 73.41 ± 0.28 mg.

Keywords: UTI, mango seed kernel powder, green tea, antibacterial, antioxidant

1. INTRODUCTION:

Urinary tract infection (UTI) is being the prominent disease, around 230 million people are affected worldwide every year with irrespective to age and gender, patients undergo severe distress (Sheerin N.S, et al., 2019). UTI occur more commonly in women than in men, about 40-50% of women experience this. Women under the age group of 1-50 years are much affected to UTI & recurrent UTI (rUTI) (Kasper D.L, et al., 2018). UTI is most commonly caused by bacteria and other microorganisms like fungi & viruses they are rare etiological agents (Olin S.J et al., 2015). Among uropathogens, *Escherichia coli* is the most common bacteria, 75-90% isolates (Sheerin N.S et al., 2019).

Synthetic drugs- Antibiotic therapy is a promising way, helps in reducing the symptoms and pain usually within 3 days of medication, which cures 85-90% of women (Khameneh B, et al., 2019). Whereas continuous usage of synthetic drugs results in Antibiotic-

resistant bacterial pathogens (Khameneh B, et al., 2016).

Infectious and recurrent diseases are being the most threatening diseases reason for mortality around the world, caused by the development of antibiotic resistant pathogens (Vyas A, et al., 2012) (Vincent J, et al., 2009)

Alternative treatment for these cases rely on natural remedies, which have the potential to prevent and cure UTI (Loubet P, et al., 2020).

Mango- *Mangifera indica* is a member of *Anacardiaceae* known as “The king of fruits”. There are evidence on the pharmacological effects of natural remedies for diseases. Mango was confirmed to have anti malarial effect (Tsabang P.V, et al., 2012), it acts against *Plasmodium falciparum* (Rasoanaivo P, et al., 2004). Methanol extracts of M.indica seeds was tested against 61 bacterial strains, it showed antibacterial activity against all tested strains (Vaghasiya Y, et al., 2011). The flesh of the fruit is consumed, rather the seed is thrown away considered as waste. Despite it contains 6% protein, 11% fat, 77% carbohydrate, 2% crude fiber and 2% ash (Abdalla A.E.M, et al., 2006).

Green tea- *Camellia sinensis*, an evergreen shrub from *Theaceae* family (Mahmood T, et al., 2010). Right from 18th century Buddhist monks recognized the potentials of green tea and incorporated in medical applications (Chen P.C, et al., 2002). EGCG (Epi- Catechin -3 Gallate) and ECG (Epi- catechin 3Gallate) are highly focused compounds. Green tea extract is rich in flavonoids, responsible for antioxidant. Green tea contains relatively high amounts of polyphenols, especially catechins and its derivatives, considered to provide

effect against cancer and cardiovascular diseases (Gramza A, et al., 2005). The combined use of green tea with any other natural active substance is effective in inhibiting the drug – resistance pathogens (Toda M, et al., 1989). Mango seed kernel and green tea has evident antibacterial, antifungal, antioxidant & antidiabetic property (Fujihara T, et al., 2007).

Plant origin flavonoids, polyphenols and essential oils attribute to their antimicrobial property (Calvo M, et al., 2012). Plants rich in phenolic compounds are the major natural antioxidant (Boskou D, 2006).

This study focus on combining the two promising ingredients mango seed kernel and green tea extract for suppressing the growth of uropathogens.

2. MATERIALS AND METHOD

SAMPLE PREPARATION

MANGO SEED KERNEL POWDER (MSKP)

Mango seeds were collected during the month of (May- April). The mango seeds were washed, the outer covering of the seed is removed using knife, inner kernel is cut into small pieces and completely shade dried for 10 days. The dried seeds were pulverized using electric blender and stored in air tight container.



Fig 1: Mango seed kernel powder(MSKP)

COLLECTION & PREPARATION OF GREEN TEA LEAF

Fresh green tea leaves were collected at the month of June from the tea estate of Munnar, Kerala, India. Collected leaves were washed, shade dried pulverized. Stored in sterile air tight container.



Fig 2: Dried green tea leaves

ISOLATION OF UTI PATHOGENS

Urine sample was collected in a sterile container, from a 43years old female from AVM hospital, Thoothukudi, India. The collected sample was subjected for bacterial isolation.

The isolated uropathogens were *E.coli*, *klebsiella pneumonia*, *Staphylococcus aures*, were confirmed through selective media, morphological detection, gram staining and Biochemical tests.

SOLVENT EXTRACTION

Ethanol extract of pulverized Mango seed kernel (MSK) and Green tea(GT) was extracted using soxhelt apparatus. The extract was vapourized, using dimethyl sulfoxide (DMSO) the final MSK & GT extract was obtained.



Fig 3(a): Ethanol extract of MSKP



Fig 3(b): Ethanol extract of

GT

ANTIBACTERIAL ACTIVITY

Well diffusion method was carried out on Muller Hinton agar. At various concentrations of MSK & GT extract was diffused on the well over the bacterial suspended media, the plates were incubated at 37°C for 24 hours. Zone of inhibition (ZOI) was measured (Table 3&4).

ANTIOXIDANT ACTIVITY

Phosphomolybdenum assay was used to test the antioxidant activity of MSK- GT ethanol extract.

3. RESULT AND DISCUSSION

Table 1 indicates the phytochemical analysis of MSK, where the flavonoids and phenol content is positive which is highly responsible for its antibacterial and antioxidant property. Which helps in denaturing the bacterial cell wall and submissive its growth.

Table 2 gives the results of phytochemical analysis of green tea extract, the EGCG and the flavonoid compound important in exhibiting their activity towards the bacteria, it hinders the growth and terminate the bacterial metabolism. The polyphenolic components of green tea which include EC, ECG, EGC and EGCG are mainly responsible to inhibit bacterial growth (Radji M, et al., 2013)

It is noted that ethanol is an effective solvent, brings out all the active elements of the plant extracts (Padalia H & Chanda S, 2015). Yield % of MSK was 63.3% and GT was 58% (Fig 5).

Ethanol extract of MSK showed highest zone of inhibition against *E.coli* was 12mm at the concentration of 200µl, at the concentration of 50 µl *K.pneumoniae* exhibited 8.5mm as the least zone of inhibition, (Table 3).

At the concentration of 200µl GT extract showed highest zone of inhibition against *E.coli* – 13.7mm, at 50 µl *K.pneumoniae* exhibited 9.5mm.

After combining the two prominent ingredients MSK & GT ethanol extracts in 1:1 ratio, (Fig 4) antibacterial activity of the sample was much effective at 200µl *E.coli* showed 13mm, *K.pneumoniae* showed 10.5mm, *S.aures* exhibited 12.5 mm zone of inhibition. Phosphomolybdenum assay method was used to determine the antioxidant activity of MSK was 68.26 ± 0.24 mg and GT was 73.41 ± 0.28 mg. Both the extracts showed effective MIC and MBC values in (Table 5).

Table 1. Phytochemical analysis of mango seed kernel

Phytochemicals	Mango seed extract – ethanol
Tannins	-
Saponins	++
Flavonoids	++
Inulin	-
Glycosides	++
Cardiac glycosides	+
Terpenoids	-
Phenol	++
Triterpenoids	-
Steroids	-
Alkaloids	+

Amino acids

+

Fat and oil

-

Table 2. Phytochemical analysis of green tea

Phytochemicals	Green tea extract – ethanol
Tannins	++
Saponins	++
Flavonoids	+
Quinines	+
Glycosides	-
Cardiac glycosides	++
Terpenoids	+
Phenol	++
Coumarins	+
Steroids	+
Alkaloids	++
Antho cyanin	-
Beta cyanin	-

Table 3. Antibacterial activity of MSK extract against UTI pathogens

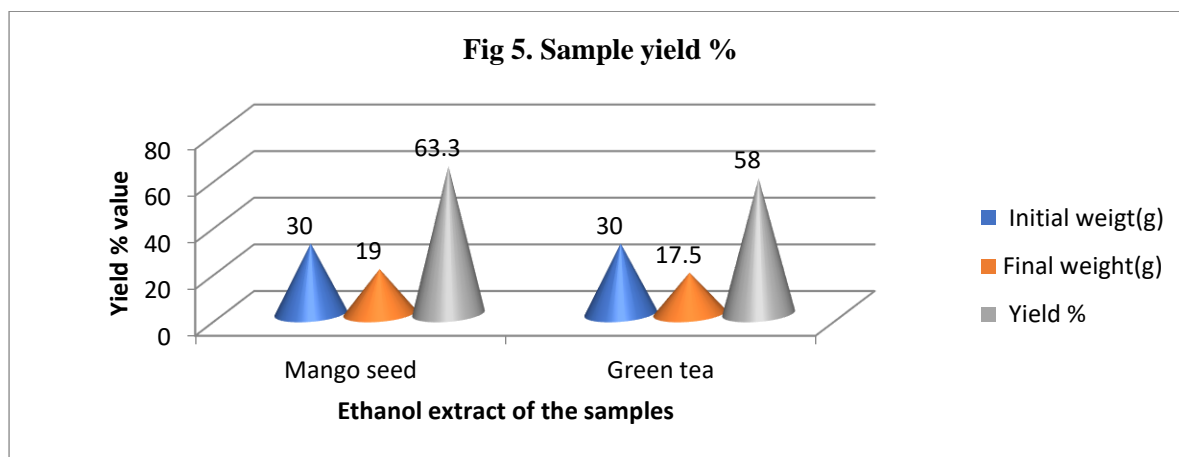
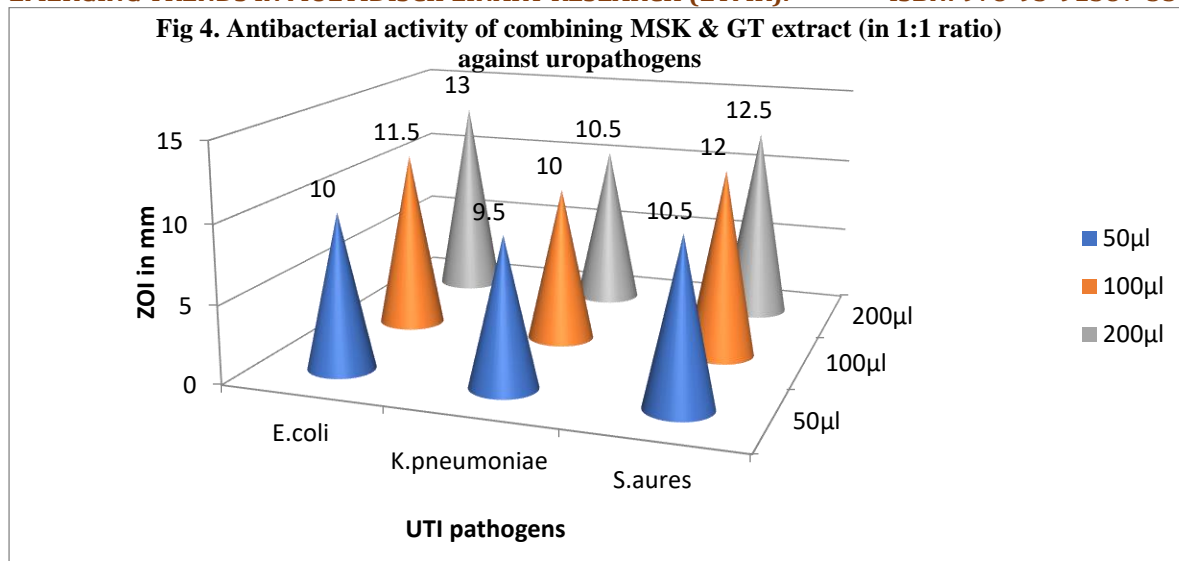
Organisms	ZOI in mm		
	50 µl	100 µl	200µl
<i>E.Coli</i>	9.5mm	11mm	12mm
<i>K.Pneumoniae</i>	8.5mm	9mm	10.3mm
<i>S.aures</i>	9mm	9.5mm	11mm

Table 4. Antibacterial activity of GT extract against UTI pathogens

Organisms	ZOI in mm		
	50 µl	100 µl	200µl
<i>E.Coli</i>	11.5mm	13mm	13.7mm
<i>K.Pneumoniae</i>	9.5mm	9.5mm	10.3mm
<i>S.aures</i>	11mm	11.5mm	12mm

Table 2. MIC and MBC value of MSK & GT extract

S.No	UTI Bacteria	MIC (mg)	MBC (mg)
1.	<i>E.Coli</i>	60	70
2.	<i>K.Pneumoniae</i>	50	60
3.	<i>S.aures</i>	60	70



4. CONCLUSION

This study concludes that natural products are effective in inhibiting the growth of bacteria responsible for UTI. Mango seed kernel and Green tea exhibited effective antibacterial, antioxidant activity. Women are highly suffering from this, thus internal mode of application using natural source cause no side effects. Doesn't promote antibiotic resistant microbes. Naturally available substances are equally effective in

preventing and curing diseases.

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CHAPTER-33

TRANSLATIONAL PERSPECTIVES: ADULT NEUROGENESIS IN TREATING NEURODEGENERATIVE DISEASES

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Abstract:

The study of adult neurogenesis has gained significant attention, particularly in relation to the treatment of neurodegenerative disorders. Neurodegeneration refers to progressive deterioration in the structure and function of neurons in the brain, leading to cognitive dysfunction, memory loss, and motor impairment. Adult neurogenesis is the process by which new neurons are generated in the adult brain. A deeper understanding of adult neurogenesis could open up new therapeutic strategies to treat neurodegeneration and improve brain function. Preclinical studies have revealed that stem cell-based therapies that promote the growth and differentiation of new neurons

in this region could potentially reverse the neuronal damage caused by neurodegeneration. Similarly, several studies have also explored the possibility of pharmacologically enhancing adult neurogenesis, with promising results in animal models of neurodegenerative diseases. In addition to promoting the growth of new neurons, adult neurogenesis also plays a crucial role in regulating neuronal plasticity, synaptic function, and the proliferation of glial cells. These processes are critical for maintaining brain health and cognitive function. In recent years, several clinical trials have explored the use of stem cells in treating neurodegenerative disorders. For instance, clinical studies have shown that autologous mesenchymal stem cells transplantation could improve cognitive function in patients with AD. Similarly, in a phase I clinical trial, neural stem cells transplantation in patients with amyotrophic lateral sclerosis (ALS) showed improvements in muscle strength and respiratory function. While clinical studies have shown some promise, several obstacles still need to be overcome before adult neurogenesis could be used as a mainstream therapy for neurodegeneration. One of the major challenges is the identification of the optimal type of stem cell and protocol for treatment. The heterogeneity of stem cells and the lack of a consensus on the ideal protocol for cell transplantation have resulted in mixed results in clinical studies. Another challenge is the development of safe and effective pharmacological interventions for promoting adult neurogenesis. While several compounds have demonstrated efficacy in animal models of neurodegeneration, their

potential toxicity and side effects in humans need to be carefully evaluated before clinical translation. Additionally, the use of pharmacological interventions in combination with cell-based therapies could further enhance the efficacy of adult neurogenesis in treating neurodegeneration. Overall, translating the potential of adult neurogenesis into clinical practice holds great promise for the treatment of neurodegenerative diseases and improving the quality of life for millions of affected individuals.

Keywords: Adult neurogenesis, Neurodegeneration, Clinical application, Alzheimer's disease, Cognitive impairment

Introduction:

Neurodegenerative diseases, such as Alzheimer's disease, Parkinson's disease, and Huntington's disease, pose one of the greatest challenges in healthcare today. Despite extensive research efforts, effective treatments for these debilitating conditions remain elusive. However, recent advances in our understanding of adult neurogenesis and its role in maintaining brain function have opened up new therapeutic possibilities. This chapter explores the translational perspectives on harnessing adult neurogenesis as a potential treatment strategy for neurodegenerative diseases. One promising avenue is stem cell therapy, which involves transplanting exogenous stem cells into the brain to replace damaged or lost neurons. Several animal studies have shown successful integration and differentiation of transplanted stem cells, leading to functional

improvement and disease modification. Human clinical trials are currently underway to validate these findings [1]. However, challenges such as immune rejection and ethical concerns need to be addressed before this approach can be widely implemented. The chapter reviews the various neurogenic factors and signaling pathways that can be targeted pharmacologically to enhance neurogenesis. For example, the administration of certain drugs such as selective serotonin reuptake inhibitors (SSRIs) have been found to stimulate neurogenesis in the hippocampus [2]. Furthermore, lifestyle interventions such as exercise and environmental enrichment have been shown to enhance adult neurogenesis and improve cognitive function in neurodegenerative conditions. The chapter explores the underlying mechanisms by which these interventions exert their effects on neurogenesis with emphasis on the challenges associated with incorporating these interventions into clinical practice and the need for personalized approaches. Lastly, the chapter provides an overview of the current translational landscape and future directions in adult neurogenesis research for neurodegeneration treatment. In a nutshell, adult neurogenesis holds great promise as a therapeutic target for neurodegenerative diseases. The various translational perspectives discussed in this chapter highlight the potential of stem cell therapy, pharmacological interventions, lifestyle modifications, and anti-inflammatory approaches in harnessing the regenerative capacity of the brain. Although significant challenges remain, ongoing research in this field may pave the way for novel treatments that can slow down or halt disease

progression in neurodegenerative disorders.

Neurogenic Factors and Signaling Pathways in Targeting Neurodegeneration

Recent research has focused on understanding the role of neurogenic factors and signaling pathways in neurodegeneration. These factors and pathways regulate various processes, including neurogenesis, neuronal survival, synaptic plasticity, and inflammation. Targeting these mechanisms may offer potential therapeutic strategies for halting or reversing neurodegeneration.

Neurotrophic factors can be classified into four families: neurotrophins, neurokines, glial cell line-derived neurotrophic factor (GDNF) family of ligands, and cerebral dopamine neurotrophic factor (CDNF)/mesencephalic astrocyte-derived neurotrophic factor (MANF) family. Neurotrophins include nerve growth factor (NGF), brain-derived neurotrophic factor (BDNF), neurotrophin-3 (NT-3), and neurotrophin-4/5 (NT-4/5). Neurokines include ciliary neurotrophic factor (CNTF), cardiotrophin-1 (CT-1), leukemia inhibitory factor (LIF), and oncostatin M (OSM). GDNF family of ligands include GDNF, neurturin, artemin, and persephin. CDNF/MANF family include CDNF and MANF.

Brain-Derived Neurotrophic Factor (BDNF): BDNF is a neurotrophin that promotes neuronal survival, differentiation, and synaptic plasticity. Reduced BDNF levels have been observed in neurodegenerative diseases, contributing to neuronal dysfunction and degeneration. Studies have shown that enhancing BDNF signaling through

pharmacological or genetic interventions can protect against neurodegeneration. For example, Zuccato et al. (2001) demonstrated that BDNF overexpression in a mouse model of Huntington's disease (HD) improved motor function and increased neuronal survival [3].

Insulin-like Growth Factor-1 (IGF-1): IGF-1 is a growth factor that promotes neuronal survival, neurogenesis, and synaptic plasticity. Reduced IGF-1 signaling has been implicated in neurodegenerative diseases. Studies have shown that enhancing IGF-1 signaling can protect against neurodegeneration. For instance, Carro et al. (2002) demonstrated that IGF-1 administration improved cognitive function and reduced amyloid-beta deposition in a mouse model of Alzheimer's disease [4].

Mechanism of action: Neurotrophic factors exert their effects by binding to specific receptors on the surface of neural stem cells or progenitor cells and activating intracellular signaling pathways that regulate cell cycle progression, survival, differentiation, and synaptic plasticity. Neurotrophins bind to two types of receptors: tropomyosin receptor kinase (Trk) receptors and p75 neurotrophin receptor (p75NTR). Trk receptors are tyrosine kinase receptors that mediate the survival and differentiation effects of neurotrophins. p75NTR is a member of the tumor necrosis factor receptor superfamily that can mediate either pro-apoptotic or pro-survival effects of neurotrophins, depending on the co-receptor and ligand availability. **Neurokines** bind

to heterodimeric receptors composed of gp130 and LIF receptor β (LIFR β) or CNTF receptor α (CNTFR α). These receptors activate the Janus kinase/signal transducer and activator of transcription (JAK/STAT) pathway, which is involved in cell proliferation and differentiation. **GDNF** family of ligands bind to heterodimeric receptors composed of GDNF family receptor α (GFR α) and rearranged during transfection (RET) receptor. These receptors activate the phosphatidylinositol 3-kinase/Akt (PI3K/Akt) pathway, which is involved in cell survival and migration. **CDNF/MANF** family bind to unknown receptors that activate the endoplasmic reticulum stress response pathway, which is involved in cell survival and protection.

Signaling Pathways:

Notch Signaling Pathway:

The Notch signaling pathway plays a crucial role in neurogenesis, neuronal differentiation, and synaptic plasticity. Dysregulation of Notch signaling has been implicated in neurodegenerative diseases. Studies have shown that modulating Notch signaling can have therapeutic effects. For example, Ables et al. (2010) demonstrated that activating Notch signaling in a mouse model of AD improved cognitive function and reduced amyloid-beta plaque burden [5].

Wnt Signaling Pathway:

The Wnt signaling pathway is involved in various processes, including neurogenesis,

neuronal survival, and synaptic plasticity. Dysregulation of Wnt signaling has been observed in neurodegenerative diseases. Studies have shown that modulating Wnt signaling can have neuroprotective effects. For instance, Toledo et al. (2008) demonstrated that activating Wnt signaling in a mouse model of PD protected against dopaminergic neuron loss and improved motor function [6].

Inflammatory Pathways:

Chronic inflammation is a common feature of neurodegenerative diseases and contributes to neuronal damage and degeneration. Targeting inflammatory pathways may offer therapeutic potential. For example, the nuclear factor-kappa B (NF- κ B) signaling pathway plays a crucial role in inflammation. Inhibition of NF- κ B signaling has been shown to reduce neuroinflammation and protect against neurodegeneration. For instance, Kaltschmidt et al. (2006) demonstrated that inhibiting NF- κ B signaling in a mouse model of AD reduced amyloid-beta plaque burden and improved cognitive function [7].

Thus, understanding the role of neurogenic factors and signaling pathways in neurodegeneration is crucial for developing effective therapeutic strategies. However, further research is needed to fully elucidate the underlying mechanisms and develop safe and effective strategies for targeting neurodegeneration. Harnessing the potential of neurogenic factors and signaling pathways may provide novel approaches to halt or

reverse neurodegeneration, offering hope for improved treatments for these devastating diseases.

Stem Cell Therapy in Treating Neurodegeneration: A Promising Approach

Stem cell therapy offers a promising approach for treating neurodegenerative diseases by providing a renewable source of cells that can replace damaged or lost neurons. However, further research is needed to overcome the challenges and optimize the efficacy and safety of stem cell-based treatments. With continued advancements in stem cell technology, stem cell therapy may revolutionize the field of neurodegeneration and offer hope for improved treatments for these devastating diseases.

Induced Pluripotent Stem Cells [iPSCs] are generated by reprogramming adult cells, such as skin cells, to a pluripotent state. They share similar characteristics with ESCs and can differentiate into various cell types, including neurons. iPSCs offer the advantage of being patient-specific, reducing the risk of immune rejection. For instance, Liu et al. (2012) reprogrammed skin cells from patients with familial Alzheimer's disease (AD) into iPSCs and differentiated them into neurons, revealing disease-specific phenotypes [8].

Neural Stem Cells (NSCs): NSCs are self-renewing cells found in the adult brain that have the ability to differentiate into neurons, astrocytes, and oligodendrocytes. They hold promise for neurodegenerative diseases as they can be isolated from the patient's own brain or generated from pluripotent stem cells. For example, Blurton-Jones et al. (2009)

transplanted NSCs into a mouse model of AD and observed improved cognitive function and reduced amyloid-beta plaque burden [9].

Mechanisms of Action:

Neurotrophic Support:

Stem cells can provide trophic support and increase cell survival and plasticity. For instance, Chen et al. (2013) demonstrated that transplantation of human umbilical blood-derived NSCs into a mouse model of AD increased the levels of neurotrophic factors and improved cognitive function [10].

Modulation of Inflammation:

Chronic inflammation is a common feature of neurodegenerative diseases and contributes to neuronal damage and degeneration. Stem cells have been shown to modulate inflammation by secreting anti-inflammatory factors and promoting the activation of immune cells with neuroprotective properties. For example, Lee et al. (2010) demonstrated that transplantation of human umbilical cord blood-derived NSCs into a mouse model of PD reduced neuroinflammation and protected against dopaminergic neuron loss [11].

While stem cell therapy holds great promise for treating neurodegenerative diseases, several challenges need to be addressed. These include optimizing the differentiation protocols to generate specific neuronal subtypes, ensuring long-term survival and integration of

transplanted cells, and minimizing the risk of tumor formation. additionally, ethical considerations and regulatory frameworks surrounding the use of embryonic stem cells need to be carefully addressed.

Environmental Enrichment and adult neurogenesis

Environmental enrichment (EE) and cognitive stimulation are two non-pharmacological interventions that have been shown to promote adult neurogenesis and thereby treat neurodegeneration [12]. Environmental enrichment refers to the provision of a complex and stimulating environment that includes social interaction, physical activity, and cognitive challenges [13]. Cognitive stimulation, on the other hand, involves the use of various activities that challenge the brain, such as puzzles, games, and learning new skills. Both environmental enrichment and cognitive stimulation have been found to increase the production of new neurons in the hippocampus, a region of the brain that is important for learning and memory [14].

Studies have shown that environmental enrichment can improve cognitive function and ameliorate depressive and anxiety-like behaviors in animal models [15]. Environmental enrichment has also been found to promote neurogenesis in the hippocampus of adult rodents. The mechanisms underlying this effect are not fully understood but may involve increased levels of brain-derived neurotrophic factor (BDNF), a protein that promotes the survival and growth of neurons [16]. Other factors that have been implicated in

promoting adult neurogenesis include exercise, diet, and stress reduction [17].

Cognitive stimulation has also been found to promote adult neurogenesis in animal models. For example, studies have shown that exposure to an enriched environment can increase the number of new neurons in the hippocampus of adult rats [14]. Similarly, cognitive stimulation using environmental enrichment has been found to protect against memory decline in transgenic mouse models of Alzheimer's disease [13]. The mechanisms underlying this effect are not fully understood but may involve increased levels of BDNF and other growth factors [13].

The promotion of adult neurogenesis through environmental enrichment and cognitive stimulation has potential therapeutic implications for neurodegenerative diseases such as Alzheimer's disease. Studies have shown that environmental enrichment can improve cognitive function and reduce amyloid-beta deposition in transgenic mouse models of Alzheimer's disease [16]. Similarly, cognitive stimulation using environmental enrichment has been found to protect against memory decline in transgenic mouse models of Alzheimer's disease [13]. These findings suggest that environmental enrichment and cognitive stimulation may be effective non-pharmacological interventions for treating neurodegeneration [17].

Exercise and Adult Neurogenesis: Potential Therapy for Neurodegeneration

Neurogenesis may offer a potential mechanism for brain repair and regeneration in these

conditions, as well as a way to enhance cognitive function and mood in healthy individuals [18]. However, the factors that regulate neurogenesis in the adult brain are not fully understood, and the therapeutic potential of modulating neurogenesis is still under investigation.

One of the most influential factors that affects neurogenesis in the adult brain is physical exercise. Physical exercise is known to have various beneficial effects on health, such as improving cardiovascular function, glucose metabolism, and preventing osteoporosis and cancer [19]. Moreover, physical exercise has been shown to modulate brain physiology through a network of long- and short-range cellular interactions, involving multiple organs, systems, and molecules [19]. Physical exercise can enhance neurogenesis in the adult hippocampus by increasing the proliferation, survival, differentiation, and integration of new neurons [20, 21]. The mechanisms underlying this effect are complex and multifactorial, involving both intrinsic and extrinsic factors. Some of the intrinsic factors include neurotrophic factors, such as brain-derived neurotrophic factor (BDNF), vascular endothelial growth factor (VEGF), insulin-like growth factor-1 (IGF-1), and fibroblast growth factor-2 (FGF-2), which are released from various sources, such as skeletal muscle, liver, endothelial cells, astrocytes, and neurons themselves [20, 21]. These factors can stimulate neurogenesis by binding to their receptors on neural stem cells or progenitor cells and activating intracellular signaling pathways that

regulate cell cycle progression, survival, differentiation, and synaptic plasticity [20,21].

Another intrinsic factor that mediates the effect of physical exercise on neurogenesis is inflammation. Physical exercise can modulate the inflammatory response in the brain by altering the balance between pro-inflammatory and anti-inflammatory cytokines, such as interleukin-1 beta (IL-1 β), tumor necrosis factor-alpha (TNF- α), interleukin-6 (IL-6), interleukin-10 (IL-10), and transforming growth factor-beta (TGF- β) [20]. These cytokines can have either positive or negative effects on neurogenesis, depending on their concentration, timing, and context. For example, IL-1 β and TNF- α can inhibit neurogenesis by inducing apoptosis or cell cycle arrest of neural stem cells or progenitor cells, while IL-6 and IL-10 can promote neurogenesis by enhancing cell survival and differentiation.

Some of the extrinsic factors that influence the effect of physical exercise on neurogenesis are environmental enrichment, social interaction, learning, stress, diet, and circadian rhythm. These factors can modulate neurogenesis by affecting the availability or activity of intrinsic factors or by directly stimulating or inhibiting neural stem cells or progenitor cells [21]. For instance, environmental enrichment can increase neurogenesis by providing sensory stimulation and cognitive challenges that increase BDNF expression and synaptic plasticity. Social interaction can enhance neurogenesis by reducing stress levels and increasing oxytocin release. Learning can promote neurogenesis by inducing

neuronal activity and synaptic plasticity that facilitate the integration of new neurons into functional circuits. Stress can suppress neurogenesis by increasing glucocorticoid levels and activating the hypothalamic-pituitary-adrenal (HPA) axis. Diet can affect neurogenesis by modulating energy metabolism, oxidative stress, inflammation, and hormonal balance. Circadian rhythm can regulate neurogenesis by synchronizing the expression of clock genes and hormones that control cell cycle progression and differentiation [21].

The potential therapeutic implications of physical exercise-induced neurogenesis for neurodegenerative diseases are promising but still need further validation. Several studies have shown that physical exercise can improve cognitive function and mood in patients with AD or PD, as well as in animal models of these diseases. However, the causal relationship between exercise-induced neurogenesis and behavioral outcomes is not clear, as other mechanisms may also contribute to the beneficial effects of physical exercise, such as neuroprotection, angiogenesis, synaptogenesis, and neuroinflammation. Moreover, the optimal type, intensity, duration, and frequency of physical exercise for enhancing neurogenesis and cognition are not well established, and may vary depending on the individual characteristics and disease stage of the patients.

Conclusion

- **Future Directions and Research Priorities:** Several approaches have been explored to

modulate adult neurogenesis in animal models, including environmental enrichment, physical exercise, pharmacological interventions, and stem cell transplantation. These interventions aim to promote the survival, migration, and integration of newborn neurons into existing neural circuits [22]. Translating these findings into clinical applications and developing effective neurodegeneration treatments, however, poses several challenges and limitations. Firstly, it is crucial to determine the optimal timing and duration of neurogenesis modulation to achieve therapeutic benefits. The dynamic nature of neurodegenerative diseases necessitates careful consideration of treatment windows and their effects on disease progression [23]. Additionally, enhancing neurogenesis may not be a viable option in all neurodegenerative conditions. For instance, some diseases involve abnormal protein aggregation and neuroinflammation, which can inhibit neurogenesis. Understanding the specific pathological mechanisms underlying different conditions is essential to guide treatment strategies

accurately [23]. Furthermore, delivering interventions to specific brain regions poses technical challenges. The blood-brain barrier (BBB) limits the passage of therapeutic agents into the brain, making it difficult to target neurogenesis-enhancing molecules. Developing efficient methods to bypass or permeate the BBB is a crucial step in translating these techniques into clinical practice.

Moreover, the innate complexity of adult neurogenesis necessitates a better understanding of the mechanisms regulating neurogenesis and its interaction with other processes such

as aging and inflammation. Further research is needed to elucidate the signaling pathways, molecular cues, and epigenetic factors involved in neurogenesis to design more targeted interventions [24,25]. While preclinical studies in animal models have shown promising results regarding neurogenesis modulation and its potential benefits for neurodegenerative diseases, moving forward into clinical trials is essential. Conducting well-designed and rigorous clinical trials will help determine the safety, efficacy, and long-term effects of targeting adult neurogenesis in humans.

In conclusion, targeting adult neurogenesis holds significant potential as a therapeutic strategy for neurodegenerative diseases. However, several challenges and limitations need to be addressed to translate these findings into effective clinical applications [25]. Optimizing treatment windows, understanding disease-specific mechanisms, overcoming BBB limitations, and conducting thorough clinical trials are critical steps for future research in this field.

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CHAPTER-34

NANOCRYSTALS: SYNTHESIS AND PROPERTIES OF METALLIC GLASS

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Abstract:

A decisive part of fashionable nanoscience and nanotechnology is played by nanocrystals. Nanocrystals can also be covered and applied to stretchy substrates to crop solar panels. Early exertions in nanocrystal research were primarily concerned with diversity and the achievement of inimitable structures (for example, shape and size control). The relationship between the micro-mechanisms of nanocrystalline formation in the metallic glass while milling has not been thoroughly investigated, despite numerous advances being made in recent years to progress the mechanism of crystallization of metallic glass using annealing or deformation processes. This chapter focuses mostly on the synthesis of nanocrystals in metallic glasses and their involvement in the characteristics of metallic glasses.

1. Introduction:

A nanocrystal is a microscopic particle with at least one dimension less than 1,000 nanometres and is primarily made up of crystalline components. The definition of a nanometre is one thousand-millionth of a meter or 10^{-9} m in decimal form. A nanoparticle

is referred to as a quantum dot if its size is less than 10 nanometres [1–5]. For the creation of imminent non-volatile, high-density, and low-power memory systems, nanocrystals are attracting a lot of attention [6–8]. Recent years have seen the development of a wide range of nanostructures, from atomically accurate nanoclusters of tens of atoms to shape-controlled polyhedral nanocrystals of tens of nanometres in size. Such materials have also found an inclusive range of uses, including in optical, electrical, catalytic, optoelectronic, chemo- and bio-sensing, and nanomedicine fields [9–12]. For instance, silicon nanocrystals can emit light effectively, although this is not possible in bigger silicon samples. This implies that they can be included in the design of computer memory chips. Similarly, solids containing nanoparticles melt in fascinating ways as compared to other, more common solids, and as a result, they belong to a unique, specialized class of solids with unique properties [13–15]. This chapter primarily focuses on the synthesis of nanocrystals in metallic glasses and how they affect such glasses properties. Amorphous alloys and metallic glasses have different properties; however, they are both used interchangeably in this chapter. For a description of the distinctions between amorphous alloys and metallic glasses, the interest in nanocrystals for metallic glasses is driven by two interrelated factors. In order to study crystallization reactions from the stand point of fundamental material science, metallic glasses offer a highly useful approach. An extremely practical method for researching crystallization reactions is using metallic glasses [16–17]. In contrast, the crystallization of metallic glass

can be triggered by a "slow-motion" procedure that allows for minute test considerations of the crystallization procedure [18-19]. The motivation currently driving the idea of incorporating nanocrystals in metallic glasses is much more practical and relates to changes in characteristics. Iron-based metallic glasses are some of the most reliable metal-based glasses, and it was soon discovered that the soft-magnetic properties of transition-metal nanocrystals were improved by their crystallization [20-22]. The combination of metallic glass/nanocrystal composite materials has advanced toward a considerably broader range of applications, particularly toward auxiliary ones. As though a grasp of the nanocrystal arrangement empowers a regulated synthesis, and therefore controlled advancements in characteristics, the role of nanocrystals for primary crystallization ponders and for applications are connected.

2.Synthesis of nanocrystals

2.1.1 Growth of crystallites in metallic glasses

The fastest (development instrument functioning parallel) or slowest (successive) preparation determines the growth rate depending on whether midway forms act in a parallel or consecutive manner. Since the nanocrystals that have been synthesized in metallic glasses based on warm handling are frequently essential nanocrystals and as a result require a solute redistribution or dissemination during development, diffusional

development is of particular interest for the arrangement of nanocrystals in metallic glasses [23].

2.2 Mechanical processing – deformation-induced crystallization

The fastest (development instrument functioning parallel) or slowest (successive) preparation determines the growth rate depending on whether midway forms act in a parallel or consecutive manner. Since the nanocrystals that have been synthesized in metallic glasses based on warm handling are frequently essential nanocrystals and as a result require a solute redistribution or dissemination during development, diffusional development is of particular interest for the arrangement of nanocrystals in metallic glasses [24].

2.2.1 Experimental Findings for deformation-induced Crystallization

The range of external driving modes for crystallization can therefore include electrochemical intelligence with metallic glasses. The preliminary evidence for deformation-induced crystallization is discussed in the following. At that point, a summary of instruments for externally driven crystallization is given. A summary of crystallization that has been impacted by deformation concludes this section. Distortion can affect crystallization among warm drugs that take after distortion, as opposed to deformation-induced crystallization. According to historical records, research on the

impact of rolling or malleable stacking on annealing-induced crystallization began in the early 1970s. It wasn't until the early 1990s that deformation-induced crystallization was discovered [25-28].

Morphology of nanocrystals

Studies using transmission electron microscopy have frequently demonstrated that nanocrystals forming in amorphous matrices have a spherical shape during their initial growth stages, which occur when they are between 5 and 10 nm in size.

2.2.2 Mechanisms for deformation-induced crystallization

The main challenge in empathetic the mechanism of deformation-induced nanocrystal formation in metallic glasses is to distinguish between thermal and thermal effects. Under the strong deformation modes that have been used to induce nanocrystals, it is unavoidable that shear bands develop during the deformation process [29].

2.3 Mechanical processing – deformation prior and during thermally induced crystallization

The first correlation between deformation and crystallization was historically established for cold-rolling of melt-spun glassy ribbons followed by tempering. Crystallization responses can occur during deformation at room temperature. Since then,

both cold-rolling and uniaxial compression have been examined in relation to the arrangement of deformation and annealing. In a third group of studies, deformation occurred during annealing. The stress state can be changed in this series of studies; hydrostatic and uniaxial stress states were investigated to see how they affected thermally induced crystallization [30].

2.3.1 Deformation followed by thermally induced crystallization

Starting in the 1970s, studies on the impact of cold-rolling on crystallization behavior were conducted, but at first, the cold-rolling experiments were followed by annealing processes [31]. In these investigations, the impact of cold rolling on the thermally induced crystallization process was investigated.

2.3.2 Deformation superposed on thermally induced annealing

The thermally induced annealing process was under the influence of hydrostatic and uniaxial tensile stresses. Several investigations for melt-spun amorphous flags and bulk metallic glasses have examined the impact of hydrostatic stress conditions on crystallization. Emmens and coworkers observed a shift in the crystallization onset temperatures to higher temperatures when studying the crystallization behavior of $\text{Pd}_{75}\text{Ag}_5\text{Si}_{20}$ metallic glass under a hydrostatic load of 600 MPa. They claimed that an increase in hydrostatic compression increased the nucleation rate because the

crystallizing phase had a higher density. The growth rate was slowed down concurrently because of a summarized mobility under hydrostatic pressure [31].

2.4 Mechanical processing of metallic glass/crystal composites

The mixture approaches for metallic glass composites containing crystalline second phases fall into one of two universal categories. Crystallites can develop “in-situ”, i.e., during the annealing of metallic glass precursors or during the quenching of the liquid alloys into glassy metals. This approach is very useful and effective for the synthesis of metallic glasses containing nanocrystals. In totalling to the annealing of metallic glasses and the establishment of crystallites directly during quenching, metallic glass/crystal composites can be synthesized “ex-situ”. The maximum important example of ex-situ processing is melt-infiltration [32]. In this method metallic glass is heated up to the supercooled liquid state and subsequently lacking into a form containing the second phase. The form containing the metallic glass and the second phase is then quenched. The second phases that have been used so far embrace metals, alloys, and non-metallic materials. Different shapes have been used including fibres, rods, or particles. A major advantage of the melt-infiltration process is that the volume segment of the second phase can be raised beyond the thermodynamic limits inherent to current processing. On the downside it is very hard to achieve dispersions of nano-sized second phases without agglomeration of the second phase particles [33].

3. Properties of nanocrystals in amorphous matrices

Most studies of nanocrystal/metallic glass mixtures focus on the overall composite properties and the effect of the nanocrystals on the composite properties. From particle-matrix composite studies with crystalline materials, it is known that not only the magnitude distribution and particle number densities determine the composite possessions, but furthermore the geomorphology of the particles, the flaws that might exist in the particles, and the particle composition. This chapter highlight the current knowledge of defects in nanocrystals that are fixed in metallic glasses, their morphology and composition.

3.1 Defects in nanocrystals

Thermally encouraged nanocrystals in metallic glasses were primarily considered to be defect free. This notion looks to be true for the vast majority of nanocrystals that develop during annealing of amorphous ancestor alloys. Most surveys focused on Al-based amorphous alloys and open a defect free nature of the Al nanocrystals that grow to about 20 nm in size during controlled heat treatment. Aronin, yet, reported in 2001 the presence of twins and dislocations in Al nanocrystals of strengthened $\text{Al}_{86}\text{Ni}_{11}\text{Yb}_3$ melt-spun ribbons for a nanocrystal with a size of about 25 nm [34].

4. Properties of Nano Crystals

4.1 Mechanical properties

Metallic glasses generally offer strong strength, elastic elasticity, and frequently additional beneficial qualities like excellent wear resistance. The vastly differing deformation mechanisms are what cause the wide variations in mechanical behaviour between crystalline and amorphous metals. Defects that cause crystalline materials to twist plastically include dislocations, loading faults, and twins. Most metallic glasses deform at threshold stress at ambient temperature, causing shear bands to form and spread [35].

4.2 Wear properties

Since 1979, wear characteristics of metallic spectacles have been researched. Wear studies on Fe-based and later Al-based metallic glass melt-spun ribbons were presented prior to the discovery of bulk metallic glasses. The vast majority of studies on the influence of metallic glass crystallites on wear characteristics show improvements in wear behaviour with crystallite establishment. For instance, the wear resistance of $\text{Al}_{88}\text{Ni}_4\text{Sm}_8$ metallic glass increased initially before plateauing [36].

4.3 Corrosion properties

Overall, metallic glasses corrosion behaviour compares favourably to that of their crystalline counterparts, The absence of mechanical or chemical inhomogeneities such as grain boundaries or inclusions helps explain why single-phase metallic glasses exhibit less corrosion. Metallic glasses are advised to encourage the production of amorphous oxides [37]. Numerous metallic glasses reveal solute levels that are significantly higher than those of their crystalline equivalent systems.

5. Conclusion

Nanocrystals can provocatively improve the properties of metallic glasses, for example, mechanical properties or magnetic properties. Some progress has been made to escalate the mechanisms behind these enhancements, but in numerous cases, a clear consideration has not been achieved, yet. Arguably the greatest stimulating part of nanocrystals in metallic glasses, though, is the longest-standing issue: their synthesis. Changes in local atomic configuration or changes in nanocrystal number thicknesses by orders of magnitude, or deviations in the phase creation with a 1 at % alloying calculation offer exhilarating opportunities to enterprise new composite materials.

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CHAPTER-35

NEED AND ROLE OF RESEARCH IN BANKING AND FINANCIAL INDUSTRY 5.0.

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Abstract

Banks and financial institutions play very important role in economic development of any country, so is the case of India. There is lot of importance of banking sector in Indian economy. Not only banks but other financial institutions than the banks are also very important for the country's financial growth. Research is very necessary to enlighten the people with financial literacy. Not only to individuals but it is also necessary for companies to get the latest information and utilize it for their benefit in future. Banks and financial institutions have power to alter how money is governed nationwide as well as international. India is on the path of becoming superpower. We are going to set new standards and trends in industry 5.0. market research is therefore very necessary to be carried out whether online or in- person so that the new trends can be set up and the firms worldwide can serve to the people with the financial services. We Indians have

unmatched knowledge and passion for financial sector and that is to be utilized with the research in this sector. This chapter puts the light on the need and role of research in banking and financial industry 5.0.

Keywords: Financial industry, Financial Industry 5.0, Digital twins, Blockchain technology, Cobots.

Introduction

Financial industry is a backbone of any economy. Days have gone when everything was manual, and people purposely neglected the use of technology in financial sector. The industrial revolution has transformed the whole world substantially. The first three industrial revolutions were related to the mechanization, electrification, and automation of various processes. Nowadays Automation, robotization, big data analytics, smart systems, virtualization, AI, machine learning, and the Internet of Things are all components of Industry 4.0, a fourth industrial revolution made possible by IT developments. Industry 5.0, on the other hand, is already in motion, posing fresh difficulties and having repercussions for the present and next company plans (Fdez, 2022). In the financial sector research is crucial. For doing financial data analysis, supplying various information on market trends as well as giving recommendations to investors and customers, research is required. With the increasing technology and data

driven decision-making in banking and financial sector industries, the function of research is increased. It covers the essential duties like finding out opportunities and difficulties that may be faced in present and future((25) *Exploring the Role of a Research Analyst in the Financial Services Industry* / *LinkedIn*, n.d.). Fintech companies are nowadays very keen to pay attention to the consumer trends. People are now using digital tools to manage their accounts, pay online, and take money online from the different sources. Even elderly people and the people with less knowledge of digitization can do various cashless transactions with the help of their smartphones. That is the reason financial businesses are springing up like mushrooms. Other than these consumers still have confidence in traditional banking system, lending institutions and non-banking financial companies. As a result, many established financial services providers have expanded their services to fintech divisions(White, 2022). Banking 5.0 is a very powerful foundation of the changing customer needs for services and business models. It is again a part of industrial revolution. It is innovative and challenging. Financial sector 5.0 is very advanced and still need research to make it dynamic.

Characteristics of banking and financial industry 5.0

- Banking managers are required to take strategic decisions for the accuracy of transactions with the help of AI.
- Technological innovation makes the finance managers to introduce new revolution in the

financial industry.

- It's a big challenge to collaborate with creativity of human being with that of accurate, efficient, and intelligent machines.
- Learning skills for the use of internet of things, machine learning, big data analysis and artificial intelligence is a big challenge.
- Use of Crypto currency for the purpose of doing business is restricted in some countries. Whereas nowadays many countries want to authorise this currency.
- Growth of technology like artificial intelligence and virtual reality as well as voice recognition systems have made financial sector to reset their style and strategy to carry out business very fast.
- Nowadays it is not necessary to carry out banking activities in banks instead all banking and financial transactions can be carried out anywhere and anytime so for that technology is to be upgraded very quickly.
- Stock market is also adopting electronic technology that is the reason there is no need for paper but computers and software.

Need and role of research to be carried out for implementation of financial industry 5.0.

- Using Digital twins which are the digital replication of physical system and can be used to digitally represent real world objects. Digital twins can be integrated to value creation and customization of various financial products in markets to enhance the functioning of

financial businesses and develops various models to increase the profitability of the financial sector. There is requirement of research in the field of technology to smoothly implement the digital twins.(Soomro et al., 2022).

- Blockchain technology is the key feature of financial industry 5.0 it facilitates the transparency and transfer of funds efficiently. It will lead to secured transactions, reliability, and reduction of intermediaries. But still there is a need for improving and advancing the blockchain technology.
- Use of Cobots (Collaborative robots) which use smart technology and artificial intelligence to synchronize various financial transactions will be helpful to make the all the financial transactions customized. A lot of research is required in this field to combat the technology with the demand for it.
- Use of Big data will be very helpful for managing the credit services, auto-payment system, risk management and fraud detection. Big data can be used to reconstruct the sophisticated decision making models which can be employed to have predictive analysis and monitor different expenditure incurred in financial sector (Team, 2023).
- There is need to do research in the field of mobile data and internet as 4G and 5G will not be enough to adopt the new technology and implement in the field of financial sector so there is need to adopt and experiment with 6G and beyond technologies.
- Internet of Things had brought a revolution in financial sector it had transformed banking sector, IoT had facilitated real time data to give individualized and customized

financial services.

- Tracking of customer preferences and predicting their behaviour had led to the financial companies to initiate offer the required services to customers before they understand their need.
- Advanced security is required in the financial sector so there is great need for research in the field of data privacy and fraud detection. People need to do faster transactions and with full security. Systems should be developed to provide security to financial institutions as well as individuals.
- Upskilling and re-skilling is required at the employee level so that they can also enhance their knowledge for tackling the financial sector issues.

Conclusion

Research is backbone of all invention. So is the case of financial industry. Due to introduction of online banking, online trading in stock markets, mobile banking, mobile wallets and various other online financial services the financial sector 5.0 is incepted and it is just a start. The future is unexpected. Revolutions are yet to come. With the advent of banking 5.0 banks will leverage data to customers to get personalized and customized experience while doing transactions. Almost the whole financial industry will be dominated by artificial intelligence which will convert the financial sector 4.0 to financial sector 5.0. The global economy is transforming the financial sector with the help of

fintech companies and in this digital economy banks and financial institutions focus on adopting new technologies.

(Jio Financial: Jio Financial Services to Be Excluded from NSE Indices from September 7 - Times of India, n.d.)

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CHAPTER-36

E-LEARNING APPS: CONSUMER SATISFACTION IN MADURAI CITY

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Abstract

This learning environment uses Information and Communication Technologies (ICT's) as a platform for teaching and learning activities. As this teaching and learning pedagogy earns high momentum amidst teaching and student community, the researchers belonging to the respective communities undertook this study with the sole purpose of finding out the effect of e-learning apps in this high technology invaded the digital world with X-Generation learners. This study is descriptive and analytical. This research paper focuses on customer awareness, preference, and the level of satisfaction towards eLearningapps. The researcher has formulated core objectives relevant to the study and, both primary and secondary data are collected from the customers belonging to Madurai City. This study has well defined the number of e-Learning apps to fulfill the objectives of the study with the help of the statistical techniques. The researcher has used

the IBM SPSS statistics tool for data analysis and interpretation. The study reveals the fact that despite the majority of the respondents supporting e-learning methodology but there are a handful of respondents who strongly believe that e-learning cannot replace face-to-face teaching and a tight bond between a teacher and a student.

Keywords: E-Learning, IBM SPSS Statistics, Traditional Classroom, Digital Resources, Awareness and Moodle

Introduction

E-learning is a computer-based educational tool or system that enables us to learn anywhere and at any time. E-learning provides training or educational courses with the help of some electronics equipment such as a) a computer or a mobile computing device like a notebook, a tab, or smart mobile phone, b) some multimedia support equipment in the form of the mike, speakers, video camera, LCD projectors, CDRoms/DVDs, touch screens, light pens, smart boards, video-conferencing, etc., Honorable Prime Minister., Mr. Narendra Modi's government implemented some schemes like SWAYAM (Study webs of Active- learning for young aspiring minds): Under this program, professors of centrally funded institutions like IITs, IIMs will offer online courses to citizens of our country. The content can be easily accessed by students, working professionals, and

researchers across the country through laptops, smart phone, and tablets. E-learning offers an alternative that is faster, cheaper, and potentially better.

Statement of the Problem

There are several trends impacting the increased use of E-Learning. The ever-increasing global pressure to conform to the fast-paced changes in electronic communications today constantly renders current practices essential in a few years. So the researchers are interested in knowing about the customer awareness and preference towards e-learning applications and knowing about their level of satisfaction among e-learning apps.

Scope of the Study

Despite affirmative steps taken by the government in the form of national programs on technology-enhanced learning, national mission on education, national knowledge network, the gap between demand and supply in higher education is still high. So the researchers have taken only popular and significant apps for conducting the survey. The study is confined to the customers who use e-learning apps like BYJU'S, linked in learning, English-Tamil dictionary, the Hindu app, Dailyhunt (Newshunt), Kindle, Wikipedia (Encyclopedia), TED, TNPSC Tamil, Vision IAS, U-Dictionary, MOODLE, Office automation apps, Multimedia apps, National Geographic, BBC News service, English dictionary-thesaurus, Oxford Dictionary of English, and Bible.

Objectives

1. To locate the meaning of e-learning.
2. To find out customer awareness of e-learning apps.
3. To know the customer preference toward e-learning apps.
4. To evaluate the level of satisfaction toward e-learning apps.

Methodology

This study is descriptive and analytical.

Sources of Data: The study is based on both primary and secondary data.

Primary Data: Primary data is the information collected directly from the respondents. It is first-hand information. Primary data is collected from customers who use e-learning apps through structured questionnaires.

Secondary Data: Secondary data are data that have already been collected by someone. Secondary data is composed of experiments or surveys, books, journals, websites, and newspapers.

Sampling Design: The population of the study is e-learning apps users. A simple random sampling technique is used.

Sample Size: The size of the sample for the study is 100 respondents.

Geographical Area of the Study: The vicinity of the study is limited to Madurai city only.

Period of the Study: The period of the study is 2019-2020

Limitations

1. The study is confined only to Madurai city.
2. The opinion and satisfaction level of E-learning app usage does not remain the same in the minds of consumers for a long duration.
3. E-learning depends on technology because not all people have stable internet access and computers that are powerful enough to support online streaming.

Analysis and Interpretation Demographic Profile of the Respondents

The study implies that 34% of the respondents belong to 18 – 21 years. In the gender-wise classification of the respondents, 73% of the people were female, and 27% of the people were male, and 56% of the people who do not earn income were using E-Learning applications. It was found that the respondents of 18 -21 years of age group and the female respondents were mostly using E-Learning applications. In the educational qualification, 34% of the respondents were undergraduate. In the occupation-wise classification, 59% of the respondents are students, and it was observed that 74% of the respondents are unmarried, and 26% of the respondents are married. It was concluded that most of the respondents are undergraduate students, and unmarried were using E-Learning applications compared to others.

Awareness of e-Learning apps

The study clearly states that 78% of the respondents have Multimedia apps, and 51 % of the respondents have Games, and 82% of the respondents do not have Translators, and 70% of the respondents do not have Learning apps.

e-Learning Apps that are Aware of Downloaded and Used

The study reveals that 60% of the respondents are aware of The Hindu app, TNPSC Tamil app and 59% of the respondents are aware of BYJU'S app, 58% of the respondents are aware of English – Tamil Dictionary, Wikipedia (Encyclopedia), TED, Linked in learning, National geographic channel, 51% of the respondents have downloaded English – Tamil Dictionary app, 32% of the respondents have downloaded, and Dailyhunt (Newshunt), 31% of the respondents have downloaded Oxford Dictionary of English, 51% of the respondents have used the English – Tamil Dictionary app and 30% of the people have used the Oxford Dictionary of English, and 29% of the respondents have used Dailyhunt (Newshunt).

Concept Regarding the usage of e-Learning Apps From the study, it is understood that 2.64% of the respondents often use E-Learning applications, and 2.58% of the respondents think that E-Learning is costlier than classroom learning. Also, they suppose that Classroom learning is more expensive than E-learning.

Opinion of e-Learning Apps from the Customer's Perspective

About the opinion of e-learning apps from the customers, it shows that 4.24% (Mean Score) of the people like the idea of E-learning apps, 4.13% (Mean Score) of the respondents are identified that it is necessary to have high-quality E-learning apps, and 4.04% (Mean Score) of the respondents think E-learning is an innovative concept and must be encouraged.

Preference of e-Learning Apps has been Given by the Respondents from One to the Sixth Rank From the study, it is understood that learners can learn in their leisure time and convenient place ranks first with Garrett mean score of 60.64 among the respondents, and E-Learning can save costs and time ranks second with Garrett mean score of 55.87 among the respondents.

Significance of E-Learning Apps

The study reveals that in the significance of E-learning apps from the customer's perspective shows E-Learning should be offered fully online to teach students living in a remote area is 4.30% (Mean Score), and E-Learning should be adopted to allow working students to study from office is 4.17%, (Mean Score) E-Learning increases the quality of teaching & learning because it integrates all forms of media: Print, Audio, Video, Animation is 4.08%.

Satisfaction towards e-Learning Apps

The study reveals that 4.31%(Mean Score) of the respondents think that E-Learning is useful for learning/teaching, 4.09%(Mean Score) of the respondents are compatible with general browser on familiar hardware such as PCs, mobile devices, tablets, etc. and 4.15%(Mean Score) of the people are satisfied that Distance education (E-Learning) is worth the time.

Limitations towards e-Learning Apps

The data shows that 4.09% (Mean Score) of the respondents believe that E-Learning experiences cannot be equated with face-to-face learning, 3.99% (Mean Score) of the respondents think that lack of constant net high connection and charges for the services.

Suggestions

The classroom environment will help the student to grow in all ways, and this is a great opportunity for those who should keep the education continue and make knowledge which gains from the classroom environment.

Support for offline content is must-have for E-learning apps. This feature allows the user to download the course content and access it at their convenience. So, the learners won't have to worry about connectivity issues, slow loading, and excessive battery consumption, which helps them focus on what really matters-learning.

Online education is a good platform for the people who are not able to complete their studies, which they had left due to any reason. So due to that, they can be easily able to get a good position in a job. E-learning is also providing an opportunity for self-learners virtually.

E-learning is easy to capture at anytime, anywhere, and they can learn their desired subjects through online education with stable internet access. Moreover, this also allows students to organize their time more effectively.

Without the physical presence of the teacher, learners can't learn properly. And also, learners wanted to accept all the foreign learning styles like E-learning apps.

E-learning will help the student to learn completely by giving more timely knowledge.

Learners can decide their speed of learning from the E-learning instead of following the velocity of the whole group from the classroom learning.

Conclusion

E-learning is not just a change in technology. It has brought a positive impact on the lives of students and working professionals. So it is a redefinition of transmitting knowledge, skills, and values to younger generations of workers and students. In the era of digitalization, the scope of E-learning increases even more and will be beneficial for students, professionals, and also institutions. So this study shows that the level of satisfaction on the usage of E-learning apps among consumers.

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CHAPTER-37

IMPACT OF PARTICIPATING TEACHING AND LEARNING METHODS IN EDUCATION FOR SUSTAINABLE DEVELOPMENT

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Abstract:

The key elements in the implementation of education are the students themselves. Their motivational readiness to learn depends inter alia on the emotional state of mind, cultural and educational backgrounds. Emotional status and disposition also have an effect on what will be their approach to learning. Motive is an internal momentum that causes a change in human's behaviour and to leads to his needs. Much of the criticism has been directed to higher education in Slovakia over the decades. It is argued that the current education focuses more on acquiring encyclopaedic knowledge rather than promoting the creativity to develop ability to identify problems. Participative teaching methods are didactic methods, strategies and techniques that are focused on

encouraging students to become actively involved in their learning process. They also aim to raise students' awareness and sense of responsibility about the organization, management and evaluation of their educational experience. Participative teaching includes a set of didactic strategies and techniques that aim to promote a more active role of students in the learning process. This implies not only to engage students' interest in theoretical lessons, encouraging group discussions and critical reflections, but also to involve them in more practical activities, to connect academic achievement with real-life issues and to understand the impact of the individual actions on the community. The word participatory comes from participation, which refers to the action of taking part in activities and projects, the act of sharing in the activities of a group. The process of participation fosters mutual learning. The participatory learning strategy has its theoretical basis in the behaviorism as well as in cognitive and social psychology. Collaboration is a useful tool used within participatory culture as a desired educational outcome. The Partnership for twenty-first century Skills, for example, defines collaboration as working effectively and respectfully with diverse teams, exercising flexibility and a willingness to make compromises to accomplish a common goal, and assuming shared responsibility for collaborative work while valuing individual contributions.

KEYWORDS: Participative, organization, Evaluation, compromises, collaboration

Introduction:

This research is an empirical study on assessing the students' academic performance and development of generic skills through participatory teaching. Generic skills inventory and academic performance were utilized as measuring instruments where as activities of participatory learning used as an independent variable. The main purpose of the research was to explore the extent to which participatory teaching contributes to students' acquisition of generic skills and obtaining outstanding academic standing. Outstanding academic achievement and development of generic skills much depend on the instructional strategies employed in teaching and learning. Participatory learning approaches are those, which put students at the center of the teaching and learning activities. Through participatory teaching strategies, the acquisition of generic skills becomes more enjoyable, meaningful and exciting. as well as activities of participatory teaching. As result of this, this study proves that participatory teaching produces two core outcomes (better academic performance and possession of generic skills) expected students develop during academic course. A comprehensive model of generic skills development was proposed which consists of the three constructs investigated which are indicating the strength and the direction of their relationships.

The key elements in the implementation of education are the students themselves. Their motivational readiness to learn depends inter alia on the emotional state of mind, cultural and educational backgrounds. Emotional status and disposition also have an effect on what will be their approach to learning. Motive is an internal momentum that

causes a change in human's behaviour and to leads to his needs. Much of the criticism has been directed to higher education in Slovakia over the decades. It is argued that the current education focuses more on acquiring encyclopaedic knowledge rather than promoting the creativity to develop ability to identify problems. As a result, students are less able to analyse specific situation, to present and evaluate alternative solutions, stand up for their own opinions and use their knowledge in practical applications. These applied tools will help us enhance the quality of education and attract the attention to more effective learning at the universities as the imperative of successful preparation of students for both their professional and personal life. Motivation At universities, unfortunately, studying also those students who do not wish to periodically prepare and they decided to study only because this wished their parents or because of their field of study is the low interest from other students. The idea of obtaining a university degree is great, but interest in the study and willingness to make an effort - it is negligible for some of students. What to do in such cases? Is it possible to motivate some young people with no interest in anything? There are a lot of motivational factors, of course. Interest in the subject depends on the content and form of teaching, nature of teachers and students and of other factors. Everything is determined by the time possibilities arising from the timetable, the number of students in a class, surround possibilities, teacher's readiness and alike. For students is motivating when the teacher at the beginning of the semester informs about content and goals of the course, and also gives them space to comment

about what they interested in, respectively what another topic related to the content of the course would be welcomed and what are their expectations. This is useful information for teachers about what could be added to the content part to meet the requirements and the interest of teachers and students, too. Motivation increases the amount of effort and energy that learners expend in activities directly related to their needs and goals.

Objectives of the study:

- To promote more active role of students in learning process
- To involve students in more practical activities.
- To connect academic achievement in real life issues
- To understand the impact of the individual actions on the community

Literature survey

(Csikszentmihalyi & Nakamura, 1989). It determines whether they pursue a task enthusiastically and wholeheartedly or apathetically and lackadaisically. The Online Journal of Science and Technology - January 2016 Volume 6, Issue 1 www.tojsat.net
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The Online Journal of Science and Technology 82 Motivation increases initiation of and persistence in activities. Students are more likely to begin a task they actually want to do. They are also more likely to continue working at it until they've completed it, even if they

are occasionally interrupted or frustrated in the process Motivation increases students' time on task and it is an important factor affecting their learning (Larson, 2000). We can say that motivation is the force that drives us to carry out activities. We are motivated when we feel like doing something and we are able to sustain the effort required during the time required to achieve the objective we set ourselves.

Motivation should be considered carefully by teachers, trying to mobilize the capabilities and potential of each student for academic success. (Ferreira, Cardoso & Abrantes, 2011) Educational science defined two basic types of motivation: intrinsic and extrinsic, that have a potentially different consequences on learning (Standage, Duda & Ntoumanis, 2005). These are based on self-determination theory that considers humans to actively seek optimal challenges and new experiences to master and integrate. The most self-determined type of motivation is intrinsic motivation. The methods used represent an important tool for ensuring the educational process. The selection of appropriate methods is determined by the aim of the subject. However, the use of a suitable combination of mutual educational methods should be conditional on the individual needs of students and teachers, social needs and trends. The selection should respond to the current global trends in technical, economic, and educational research and development. The implementation of appropriate methods is determined by various factors. It is, for example, the number of students in one group, their present and desired level of knowledge, skills, motivation to learn, functional position. The level of expertise

and experience of teachers and spatial capabilities are also important. The aim of the article is to show how it is possible to increase the efficiency and attractiveness of the subject at university using participatory methods. Keywords: motivation, teaching methods, participatory methods, role.

Educating academic staff to reorient curricula in ESD

M Biasutti, V Makrakis, E Concina... - International Journal of ..., 2018 - emerald.com

Purpose The purpose of this paper is to present a professional development experience for higher education academic staff within the framework of an international Tempus project focused on reorienting university curricula to address sustainability. The project included revising curricula to phase sustainable development principles into university courses. **Design/methodology/approach** A qualitative approach was used to examine perceived professional development. Focus groups have been conducted with the academic staff who Biasutti M, Makrakis V, Concina E, Frate S (2018) Educating academic staff to reorient curricula in ESD. *Int J Sustain High Educ* 19(1):179–196

Transformative learning for a sustainable future: An exploration of pedagogies for change at an alternative college

J Blake, S Sterling, I Goodson - Sustainability, 2013 - mdpi.com

Educators and policy makers have long recognised the central role that education can play in creating a more sustainable and equitable world. Yet some question whether current processes across mainstream higher education prepare learners sufficiently to

graduate with the capabilities or motivation to shape and create a future that is life-sustaining. This paper presents findings from a qualitative research project carried out by Plymouth University in association with Schumacher College, Devon, UK. Schumacher College. Blake J, Sterling S, Goodson I (2013) Transformative learning for a sustainable future: an exploration of pedagogy for a change at an alternative college. Sustainability 5:5347–5372

Buchs A, Blanchard O (2011) Exploring the concept of sustainable development through role-playing. J Econ Educ 42(4):388–394

HL Burns - Journal of Transformative Education, 2015 - journals.sagepub.com

Sustainability is becoming increasingly relevant in higher education, as the need to address complex cultural and ecological problems intensifies. How sustainability is taught has a profound influence on the kind of learning that takes place and the impact it has in the world. Sustainability pedagogy is offered as a tool for creating transformational sustainability learning that is thematic and cocreated, critically questions dominant norms and incorporates diverse perspectives, is active, participatory and relational, and is grounded in Burns HL (2015) Transformative sustainability pedagogy: learning from ecological system and indigenous wisdom. J Transform Educ 13(3):259–276

M Coffey - Gamification: Concepts, Methodologies, Tools, and ..., 2015 - igi-global.com
Games in a variety of formats are viable educational tools for a range of disciplines and students of all ages. However, the adoption of serious games within sciences is

limited, particularly so in higher education (HE). This chapter describes the classroom adoption of an educational board game based on chemical production, pollution mitigation and greenchemistry principles. Design and development considerations in creating the GreenChemistry game are outlined. The game is available free-of-charge as print-and-play files.

Coffey M (2014) Green chemistry: classroom implementation of an educational board game illustrating environmental sustainable development in chemical manufacturing. In: Thomas KD, Muga HE (eds) Handbook of research in pedagogical innovations for sustainable development. Information Science Reference, Hershey, pp 453–473

The elementary school teacher, 1903 - journals.uchicago.edu

MODERN life means democracy, democracy means freeing intelligence for independent effectiveness-the emancipation of mind as an individual organ to do its own work. We naturally associate democracy, to be sure, with freedom of action, but freedom of action without freed capacity of thought behind it is only chaos. If external authority in action is given up, it must be because internal authority of truth, discovered and known to reason, is substituted. How does the school stand with reference to this matter? Does the school as an ...Dewey J (1916) Democracy and education: an introduction to the philosophy of education. Macmillan, New York.

Dieleman H, Huising D (2006) Games by which to learn and teach about sustainable development: exploring the relevance of games and experiential learning for

sustainability. J Clean Prod 14:837–847

H Dieleman, D Huisingh - Journal of cleaner production, 2006 - Elsevier

This paper discusses the roles of games in experiential learning for sustainability. It includes applied emphases upon four topics:(1) The challenges of sustainable development education with the need for interdisciplinarity, knowledge, skills and attitudinal training and with a special focus upon the urgent needs for paradigm, context and practice changes to help ensure that we make progress toward sustainable societies. We emphasize that these characteristics challenge existing teaching and educational philosophies and methods.(2) ...

Gourmelon F, Chlous-Ducharme F, Kerbiriou K, Rouan M, Bioret F (2013) Role-playing game developed from a modelling process: a relevant participatory tool for sustainable development? A co-construction experiment in an insular biosphere reserve. Land Use Policy 32:96–107

F Gourmelon, F Chlous-Ducharme, C Kerbiriou... - Land use policy, 2013 - Elsevier

This contribution refers to a companion modelling approach applied to the study of interactions between social and environmental dynamics in a small protected island, part of a biosphere reserve. This approach leads to a role-playing game designed by a pluridisciplinary workgroup (researchers and reserve manager), used as management support and as a tool to help people regarding the stakes of sustainable development. For several years, Ushant Island (Brittany, France) was in the process of social.

Research methodology

Both primary data and secondary data will be taken for this study. The required tools are simple percentage, chisquare and anova. The research is exploratory and qualitative in nature. The research work is mainly based on primary data that was collected from the sample respondents through survey method by administering questionnaire developed for the purpose.

Conclusion

"Education for Sustainable Development allows every human being to acquire the knowledge, skills, attitudes and values necessary to shape a sustainable future. Education for Sustainable Development means including key sustainable development issues into teaching and learning; for example, climate change, disaster risk reduction, biodiversity, poverty reduction, and sustainable consumption. It also requires participatory teaching and learning methods that motivate and empower learners to change their behaviour and take action for sustainable development. Education for Sustainable Development consequently promotes competencies like critical thinking, imagining future scenarios and making decisions in a collaborative way. Education for Sustainable Development requires far-reaching changes in the way education is often practised today." we point to indicative curricular themes that may be more or less relevant to each disciplinary area and which might be used and adapted as 'entry points' to develop sustainability education further.

CHAPTER-38

PERCEPTION OF MICRO ENTREPRENEURS TOWARDS MANAGING MARKETING RISK IN TIRUNELVELI DISTRICT

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Abstract

This study explores the perception of micro entrepreneur towards marketing risks in Tirunelveli District. The primary data collected from 450 respondents in rural, urban and semi urban in Tirunelveli District. The research tool was used chi square test by using ANOVA, 'F' test and 't' test. This research presents the analysis of the Marketing Risk perception of micro entrepreneurs. It gives an analysis of Marketing Risks of the micro entrepreneurs such as risks faced while advertising the goods and services, risks

in connection with increased competitors for the goods and services and risks faced while in the marketplace of goods and services etc.

Key Word: Goods and Services, Advertisement, Discount, Product, Competitors etc.,

I. Introduction

1.1 Introduction

The word 'risk' has two distinct meaning. It can mean in one context hazard or a danger, that is, an exposure to mischance or peril. In other context, risk is interpreted more narrowly to mean the probability or chance of risk.

Perception is an important part of human cognition that influences how people interact with and navigate their surroundings. It has an impact on decision-making, problem-solving, and how people react to varied stimuli. Understanding perception is important in domains such as psychology, neurology, marketing, design, and communication because it explains how people absorb information and make sense of their surroundings.

The subjective judgment that people make about the qualities and severity of a danger is known as risk perception. The expression is most usually applied to natural disasters and risks to the environment or health, such as nuclear power.

Marketing risk is the possibility of negative consequences or financial losses as a result of different marketing-related actions and choices. These risks might originate

from a variety of circumstances and uncertainties inside a company's marketing function. Understanding and managing marketing risks is critical to the success and long-term viability of marketing plans and initiatives.

Marketing risk perception is the perception and assessment of possible hazards connected with marketing actions, strategies, and choices by individuals or organizations. It entails a subjective assessment of uncertainty and probable bad effects associated with marketing initiatives. Marketers and organizations must understand and manage risk perception since it has a substantial impact on customer behavior, decision-making, and marketing performance overall. Here are some of the most important factors of marketing risk perception:

- **Consumer Perception of Product or Service Risks:** Before making a purchase decision, consumers frequently consider the risks associated with products or services. These risks can include financial risk (the cost of the product or service), performance risk (whether it will suit their needs), safety risk (possible injury or adverse effects), and social risk (how others will perceive their decision). To drive purchasing decisions, marketers must address and lessen these perceived risks.
- **Brand and Reputation Risk:** The perception of a brand's reputation and trustworthiness by consumers is crucial. Detrimental press, product recalls, or ethical concerns can all have a detrimental impact on brand reputation and customer trust. To minimize such dangers, marketers must actively maintain and safeguard their brand's image.

- **Risks of Market Entry and Expansion:** When entering new markets or expanding into new segments, organizations must consider the risks associated with market dynamics, competition, regulatory environments, and cultural variables. Understanding and controlling these risks is critical for market penetration success.
- **Risk of Innovation and New Product Development:** Introducing novel products or services might be dangerous since consumers may be unsure of their usability, dependability, or long-term worth. To explain the benefits and answer any issues, effective marketing methods are required.
- **Marketing Communication and Messaging Risk:** Marketing communications can be received in a variety of ways. Misleading or deceptive messages can result in legal and reputational consequences. It is critical to ensure honesty and accuracy in marketing communications.
- **Digital and Social Media Risks:** The digital world is fraught with dangers such as unfavorable online reviews, social media backlash, and data security breaches. Marketers must monitor and manage their online presence, as well as respond to digital hazards efficiently.
- **Environmental and Sustainability Risk:** When making purchase selections, consumers are increasingly considering a company's environmental and social responsibilities. Failure to achieve sustainability standards may result in a bad perception and possible customer backlash.

- **Competitive Risk:** Market rivalry can offer risks such as pricing wars, marketing strategy replication, or loss of market share. It is critical to understand rivals' movements and anticipate potential competitive dangers.

Businesses frequently use risk management tactics to handle marketing risk perception, such as market research to identify customer concerns, product testing and quality assurance, crisis communication plans, regulatory compliance, and ethical marketing practices. Effective risk management may aid in the reduction of unfavorable views, the enhancement of brand trust, and the support of successful marketing initiatives.

1.2 Objectives

- To analyze the perception of Micro Entrepreneur towards Marketing Risks in Tirunelveli District.

1.3 Statement of the Problem

The important roles played by micro entrepreneurs in economic development performance is poor because micro entrepreneurs are struggling to implement, embed and sustain a proper managing risk strategy which is very important for the business to sustain and earn profit. There is question that why some entrepreneurs do not survive for long time while others do. It is realized that managing risk has not been fully understood before startup the business. Most of the business are facing serious problem of insolvency and is forced to sell due to the misperception of risk. It's clear that

entrepreneurs consistently face an inordinate amount of risks. Hence the researcher made an attempt to study the perception of micro entrepreneur towards Marketing Risk.

1.4 Scope of the study

The present research focuses on the perception the micro entrepreneurs towards Marketing Risk. The study examines the relationship among the Marketing Risk perception with different locality of micro entrepreneur. The study conducted in Tirunelveli Disrtict.

II - Review of Literature

2.1 Review of Literature

Lynnette D. Purda (2007) documented that firms in bank-oriented financial systems receive better credit ratings and suggested that the reduction in perceived credit risk stems from benefits provided by banking relationships. Whether these relationships can help to explain within-country differences in ratings is ultimately an empirical question. This suggests that a possible research extension would be to examine whether the proportion of debt financing that a firm receives from bank versus public markets impacts domestic credit rating assignments.

Lap Duong (2009) studied risk and risk management has become an unavoidable issue on the organization in the context of booming internationalized markets and in the era of increasingly diverse forms and processes of business operations. Risk is not new, but an integral part of every organizational activity. Debates are primarily

conducted for risks at corporate level. However, with the small and medium sized enterprise sector's growth and its impact on the society, risks management equally calls for attentions and strategies to this sector. Project risk management is considered a suitable model for SMEs and micro to adopt and implement, thanks to the match in the nature of project risk management and the organizational operation style of small business.

Selcuk Kendirli (2009) mentioned entrepreneur is constantly required to make decision in an indefinite environment, risk is one principal features characterizing entrepreneurship and risk tendency is a topic tried to be explained via different approaches in the literature of entrepreneurship. Undoubtedly, such approaches provide important tools for understanding entrepreneurship, which is regarded as a social case, rather than an economic activity. However, based on recent researches, it is understood that it is not possible to mention about a single entrepreneur typology and social-cultural factors influencing entrepreneurship should also be investigated (Erdem, 2001:56).

Helene Landqvist (2009) concluded that there are many differences and similarities between entrepreneurs and managers. They could have many underlying reasons for their existence, such as upbringing, education, or pure coincidences. In examining our results, we gather that yes, -entrepreneurs are more risk prone in the work life than managers are, but not in relation to their own assessment of their risk propensity. Their risk propensity could also be affected by their background to some

extent, as having been brought up by a risk-taking parent might result in a relationally higher risk propensity and the perception of a lower risk factor than others. Other possible contributing factors to this fact could lie in their personality; for example, in their use of money as an indicator of success or their trust in people or their need for independence, which implies that they do not feel the need to depend on others when taking risks.

Tilman Brück ET AL (2010) find that, contrary to expectations, Terrorist Attacks have a positive, significant, and robust impact on entrepreneurial activity, while Natural Disasters and Violent Conflict tend to impact entrepreneurial activity negatively.

III - Research Methodology

3.1 Research Design

The research study is the nature of descriptive. The descriptive research design is the one that simply describes something such as Marketing Risks of micro entrepreneurs. The descriptive study typically concerned with determining the frequency with which something occurs or how the variables vary together. Necessary primary data collected from among the micro entrepreneurs of Tirunelveli District. The registered micro entrepreneurs taken as the population for the study and stratified sampling method will be adopted to select the sample respondents for this study. For the data collection interview schedule prepared and pilot study conducted before drafting the final interview schedule. Appropriate statistical tools used to analyze the data collected from

the respondents. Proper interpretations drawn from the results of the analysis and suitable suggestions given to the micro entrepreneurs to manage the risk based on the findings of the study.

3.2 Area of the Study

This study focused only on Tirunelveli District.

3.3 Sample Size

In this study the sample size is 450.

3.4 Data Collection

Under this study the researcher took the Primary and Secondary data

3.5 Statistical Tools

The research tool was used chi square test by using ANOVA, 'F' test and 't' test. This research presents the analysis of the Human Resource Risk perception of micro entrepreneurs.

3.6 Hypothesis

- There is no significant difference in the perception towards marketing risks among different age group of micro entrepreneurs in Tirunelveli District.

IV – ANALYSIS AND INTERPRETATION

4.1 Perception towards Marketing Risks among different location of the micro entrepreneurs

Perception towards marketing risks among different region/locality of the micro

entrepreneurs was analyzed with the help of ANOVA and 't' test and the results are presented below.

Perception towards Marketing Risks

To find out the significant difference in perception towards marketing risks among micro-entrepreneurs belonging to the different localities of the business, 'ANOVA' test is used with the null hypothesis as, "**There is no significant difference in the perception towards marketing risks among micro-entrepreneurs belonging to the different locality of the business in Tirunelveli district**". The result of the ANOVA test for the perception towards marketing risks among micro-entrepreneurs belonging to the different localities of the business is presented in Table 1.1.

Table 1.1

Micro-Entrepreneurs Perception towards Marketing Risks

Perception	towards	Locality of the Business			F
Marketing Risks		Urban	Semi-urban	Rural	Statistics
Risks associated with the					
goods and services to		3.6094	3.6516	3.5785	0.216
consumer					
Risks faced while		3.6133	3.6063	3.6009	0.117

determining the price of

goods and services

Risks faced while

advertising the goods and	3.8281	4.1719	3.8206	8.973*
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services

Risks faced while offering

discount/free/gift for goods	3.6836	3.5475	3.4978	1.678
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and services

Risks faced while

introducing new product	3.6953	3.7602	3.8789	1.751
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and service in the market

Risks in connection with

increased competitors for	3.7617	4.1222	4.0179	8.345*
---------------------------	--------	--------	--------	--------

the goods and services

Risks associated with the

market place of goods and	3.5664	3.7919	3.8655	4.681*
---------------------------	--------	--------	--------	--------

services

Risks faced during Covid -19	3.5703	3.7466	3.6368	1.274
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Source: Primary data * Significant at a five per cent level

From the above Table 1.1, it is understood that risks faced while advertising the

goods and services and risks in connection with increased competitors for the goods and services are the important perception towards marketing risks among the urban respondents as their mean scores are 3.8281 and 3.7617 respectively. It is further understood that risks faced while advertising the goods and services and risks in connection with increased competitors for the goods and services are the important perception towards marketing risks among the semi-urban respondents as their mean scores are 4.1719 and 4.1222 respectively. The Table 5.4 further shows that risks faced while arising more competitors on goods and services and risks faced while introducing new products and services in the market are the important perception towards marketing risks among the rural respondents as their mean scores are 4.0179 and 3.8789 respectively. Regarding the perception towards marketing risks, risks faced while advertising the goods and services, risks in connection with increased competitors for the goods and services and risks faced while in the marketplace of goods and services are statistically significant at a 5 per cent level.

Findings:

Among the respondents from urban and semi urban areas highly perceived marketing risk variable is 'risks faced while advertising the goods and services' as their mean scores are 3.8281 and 4.1719 and for rural respondents high Marketing risk faced variable is 'risks in connection with increased competitors for the goods and services' as their mean score is 4.0179. The study reveals that regarding the perception towards marketing risks,

risks faced while advertising the goods and services, risks in connection with increased competitors for the goods and services and risks faced while in the marketplace of goods and services are statistically significant at a 5 per cent level.

5.2 Conclusion

Based on the evaluation of the results of this research the researcher conclude that risks faced while advertising the goods and services, risks in connection with increased competitors for the goods and services and risks faced while in the marketplace of goods and services are significant with marketing risk perception.

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CHAPTER-39

PLASMID CURING WITH RELATION TO MULTI DRUG RESISTANCE

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INTRODUCTION

Plasmids are considered as the extrachromosomal material of the specific genetic material, that is usually a double-stranded circular DNA. This dsDNA possess the capability for replicating independently in the chromosome of the host, and sometimes exhibit with coexistence [1]. With till date, many different bacterial species inhabit in diverse environment possess plasmid DNA [2,3]. Some plasmids are considered to be stable and were maintained in successive generations through the process of cell division. This consecutive cell division promotes the cell to receive the copy of atleast one plasmid.

In the report of present investigations, plasmids were observed in a wide variety of bacterial species. In a specific observation, this may be due to the development of new process, new methodology for isolation, detection, and molecular characterization of plasmid DNA. In some plasmid-containing bacteria, it is desirable to get a plasmid-cured derivative. This allows a direct investigation towards the plasmid-containing and plasmid-curing cells. Some plasmids has the integration to undergo spontaneous segregation as well as deletion. But, mostly they are tend to be highly stable, and also need the usage of curing agents or enhancing the growth temperature, or with the base of thymine starvation, that eventually increase the frequencies of spontaneous segregation [4]. The application and usage of curing agents is not predicted in many bacteria, because there is no proper protocol [4,5].

Sometimes, multiple plasmids share coexistence in the same bacterial strain but there may be relative cross-interference among the plasmid replication strategy, that ensures mainly on the closely related plasmids, which promotes incompatibility and cannot be adored the stable persistence together. The specific Entry exclusion systems (EES) inhibit conjugation of specific plasmid into a cell that possess resident plasmid of the same 'exclusion group' by more and more fold conditions [6].

The plasmids present in multidrug resistant bacteria can be eliminated specifically through the process called cuing. Plasmids are cured, when they undergo a mechanism

that causes them to be lost during bacterial cell division. Curing can also happen naturally through cell division or by administering physical and chemical agents like sodium dodecyl sulphate (SDS) to the cells. During the curing process, the plasmid that codes for antibiotics resistance is lost, thereby making the bacteria vulnerable to antibiotics attack. However, if the gene that codes for the antibiotic resistance is chromosomal, then the bacteria will retain its resistance after curing as curing does not remove the chromosomal gene [7].

In order to identify the most appropriate therapy for multi - drug resistance, it is very specific to understand the detailed knowledge on antibiotic susceptibility and resistance pattern of bacterial strains. Many strategies on plasmid profiling and the curing process of multidrug-resistant bacteria revealed this concept very specifically. As multidrug-resistant bacteria are widespread, and mostly they are endeavored with plasmids that ensures the resistant genes to intact spreading. Finally, in order to arrest the spreading of multidrug-resistant bacterial strains caused reatively by these types of plasmids, infection control strategies must be strengthened [6,7]. But the resistance found in some of the bacterial strains were plasmid-mediated but tend to be chromosomally transmitted, it is very specific to provide a proper and specific infection control measures.

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CHAPTER-40

ISOLATION AND CHARACTERIZATION OF PLANT GROWTH PROMOTING BACTERIA FROM THE RHIZOSPHERE OF *AVICENNIA MARINA*

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ABSTRACT

The bacteria associated with rhizosphere are beneficial to plants, as they promote growth either directly or indirectly. These bacteria are called as plant growth promoting rhizobacteria (PGPR) and are used as alternatives to chemical fertilizers to increase crop yield in agriculture. The present study was undertaken to isolate, screen and evaluate selected PGPR from rhizosphere of *Avicennia marina*. The isolated bacteria were characterized for their plant growth promoting activity. The isolates were screened for PGP traits like N₂ fixation, IAA production, ammonia production, hydrolytic enzyme production, HCN production, and phosphate solubilization activity in-vitro. A few of the isolates were found to possess plant growth promoting traits and biocontrol traits. The

isolates were screened for their PGPR trait by seed treatment assays. It was observed that PGPR treated seeds showed enhanced plant growth when compared with untreated controls. Maximum plant growth promoting activity in pot assay was recorded in seeds treated with S5. The present study, therefore suggests that the PGPR isolated have potential for utilization as biofertilizers and biocontrol agents.

INTRODUCTION

Agriculture ensures survival of the human race by production the necessary food. But in the recent years the burden of exploding human population is shouldered by agriculture. Hence developing newer and faster technique in agriculture to cope up with the ever-growing population has become mandatory. Soil microorganisms promote material cycling and energy flow on the ecosystem. They play important roles as both producers and decomposers in the ecosystem (Wu *et al.*, 2013). In addition, soil microorganisms perform functions such as oxidation, nitrogen fixation, nitrification and ammonification in the soil to promote the decomposition of soil organic matter and nutrient conversion. Soil microorganisms are widely distributed in the plant rhizosphere. The soil layer which is influenced by the plant root is called rhizosphere. In 1904, the German scientist Lorenz Hiltner first proposed the concept of the “rhizosphere” which refers to the soil around the root system. In the rhizosphere, plant root activity alters the physical and chemical properties of the soil, providing a special ecological environment for interaction between plant and soil microorganisms

(Compant *et al.*, 2010; Kloepper *et al.*, 1980; Liu, 2005). Since the concept of the “rhizosphere” was proposed, there has been increasing number of studies on the plant rhizosphere, mainly involving the physiological structure of the root system, rhizosphere soil nutrients, rhizosphere soil enzyme activities and rhizosphere soil microorganisms, as well as the connection between them.

Rhizospheric bacteria which play an important role in plant growth promotion and termed as PGPRs. The heterogeneous group of bacteria in the rhizosphere, on root surface and in association with roots, include *Azospirillum*, *Alcaligenes*, *Acinetobacter*, *Bacillus*, *Rhizobium* and *Serratia*. The plant growth promoting (PGP) effect of the PGPR is mostly explained by the release of metabolites directly stimulating growth. Several mechanisms have been postulated to explain how PGPR benefits the host plants. These include the ability to produce plant growth regulators or phytohormones such as Indole acetic acid (IAA), cytokinins and gibberellins (Marques *et al.*, 2010), enhancing symbiotic N₂ fixation (Sahin *et al.*, 2004; Khan 2005), solubilizing inorganic phosphate and mineralization of organic phosphate and other nutrients (Jeon *et al.*, 2003). Increasing crop yield through the use of PGPR as microbial inoculants is now the method of choice by most people because of increased demand for food and sustainable environment. Hence, the focus of this study is to isolate, identify PGPR bacterial isolates and to determine their suitability as plant growth promoting rhizobacteria.

MATERIALS AND METHODS**Collection of sample and isolation of bacteria:**

Soil and root samples were collected aseptically in sterile plastic bags from the rhizosphere of mangrove trees (*Avicenia marina*) between Tuticorin thermal power station (TTPS) and Tuticorin fishing harbour. 1 g of rhizospheric soil was taken and dissolved in 100 ml of distilled water, mixed well by vortexing for 15 mins. The sample was serially diluted (10^{-1} to 10^{-6}) and plated on nutrient agar medium and incubated at 37°C for 24 hours. Single colonies were identified and pure cultures were obtained by quadrant streaking.

Characterization of Isolates:

Colony morphology was observed and recorded. Morphological characteristics of the colony like the colony morphology, size, colour, texture and arrangement were recorded. The isolates were characterized as Gram positive and Gram negative by standard protocol of gram staining.

Endospore Staining

After preparing the bacterial smear and heat fixing, the slide was treated with 0.5% malachite green and kept for 5 minutes. Then the slide was rinsed gently in tap water. Then the counter stain safranin was added and kept for 30 seconds. The slide was washed again allowed to dry and observed under oil immersion objective.

Seed treatment:

Vigna radiata seeds were surface sterilized in 70% ethanol for 2 minutes and 40 % sodium hypochlorite for 10 minutes and rinsed ten times in sterile tap water. Then the seeds were treated with the bacterial suspension at the concentration of 10^{-3} , 10^{-4} and 10^{-5} CFU ml⁻¹ for 1 hour under sterile condition. The seeds were sown in autoclaved garden soil and shoot length, root length and plant weight were measured. Seeds treated with broth without inoculums was used as the control.

Tests for plant growth promoting traits:

The isolated bacterial strains were screened for plant growth promoting traits like ammonia production (Ajaykumar, 2012), production of Indole Acetic acid (Rashmi *et al.*, 2017), nitrogen fixation assay and phosphate solubilization (Martin, 1950) by following the standard protocols as described in the previous works.

Tests for biocontrol traits:

The bacterial isolates were screened for biocontrol traits like hydrogen cyanide production, protease production and starch hydrolysis activity by performing the standard protocols (Jeon *et al.*, 2003).

RESULT**Bacterial Isolation:**

Ten bacterial strains were isolated from the rhizospheric soil sample from mangrove plants in the study area mentioned. Pure culture of the 10 isolates were

obtained and named as S1, S2, S3, S4, S5, S6, S7, S8, S9, and S10. The pure cultures were stored at 4⁰ C for further study. The 10 bacterial isolates were characterized for the colony morphology such as shape, colour, margin, elevation and opacity and also characterized for cellular morphology using light microscope. The results are tabulated in Table 1. Gram staining and endospore staining was done on all the isolates. All the bacterial strains were gram negative. The strains S1, S4, S6, S7, S9, and S10 were circular. The strain S2 appeared as filamentous, while S-3 rhizoid in shape and S5 and S8 were irregular. All the bacterial strain produced endospores except the strain S2 (Table 2).

Table 1 Morphology of the isolates

Isolates	Colour	Shape	Margin	Elevation	Opacity
S1	Dull white	Circular	Entire	Raised	Opaque
S2	Dull white	Filamentous	Filiform	Raised	Opaque
S3	Yellow	Rhizoid	Lobate	Convex	Opaque
S4	Dull white	Circular	Entire	Raised	Transparent
S5	Dull white	Irregular	Entire	Convex	Opaque

S6	Dull white	Circular	Entire	Convex	Opaque
S7	Dull white	Circular	Undulate	Convex	Opaque
S8	Dull white	Irregular	Entire	Convex	Opaque
S9	Dull white	Circular	Entire	Raised	Opaque
S10	Dull white	Circular	Entire	Convex	Opaque

Table 2 Staining of the bacterial isolates

Isolates code	Gram staining	Endospore staining
S1	Negative	Present
S2	Negative	Absent
S3	Negative	Present
S4	Negative	Present
S5	Negative	Present

S6	Negative	Present
S7	Negative	Present
S8	Negative	Present
S9	Negative	Present
S10	Negative	Present

Analysis of bacterial isolates for their plant growth promoting traits:

The result of bacteria isolates for plant growth promoting traits were tabulated in Table 3. The ten pure bacterial isolates were screened for different PGP traits such as Ammonia production, IAA production, Phosphate solubilization, nitrogen fixation. Ammonia production by microbes is an important aspect of plant growth promoting trait of bacteria. Qualitative analysis of ammonia production was studied. The strains S1, S2, S4, S5, S6, S8 and S9 produced ammonia whereas the strains S3, S7 and S10 showed negative results. IAA production was found to be a common trait in all isolates. All isolates were positive for IAA production. Nitrogen fixing bacteria have the unique ability to grow on Berku's medium. The isolates were streaked on Berku's medium to check its ability to fix nitrogen. Based on the result all strains except S1, S9, S10 grew on Berku's medium which indicates that they have the ability to fix nitrogen. Phosphate solubilization ability of bacteria can be detected by culturing the isolates on potato

dextrose rose Bengal agar. Growth on this medium confirms their phosphate solubilization activity. The strains S3, S4, S5, S6, S8 and S10 grew on the potato dextrose Rose Bengal Agar, which shows that they can solubilize phosphate.

Table 3 Plant growth promoting traits of the isolates

Isolates	Ammonia Production	IAA Production	Nitrogen fixation	Phosphate Solubilization
S1	+	+	-	-
S2	+	++	+	-
S3	-	+++	++	+++
S4	+++	+++	+	++
S5	++	+++	+	+
S6	+	+	+	+
S7	-	+	+	-
S8	+	+	+	++
S9	++	+	-	-
S10	-	++	-	+++

Note; - = no production, + =weak production, ++ = medium production, +++ = high production

Analysis of bacterial isolated for their plant biocontrol properties:

The result of bacterial isolates for their plant biocontrol properties are tabulated in Table 5. 10 bacterial isolates were screened for bacterial biocontrol properties such as lytic enzyme production, HCN production. Hydrogen cyanide production of the bacterial strains indicates its biocontrol activity. The test for HCN production showed that except the strain S4 all other strains showed a positive colour change of the filter paper from deep orange to reddish brown, which indicated that all the strains except S4 are good biocontrol agents. The bacterial strains S1, S2, S3, S5, S6, S7, S9, S10 indicated the production of HCN. In protease test, the strain S1, S2, S3, S5, S6, S9, S10 showed a zone of clearance around the growth area, which indicates positive result. The bacterial strains S4, S7, and S8 did not produce hydrolytic enzyme production. In starch hydrolysis test, the strain S4, S8 and S10 did not show clear zone outside the growth area, which indicated that they do not have the ability to hydrolyze starch. A zone of clearance around the growth of the strains S1, S2, S3, S5, S6, S7, and S9 indicates that they have the ability to hydrolyze starch.

Table 4 Biocontrol properties of the isolates

Isolates	Hydrolytic enzyme production		HCN Production
	Protease Production	Starch Hydrolysis	
S1	+	+	+++
S2	+	++	++

S3	+++	+	+
S4	-	-	-
S5	+++	++	+++
S6	+	+++	+
S7	-	+++	+
S8	-	-	-
S9	++	++	+
S10	+	-	+

Note; - = no production, + =weak production, ++ = medium production, +++ = high production

Seed germination Assay:

The application of PGPR strain should promote shoot and root growth. In this study, application of bacterial strain supported higher germination rate and other growth parameters. The shoot (height and weight), and root (height and weight) parameters was compared between the control and treated seeds and are tabulated (Table 5). In all the pots where *Vigna radiata* seeds treated with bacteria were sown, there was a significant increase in growth rate when compared to control untreated seeds (Fig. 1). The higher plant growth promoting activity of the strain can be correlated with its higher IAA and phosphate solubilization activity in the biochemical assays.

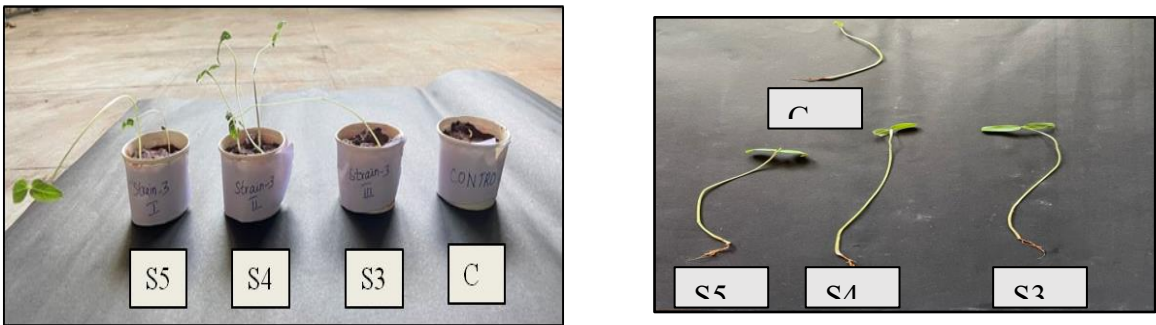


Fig. 1 Plant growth activity of the isolates. a. *Vigna radiata* seeds were treated with the bacterial isolates S3, S4 and S5. The treated seeds were germinated in pots and the plant height, weight and root length were measured 10 days post inoculation.

Table 6 Plant growth activity of the isolates

Isolates	Shoot		Root	
	Length (cm)	Weight (gm)	Length (cm)	Weight in (gm)
Control	1	0.247	2.3	0.027
S3	21.5	0.232	4.6	0.042

S4	23.5	0.381	3.5	0.040
S5	27	0.324	4.1	0.026

DISCUSSION:

PGPR are free living soil bacteria that aggressively colonize the plant roots and when applied to the seeds they enhance the growth and yield of the plants. The use of novel PGP bacteria as biofertilizers, biopesticides and phytostimulator in agricultural sectors to improve crop yield, quality and maintaining the soil fertility is advisable. The exact mechanism by which PGPR stimulate plant growth is not clearly known, although several mechanisms such as production of phytohormones, activation of phosphate solubilization and promotion of the mineral nutrient uptake are usually believed to be involved in plant growth promotion. There are many papers related to the advantages and screening of PGPR from crop plants but few on *Avicenia marina*. In this study, about 10 rhizobacterial strains were isolated from *Avicenia marina* (Mangrove Plant) rhizosphere samples and screened for different plant growth promoting traits and biocontrol properties. Ammonia production is an important characteristic of PGPR, which influence plants growth (Yadav *et al.*, 2010). In *P.fuscovaginae* and *K.oxytoca* 4.5% of the isolates were able to produce ammonia and enhance plant growth. The presence

of ammonia producing PGP bacteria is an indication for ammonification process which takes place in the rhizosphere than non rhizosphere soil. In this study, the bacterial isolates S4, S5 and S9 showed high production of ammonia which attributes to its plant growth promoting activity.

IAA is one of the most important phytohormone and function as important signal molecules in the regulation of plant development (Mirza *et al.*, 2001). In our study, all the isolates were positive for IAA production. Nitrogen fixing ability is an important criterion for the selection of potential PGPR. In this study, the PGP bacterial colonies S3, S4 and S5 isolated from *Avicenia marina* plant rhizosphere grew well on N-free agar medium, which confirmed their potential for fixing atmospheric nitrogen on such media. Our result was supported by the findings of Naher (2009) who characterized a few N-fixing bacteria by acetylene reduction assay (ARA).

The capability of rhizobacteria to solubilize insoluble phosphate has been of interest to agriculture microbiologist as it can enhance the availability of phosphorous for the plant to improve plant growth and yield (Liu, 2016). The use of phosphate solubilizing PGPR as inoculants is one of the alternative biotechnological solutions in sustainable agriculture to meet the phosphate demands of plant. In this study the isolates S3, S4, S5 and S10 isolates were able to solubilize phosphate at higher rates when compared to other isolates. All of the above identified PGP bacterial strains were found to be the most efficient phosphate solubilizers, which have a great role in increasing

crops productivity and production without contaminating the environment and affecting human health.

HCN production by rhizobacteria has been postulated to play an important role in the biological control of pathogens (Voisard, 1989). In this study, 80% of the bacterial isolates were positive for HCN production which acts as an inducer of plant resistance. Several factors have been reported to influence the rate of HCN production. Indeed the hydrogen cyanide is a part of powerful antifungal compounds produced by PGPR and involved in pathogens biological control (Haas *et al.*, 2005). Hydrolytic enzymes act as agents for prevention of plant diseases by causing lysis of pathogenic microbes in the close vicinity of the plant as they secrete increased level of cell wall lytic enzymes like chitinase, amylase and proteases (Tsegaye, 2017). In this study, the production of proteases activity in S3 and S5 is high when compared to other bacterial strain of starch hydrolysis. PGPR that synthesize one or more of these lytic enzymes has been found to have biocontrol ability against a range of plant pathogenic fungi and bacteria and enhance crop yield.

In this present study, the isolated bacterial strain S5 was found to be most efficient PGPR which solubilised phosphate, produced IAA, produced ammonia, produced HCN, produced catalase and showed hydrolytic enzymes activity. The strain can be further used as a biofertilizer and a biocontrol agent. Such type of study is necessary as it advocates that use of PGPR as inoculants or biofertilizers is an efficient approach to

replace chemical fertilizer.

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CHAPTER-41

MENSTRUATION: AN EMPIRICAL STUDY ON THE CREATION OF INFORMED CHOICE USING ADVERTISEMENTS WHILE FOCUSING ON MENSTRUAL CAPITALISM AND PERIOD POVERTY

Dr. Vikas Rajpopat

Anamika Dash

INTRODUCTION

“The silence around menstruation is so culturally ingrained that despite living in a home without restrictions, around me, I saw innumerable examples that silenced me. The extended family firmly objected to girls visiting religious places during their period, for fear of hampering the ‘purity’ of the place. We were routinely told to wear black pants to ‘avoid embarrassment.’ There was nothing worse than the world knowing you bled!” says Revati Upadhyay in her blog sharing her experience and opinions about the menstrual stigma she faced as an Indian woman. India has gone through a lot of changes throughout the 20th century both political and cultural which also includes its independence from Britain in 1947 and the declaration as a secular Nation. But unfortunately, secular India was also not able to eradicate itself from the taboo of

menstruation, a practice that came into view with religion and still functions within the Indian Culture. But as we have progressed, there has been a psychological change in people and they have broadened their perspective and it is not that of a stigma.

Right from earlier times, there has been an evolution of menstrual product advertisements. If we are to talk about the Indian Advertising Industry, the history of menstrual products ranges between 1885-1887. The only menstrual product available at that time was a sanitary napkin. Times of India was the first popular newspaper to feature the menstrual advertisement. The initial target of the product was modern upper-class women. It was positioned as a luxury product offering comfort and hygiene rather than a necessity product. In the 1920s and 30s, Kotex came into the Indian Market as an economical product for menstrual hygiene. However, it did not gain much acceptance because of a lack of awareness about the existence of such products. Even after entering the Indian market, Kotex kept targeting modern Anglo-Indian women. It was in the early 1950s when the brand started targeting modern Indian women as well. In 1992, Procter & Gamble launched 'Whisper' which took all the other associated brands on a ride. When all the other brands like Johnson & Johnson, Carefree, etc were striving to get the attention of women who were already using pads, Kotex decided to take a new way by converting non-users into their primary target audience, keeping their economical positioning intact. A number of Whisper pads were sold for ₹ 38, whereas the same pads were sold for ₹ 16 by Kotex. In the 2000s, tampons made an entry into the

market. It had no consumers because of course people thought '*virginity Chali jayegi*'! It would be wrong to say that sanitary napkin was gaining success, but the number of people using pads had starkly risen. There was a part of society that had shifted to using pads completely, but yet a larger section still stuck to the traditional cloth pads. In the early 2010s when the metropolitan Indians were already under the influence of the convenience and hygienic that disposable sanitary napkins had to offer, rural India still didn't have access and hence couldn't take advantage of this technology. It goes without saying that when they couldn't afford the necessities of life it was only a dream to them to use a sanitary napkin. It was still a luxury product for them. During this decade, the Indian Government took initiative to promote sanitary napkins in various ways like advertising campaigns, they also started distributing the product free at government schools, in collaboration with NGOs. During the late 2010s and 2020, modern Indians started exploring the phenomenon of sustainable menstrual hygiene products which are also long-lasting, taking into consideration the increasing global warming. Alongside sanitary napkins, tampons are also eventually being popularised through social media advertisements. Menstrual cups and tampons are still striving to find its customer base, their work is progressing at a snail's pace and is only present in Tier 1 cities (Tier 1 cities are more developed cities including the metropolitan cities. In India, there are eight tiers 1 city- Mumbai, Bangalore, Chennai, Hyderabad, Kolkata, Ahmedabad, and Pune). But still, rural India is grappling to make ends meet and for now, menstrual hygiene products

are nowhere in their list of necessities.

Professor Bridget Crawford coined the term “Menstrual Capitalism” which is defined as “the marketing and selling of menstrual hygiene products employing feminist messages that attempt to create a public-relations halo effect. In an article Victoria J. Haneman says that the earnings to be made in distinctive feature signalling entirely for the cause of attracting clients and riding sale. Pro-female, woke menstruation messaging can simply be an exploitative and empty co-option. Feminists have to expect more of menstrual capitalists, such as a dedication to deal with the diapositive length of poverty and a commitment that firms operating within this space address the diapositive issue of Period Poverty and meaningfully assist those unable to meet basic hygiene needs who may never be direct consumers.

Coming to the term Period Poverty, in a basic sense we can understand the lack of access to menstrual products because of financial curtailment. The major reason behind this is because of the comprehensive events of life that harm a woman/girl’s potential to avail the services of sanitary products that aid them to manage the most important “intimate life”. Without access to basic sanitary products (sanitary napkins, cups, tampons, etc.) girls make use of dirty rags and even ash (in the tribal areas) which results in many infections

Periods, about 50% of the population gets them but this natural process of shedding the uterine lining every month is a part of fertility and has long been shrouded in mystery,

embarrassment, and taboo. Let's see how women in the past and various cultures have dealt with and been treated during that time of the month. The word 'menstruation' is derived from the Latin and Greek words for month and moon because most women start a new period every 28 to 29 days similar to the moon's 29.5 days orbit around the Earth. This led many ancient people to believe that women's menstrual cycles were linked to the phases of the moon because of this connection, mythology across the world personifies the Moon as a goddess often with powers over fertility. The Greek Goddess Celine, the Roman Luna, and many more believed that menstruation was punishment for the moon goddess sleeping with the Sun God, her blood was said to be stored in 13 jars and was transformed into snakes, insects, poison, and diseases, etc.

Pads, tampons, and cups are helpful products for those with their periods. Each product is used to absorb menstrual fluid. A menstrual pad was launched in 1880 as menstrual pads. They grew from Benjamin Franklin's creation. He created it to stop wounded soldiers from bleeding. The pads were first commercially available in around 1880 with Thomas and William Southall's pad and in India it was 1976 when the brand 'Carefree' was launched, and Whisper came in 1989. A menstrual pad is used by placing the pad on the inside of a person's underwear where it can absorb the menstrual fluid as it leaves the vagina. Pads come in a variety of sizes and each pad should only be used once. It is recommended that it should be changed at least every 3-4 hours. After a person is done using a pad, they should wrap it in toilet paper and dispose of it in a trash can. Pads

should not be flushed down the toilet.

Next is a menstrual cup, which was first invented by an American actor Leona Chalmers in 1937. But it had an early version that was bullet-shaped and was made of rubber and latex. Menstrual cups are for internal use and are inserted inside the vagina. There are instructions inside the box that will explain how to insert a menstrual cup. They do not come with an applicator; a person will need to be comfortable touching their vagina to effectively insert and remove it. Cups must be changed and cleaned every 12 hours and are reusable for up to a year.

In 1931, came another product, a tampon. It was invented by Earl Haas and it was commonly used in the 21st century. Then, Gertrude Tendrich created the first commercial tampon brand, 'Tampax'. Tampons are also used for internal use and are inserted inside the vagina. They absorb the menstrual fluid as it is released before it leaves the vagina. Each tampon should be used only once and must be changed every 4-6 hours, or sooner if it is full. Some tampons come with applicators and some do not. Tampons also come in different sizes.

REVIEW OF RELATED LITERATURE

Book 1- Issues of Blood: The Politics of Menstruation

Author- Sophie Laws

Predominantly, the feminist work that included menstruation had its roots in the

matriarchal or essentialist radical-feminist schools of thought. Sophie Laws' careful examination of the politics of menstruation is a confident exercise in developing a socially constructive yet radical feminist perspective that refutes deterministic and universalistic biological explanations. She seeks it as an alternative to explain and make feel of social meanings and discover the approaches wherein competing social definitions interact. Looking at the social remedy of menstruation and the way the practices of our very own subculture spell out messages approximately male superiority and obligatory heterosexuality to women, Laws argues that during a patriarchal society, menstruation is visible through guys as a marker of femaleness and is used to deliver a specific notion in women's inferior status.

In order to offer a social constructionist argument, Laws' first venture was to call into question the universal menstrual taboo idea of an awful lot of anthropological studies on this area. The taboo presupposition proposes that menstrual blood is inherently grimy and that men are clearly repulsed via way of a bodily characteristic they do now no longer share with women, Laws' is going to extremely good lengths to show the lifestyles of enormous forms of cultural practices referring to menstruation and argues that it isn't always beneficial to lessen the complexity and form of ritual, exercise and ideals round menstruation throughout distinctive cultures to generalized statements about taboos. The tendency of Western male anthropologists to emphasize menstrual taboos says more about their own preoccupations than it reveals about the cultures they have

observed.

Rather than the Universalist perception of taboos, Laws has diagnosed a menstrual 'etiquette' which operates in present-day British secular culture. Defined by Laws' as a 'set of social practices which express and reinforce the distinctions between people of different social statuses' I determined this perception of etiquette useful, even though it does not allow for an exam of the position performed through spiritual discourse in building broadly held ideals regarding menstruation. The etiquette says that women might not make men aware of the existence of menstruation both implicitly or explicitly, because those who do are ridiculed, stressed or prevented by a larger section of the men. Many people will understand the descriptions given by Laws of the outstanding and extraordinary lengths women have a font to that allows concealing the truth that they are bleeding.

Starting with the speculation that what guys say about menstruation has engendered women's feelings of shame, Laws decided to investigate what a set of men had to mention on the subject, probing in particular questions of ways they thought that they'd acquired the attitudes and ideals they held. This is the form of study that only a handful of feminists select to talk about because a lot of us have an idea of the hateful nature of many men's reactions to menstruation. We have either been through it ourselves or have seen other women go through such hateful and sarcastic remarks by some men. The authoress herself found it difficult to hide her distaste for a lot of what she had heard from her

samples/subjects. These raise methodological issues for Laws as her loss of empathy together with topics made decoding the interviews hard and she couldn't offer a coherent description of their views. Sociologists have historically relied significantly on empathy with their subjects in making their interpretations and Laws is conscious that her research asks this insight. The stress of carrying out this research smoothly is constantly highlighted by her in the text, which makes me wonder whether or not there was a less painful way of collecting the data.

Laws' repugnance towards her subjects penetrates the text and creates a negative mood in the text throughout; just like many radical-feminist writings manage to do. It would be a stain on society if it puts people off, as this book is embodied with a lot of positive insight.

Book 2- New Blood: Third Wave Feminism and the Politics of Menstruation

Author- Chris Bobel

"New Blood" offers a new interdisciplinary look at feminism in transition. For more than three decades, menstrual activists have questioned the safety and necessity of feminine hygiene products while challenging menstruation as an ingrained taboo. Chris Bobel suggests how the unrecognised but enduring pressure within side the feminist health, environmental, and customer rights moves to lay naked tensions among second and third-wave feminisms and exhibits a complex tale of continuity and alternate within side the women's movement.

Through her scathing ethnographic lens, Bobel makes a speciality of debates important to feminist thought (inclusive of the application of the category “gender”) and demands situations to construct an inclusive feminist movement. Filled with private narratives, playful visuals and authentic humour, “new blood” famous middle-elderly progressives communing in Red Tents, city punks and artists “culture jamming” business menstrual merchandise of their zines and comic strips, queer anarchists practising DIY fitness care, African American fitness educators espousing “holistic womb fitness”, and hopeful moms refusing to skip at the disgrace to their pubescent daughters. With verve and conviction, Bobel illuminates trendy feminism-on-the-ground definitely vibrant, contentious, and ever-dynamic.

Journal Article 1

Title- Menstrual Capitalism, Period Poverty, and the Role of B Corporation

Author- Victoria J. Haneman

This article considers the earnings to be made in distinctive feature signalling entirely for the cause of attracting clients and riding sales. Pro-female, woke menstruation messaging can simply be an exploitative and empty co-option. Feminists have to expect more of menstrual capitalists, such as a dedication to deal with the dispositive length of poverty and a commitment that firms operating within this space address the dispositive issue of Period Poverty and meaningfully assist those unable to meet basic hygiene needs who may never be direct consumers.

Journal Article 2

Title- Menstruation in India: Ideology, politics, and capitalism

Author- Nikita Arora

Written against the backdrop of her two-year hard work as an activist in the 'Happy To Bleed' campaign, Nikita Arora is a 22-year-old feminist and women's rights activist who is also the founder of 'Happy To Bleed' campaign which world to eradicate the taboos against menstruation. Her goal is to provide healthy menstrual socialisation to young girls and women in India.

This paper seeks to investigate contemporary menstrual taboos in India, which have been prevalent despite significant medical interventions in reproductive and sexual health.

CHAPTER-42

Topic: Study of adaptability and efficacy of menstrual cup in managing menstrual health and hygiene

C. R. Kakani and Jalpa Bhatt

Abstract

Menstrual cups have been available for decades, but their use is limited by bulky design and the need for multiple sizes. However, some benefits have been reported like improvement in managing health and hygiene during menstruation, better information on the average menstrual fluid discharged by women during menstruation and attainment of more knowledge bridging the lacuna in knowledge about the adaptability and efficacy of menstrual cup as a better alternative to conventional options. The study is aimed towards assessing the adaptability and the effectiveness of menstrual cups by naïve users who have been using sanitary pads/tampons/cloth as conventional menstrual sanitary protection. Methods: The study was conducted at conducted Gujarat Medical Education and Research Society, Medical College and Hospital, Dharpur, Patan, Gujarat, India. A total of 158 participants aged between the ages of 20 to 50 years with regular menstrual cycles were enrolled in the study. Participants were provided with

menstrual cups to be used for three consecutive menstrual cycles. They were given detailed explanation/information about its usage. Feedback was obtained after every cycle for three cycles using a structured questionnaire. Results: The cup was preferred for comfort, dryness, and less odour. Insertion was easy for 80% of participants and 90% of participants found removal easy. The problem of leakage was encountered in 3-6%. There were few side effects like rashes, dryness or infection. Conclusions: These results demonstrate that this reusable vaginal device has no significant health risks and is acceptable to many women without the need for fitting or other medical services.

RESEARCH METHODOLOGY

The researcher has used qualitative and quantitative measures to analyse the data. With the data collected, the researcher is going to analyse whether women are in comfort with the product they are using, also interviewed 5 women using menstrual cups to know their experience, and through the quantitative analysis, I am going to analyse how many women are aware of the other alternative menstrual products present in the Indian Market.

“Qualitative Research can be constructed as a research strategy that usually emphasizes words rather than quantification in the collection and analysis of data.” (Bryman and Bell 2007, p. 28). Albert Einstein famously said, “Not everything that counts can be counted.” As a rule, qualitative research answers questions about why and how. It focuses on

generating meaning and understanding through rich descriptions, it integrates more subjective human experience rather than just focusing on purely objective external reality.

‘Quantitative Research involves the collection of data so that information can be quantified and subjected to statistical treatment to support or refute “alternative knowledge claims”’ (Creswell, 2003, p. 153) Researchers employ a quantitative research method in their attempt to develop theories, mathematical models, and hypotheses that pertain to a particular phenomenon. It is crucial as it provides data that are descriptive; it helps the researchers arrive at an objective and valid understanding of a phenomenon under investigation.

Research Methods Employed

Out of a variety of research methods available, the researcher has used two research methods in detail. They are discussed below:

- **Survey**

Looking for a way to collect valuable data then you’ll want to survey whether you use it for personal or business purposes. Surveys are an extremely effective method for gathering information. Surveys can be quick to fill out and get you the answers that you need. A survey is a structured way to collect information and feedback. They can provide valuable insights on a given topic and can be especially helpful for businesses as they can identify areas of improvement, unknown shortcomings, and potential threats. The

biggest advantage of using the survey as a tool of research is that it includes having a large population and hence has greater statistical power, the ability to gather large amounts of information, and the availability of validated models.

In my research, I have taken a survey of 64 female respondents from all over India asking them about their early menstrual days and the awareness they had, I also enquired about where they find advertisements regarding menstruation.

- **Interviews:**

According to Ary (2010), the interview is one of the most widely used and basic methods for obtaining qualitative data. Interviews are used to gather data from people about their opinions, beliefs, and feelings about situations in their own words. Interviews aid us to explain, understand properly, and explore research subjects' opinions, behaviour, experiences, phenomenon, etc. Interview questions are usually open-ended questions so that in-depth information will be collected.

I have used this tool to interview 6 girls using menstrual cups to understand their comfort level and how likely they are to recommend this to others.

Research Rationale

The researcher researches this topic because there is a lot of unawareness seen in people regarding the alternatives present in the market.

Sampling Details

Selecting the group from whom we will start collecting our data for our research is

sampling. It should be representative of the population to ensure that we can generalize the findings from the research sample to the population as a whole.

I have used non-probability purposive sampling; only menstruating women are my samples.

Purposive sampling refers to a group of non-probability sampling techniques in which units are selected because they have characteristics that you need in your sample. In other words, units are selected “on purpose” in purposive sampling.

Analysis Methods Employed

The two primary methods for data analysis are qualitative data analysis and quantitative data analysis techniques. These data analysis techniques can be used independently or in combination with others to help the researchers get insights from different data types. Here, the researcher has used a blend of the two techniques to get an understanding of the data gathered.

DATA ANALYSIS

The systematic application of statistical and logical techniques to describe the scope of data, modularize the data structure, condense the representation of data, illustrate it with images, tables and graphs, and evaluate statistical bias, probability data and derive meaningful data is known as Data Analysis.

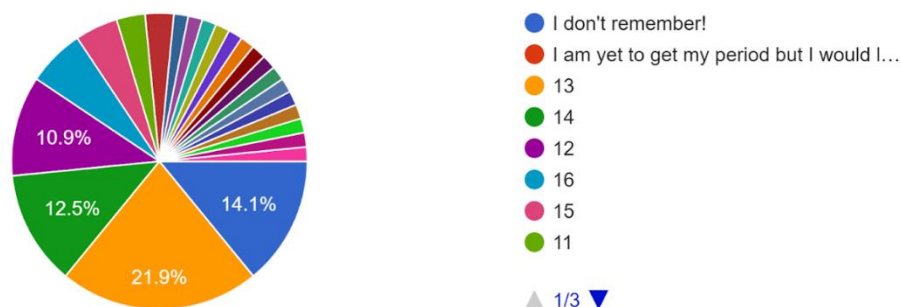
These analytical procedures allow us to draw the underlying conclusion from the data by

eliminating the unnecessary clutter created by the rest of them. Data generation is a continuous and iterative process, where data collection and analysis are performed simultaneously. Ensuring data integrity is one of the essential components of data analysis.

In the first question, the researcher probes to know at what age the respondents get their first period.

How old were you when you had your first period? (Please mention your age in the last option)

64 responses

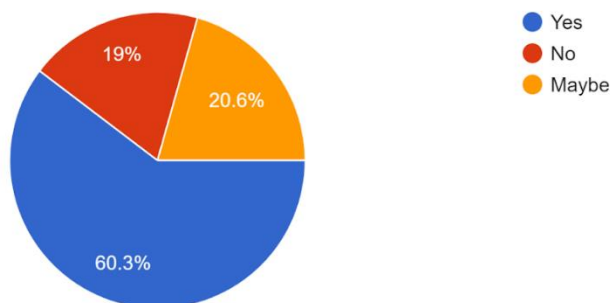


Out of all the answers of the 64 respondents, we come to the conclusion that the majority of the women got their first period when they were in the 8th grade i.e. when they were 13-14 years old.

In the second question, the researcher wants to know if the respondents were aware of the process and practices that take place during menstruation.

Were you aware of the process and practices of menstruation during puberty?

63 responses

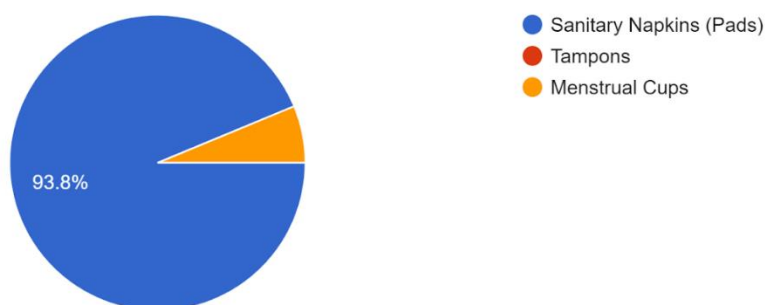


This chart clearly shows that more than half of the respondents i.e, 60.3% knew about the practices; 20.6% of respondents knew some things and were partially educated about the process, whereas 19% of the population was completely unaware of the practices and the process of menstruation.

The next question probes to find out which product is been used by the respondents, this will help the researcher know how many people are actually aware and use the alternative to a sanitary napkin.

What period product are you currently using?

64 responses

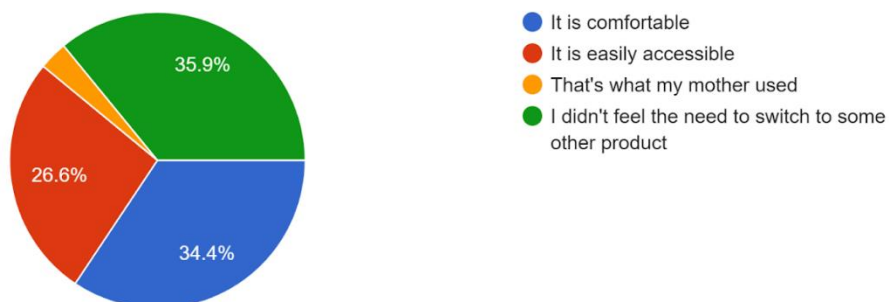


We can clearly see in the above chart that the majority of the respondents are using sanitary napkins and only a minimum of 6.3% (4 respondents) people use menstrual cups. This makes it quite clear that either the respondents aren't aware of the alternatives or they have some trouble using them.

In the next question, the researcher is keen to know what drives the respondents to use the product that they are currently using. This will help to find out why they are using what they are using.

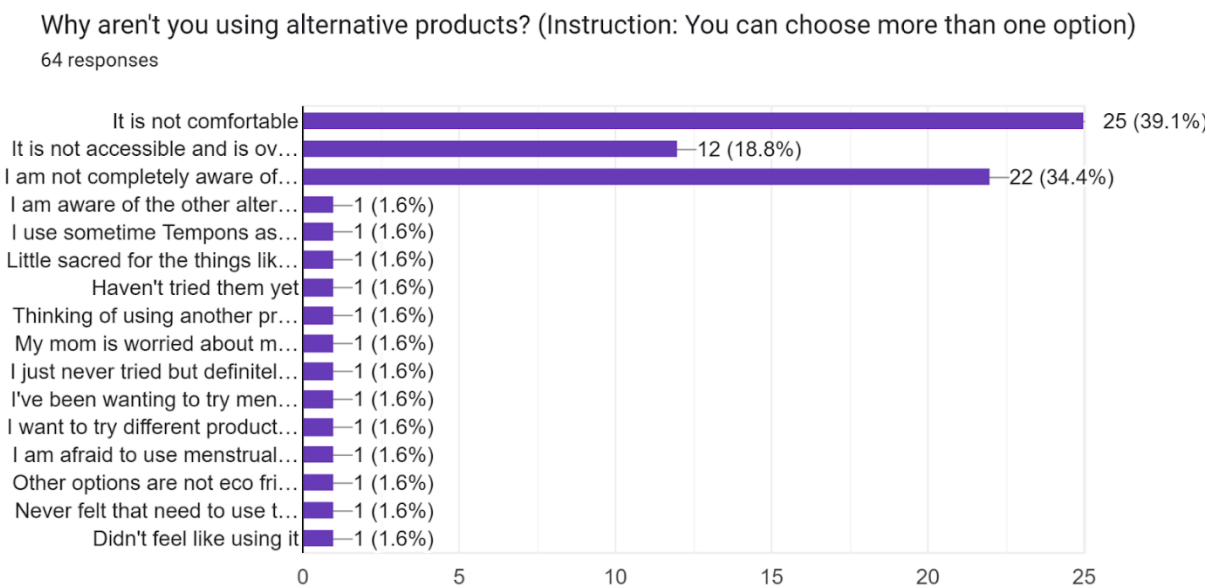
Why are you using this product?

64 responses

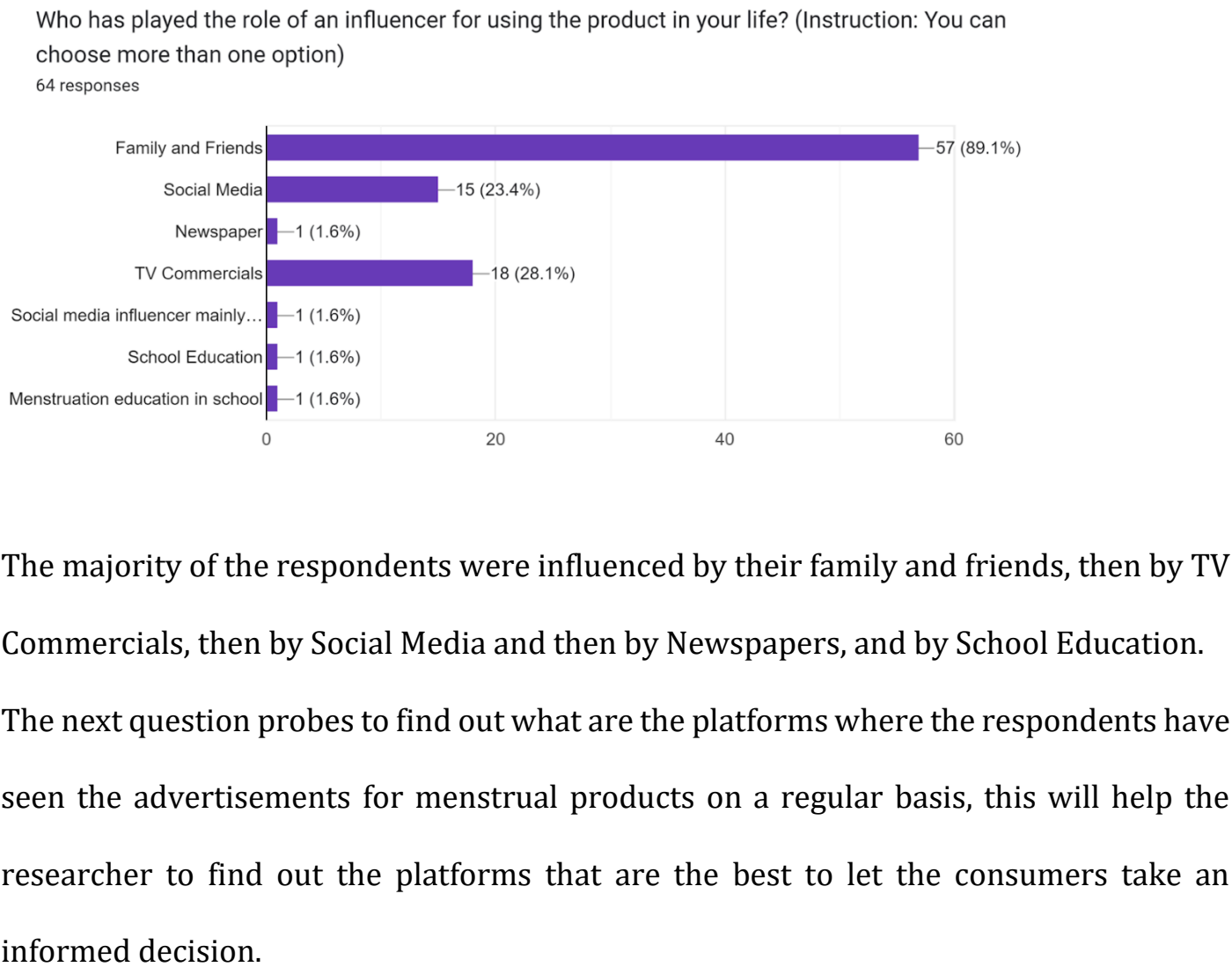


The respondents were given four options for this question, in this question 23 respondents chose that they use the products they are using because they didn't feel the need to switch to any other product maybe because they are used to it; 22 respondents choose the product because it provides them with comfort during the tough days of menstruation; 17 respondents use the products because it is easily accessible in the nearest shops or pharmacies; and a minimum of 2 people use the product as a legacy

The next question scrutinises why the respondents are not using the alternatives available in the market.

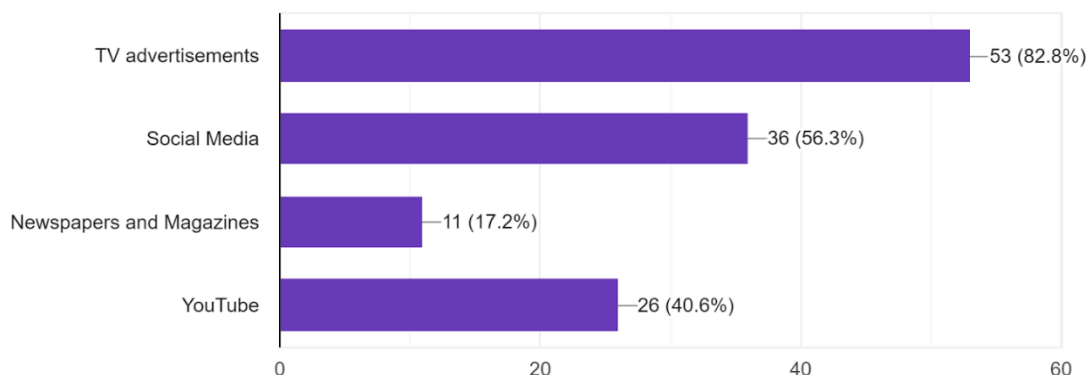


25 of the respondents, i.e. 39.1% say that it is not comfortable; 22 of them are not completely aware of the alternative products available in the market, while 12 of them feel that access to the products is not easy and that these products are heavily priced and others have several different reasons to not use them like the insertion process is a hassle, and that their mom is worried about them switching and some feel that the other options are not eco-friendly and some never really felt the need to use other products. In the next question, the researcher wants to find out the influencer that made them use the current product.



Where do you find advertisements for menstrual products on a regular basis? (Instruction: You can choose more than one option)

64 responses

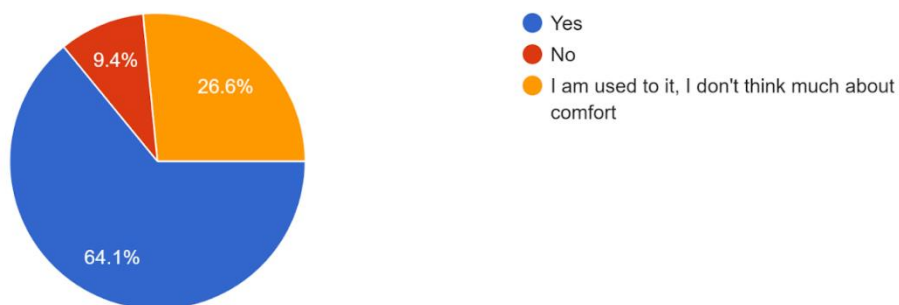


With the above graph, we come to know that people tend to find advertisements more on Television, followed by Social Media then by YouTube and lastly by Newspapers. By this, we can conclude that the best platforms for creating awareness about alternative products are Television and Social Media.

The next question enquires the respondents about the comfort that they feel using the current product.

Whatever product you are using, is it giving you comfort?

64 responses

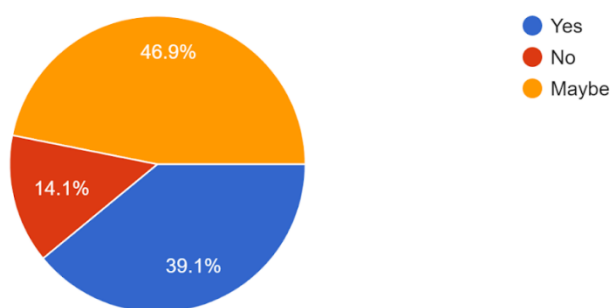


From the responses, the conclusion is that 64.1% of the respondents are comfortable with the products they are using; 9.4% are not comfortable with the products and 26.6% don't care about the comfort level as they have been using it all their life and are habituated to using them.

The researcher has designed the next question to find out if given a choice whether or not will the respondents switch to the other products.

If given a choice, would you try and shift to another product? (Instruction: If you answer no, please answer the next question)

64 responses



Out of 64, 30 of the respondents are ready to take a shift to alternative products if they are given proper awareness and education; 14.1% of respondents are rigid and loyal to their products and won't switch using it; 39.1% of respondents are ready to shift regardless of anything.

The next question probes to find out the best platform to create awareness of the products available in the market.

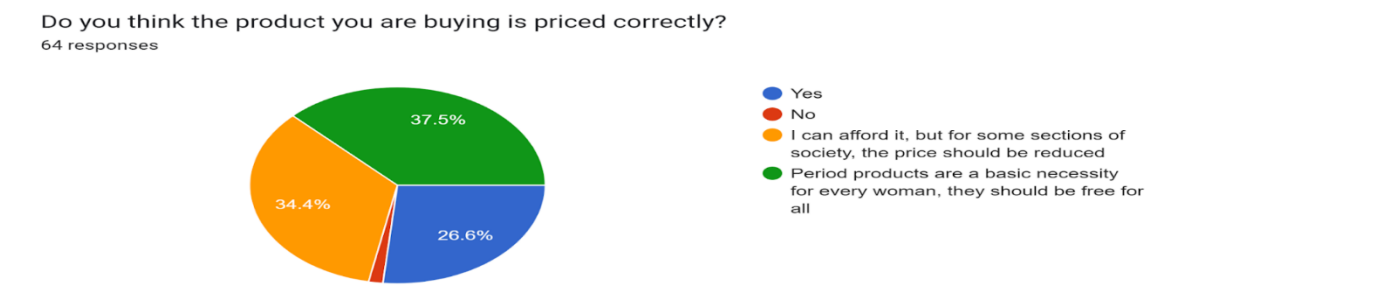
According to you, which is the best platform to create awareness about menstruation, its practices and the products?

64 responses

Platform	Count	Percentage
Advertisment, ac...	1	1.6%
Digital media esp...	1	1.6%
In schools, but in...	1	1.6%
PDA, television a...	1	1.6%
Schools are the b...	1	1.6%
Social Media, Tele...	9	14.1%
Social media and tv	11	17.2%
TV	1	1.6%
TV, Social Media	1	1.6%
TV commercials a...	3	4.7%
YouTube advertis...	1	1.6%

After careful examination of the responses, it can be concluded that the best platform as per the respondents is Social Media, however, there are some respondents that feel all types of media can be used for the same, and some feel that TV Commercials are the best way to reach to the rural audience. Some have also commented that educational institutions should be teaching the basics not only to girls but also to boys so that they know when and how they can help a fellow classmate or their female friends.

The next question asks the respondents about their opinion on the pricing of the products they are using.



Most of the respondents feel that access to period products is a basic right of every woman and that they should be free; 34.4% of the respondents feel that it is easier for them to afford, but for certain sections like rural people the price should be reduced. 17 respondents feel that the products are priced perfectly and 1 of the respondents feels that they aren't priced correctly at all.

Along with the questionnaire, the researcher has also conducted interviews with 5 women with a regular cycle who use menstrual cups. They were in the age group of 20-25. It was a face-to-face interview where they were asked some questions about their menstrual cycle and their experience of using a cup, and also what drove them to use menstrual cups instead of a sanitary napkin since it is the most used sanitary product for menstruation.

After analysing the data that was collected, there were several codes generated. They are discussed here.

Knowledge from loved ones and social media

This is the first code that has been generated based on the knowledge that they had regarding period practices and processes. All the interviewees said they knew about the menstrual process because of their mother or sister. On being asked about the process and cons of the process of using alternatives they said that the internet had helped them a lot.

Unawareness of the alternative products

This primary code came into being when the interviewees were asked about the product they used before switching to a menstrual cup. One of the interviewees also mentioned that she was wearing cloth as well.

Discomforts of using sanitary napkins

This code was generated after analysing the answers of the interviewees to the question about what their experience was before shifting to a cup and also what is the primary factor that made them think of switching to another product.

Pros of using cups

This code was also generated on similar lines to the last code, the interviewees shifted to using cups because of the benefits it holds. Some of the benefits are: it is pocket friendly; reduces irritation and vaginal dryness; has fewer leaks; and longer wear time.

Personal hygiene

They also shifted to menstrual cups because as per their experience, they felt that the sanitary napkin was 'uncomfortable', 'had bad odour', 'resulted in rashes' etc. This is made under code generation of personal hygiene.

Advertisements on Alternatives

The interviewees also suggested advertising not only sanitary napkins but also on the alternative products on different media platforms like Social Media etc.

ADVERTISEMENTS ON MENSTRUAL PRODUCTS THEN VS NOW

It wouldn't be wrong to say that we have progressed a lot when it comes to the advertisement of menstrual products. It is the most normal and biological thing that affects half the population. According to The Drum, in 2020, Facebook had to face disgrace when it vetoed the Modibodi ad for showing blood and this thing left people utterly astonished that even in the 21st century people can feel periods are a taboo.

Menstrual Advertisements first began in the year 1870, the most advertised products were menstrual pads. If one takes a glance over this advertisement it might look like a lingerie advertisement. All this time, menstrual ads have emphasized the point that women should stay close-mouthed about their periods.

In spite of the fact that Television and Sanitary Napkins came at the same age. It still took until 1972, for sanitary napkins to be advertised vastly on television. Just because they were unable to market and place their products properly, many brands worked together to let them advertise their product and fought the guidelines that were set by the National Association of Broadcasters (NAB). Finally, after being pressurized by the rebel, NBA lifted the ban, and Scott Confidets emerged as the first menstrual hygiene product to be aired on Television.

Even though the TV ban was lifted in 1972, till 1985 the word 'period' wasn't employed. In the 80s, Courtney Cox used this word in the ad of Tampax, and told the audience that "feeling cleaner is more comfortable. It can actually change the way you feel about your

period.”

After 20 years of this ad, society thought that advertising would have boomed in regard to menstruation but unfortunately, in 2005 yet another ad faced backlash. However, in 2014 an innovative #LikeAGirl was widely recognized for breaking stereotypes and empowering women.

And in our country India, the way in which menstrual products are advertised has a lot to do with how society thinks about menstruation. These ads not only show how stigmatized menstruation is but also validate it. The premises under which the ads are created and marketed to Indian women are rustled under one and only theme- women empowerment. The ads show girls running, and jumping around and are all fresh and happy only because they are wearing sanitary napkins.

Stayfree's ad commercial was aired in 2008 with the tagline '*Kisi bhi roop ke saath samjhauta nahi*'. The lady in the ad wouldn't have compromised with whatever role she chose to play- whether that of a teacher or a loving daughter. Why? Because she was wearing Stayfree's ultra-thin, secure, dry sanitary pads.

The fact that the ad presumes that a woman is somehow compromising her true identity, or always has low self-esteem when she is on her period demonstrates period is some kind of disease.

One more noticeable thing that can be seen is the excessive use of the color white. Right from their bedsheets to their clothes, everything is white. They did not leave the walls

and curtains as well, everything is white!! The thing that won't be in one glance evident to the audience is that, here, white is a major subtext, that creates a stark difference between the normal days and 'those days.' The basic understanding that the advert wants to create in the minds of the consumers is "You can sit anywhere or wear anything white, take these pads and rest assured you'll never stain."

Every period is different. And the experiences are different for every female, but the only thing that is similar is that- WE DON'T BLEED BLUE. The incomprehension of menstrual being represented by a blue gel is problematic to an extent. Even though this ad is meant for those who menstruate, these ads are made with keeping in mind the discomfort that society would feel if they see the dirty, unholy blood. They shouldn't necessarily use blood, but why a blue gel? Hence, the aspirations of the adverts match the socio-cultural aspirations of society.

Even the ad protagonists refuse to talk about periods and refer to menstrual days as '*undinon*'. This is clearly represented in Whisper's 2014 ad, where a young girl sits unhappily on the hockey field and her mother comes with Whisper's special dry-weave top sheet sanitary pads assuring her that she will win. One advert that was away from the usual template was Whisper's 'Touch the Pickle' which broke the taboo that came along with menstruation in general.

Supposedly, Indian ads will start representing menstruation as it is, without any mortification or hesitation and the menstrual flow will be respected and not

dehumanized like it is now. We hope for an ad that has no euphemisms and a direct conversation between two people about periods. The advertising companies can also involve a brother or father having this conversation freely, and stop adolescent girls from being embarrassed about a normal, physiological process they undergo every month.

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CHAPTER-43

ROLE OF GENETICS, AGING AND ENVIRONMENTAL / EXTERNAL FACTORS IN MALE'S INFERTILITY - A REVIEW

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Abstract

There are a lot of physiological conditions are well known which are related to infertility, like sexual dysfunctioning, failure of gametes fusion, conceiving problems and so on. Genetic conditions, environmental factors diet, lifestyle etc. are greatly influences the fertility. But now – a - days, we are not aware about our lifestyle and diet plan, eating junk food or processed food, drinking canned juices and/or Beverages, drinking alcohol, smoking, lack of exercise. Therefore, India is greatly affected by infertility. Every one couple out of six couples is affected from infertility. Not only India, but this problem is facing worldwide. In this review, we are mainly focused on some, elemental, environmental and genetic conditions which influences the male infertility.

Keywords : Infertility, genetics, Elements, Environmental factors, ROS, aging etc.

Introduction

Some elements like cadmium, mercury, arsenic, boron, Vanadium, nickel, lead; anti-metabolites, dyes, dioxins, food additives, pesticides like DDT, even dust of our home have toxic mixture that people are daily exposed to them. This may lead to affecting the various important organs of human body like organ of reproductive system, lungs, liver and too many. Long term exposure causes the diseases like cancer, infertility like problems etc. Toxic heavy metals and many chemicals like DDT are acts as oxidative stress inducers. Oxidative stress condition may lead to the overproduction of ROS. (1) (2) (3) (4) (5)

ROS's production is greatly increasing by our daily conditions like traffic and industrial activities (like traffic fumes, smog and so on). These ROS productions is also generated in our body and play an important role in our metabolic activities, formation of ROS by an enzyme called SOD, by using hydrogen peroxide. (6) (7) (8) (9) (10) (11) (12)

So, production of ROS is controlled by consuming anti-oxidant which destroys the ROS. Fruits and green vegetables are rich in bioactive substances and have anti-oxidant properties. A lot of vitamins like Vitamin A, Vitamin B, Vitamin C, Vitamin E; Vegan products, diary products are also beneficial for lowering the production of ROS. Elements like copper, selenium, zinc; melatonin, beta carotene and/or luteine, plays the crucial role for the process of spermatogenesis, sperm mobility, increase the number of sperm

or sperm count, sperm viability and thus high semen quality. Avocados, a fruit, is effective and a lot of sources of nutrients like folate and potassium etc. is the best way to maintaining the fertility. (13) (14) (15) (16)

Elements which affects the Male's Infertility

Among the basic molecules or ions of the plasma of sperm, sodium, potassium, magnesium, calcium, iron, copper, zinc, selenium is greatly significant. The concentration of potassium in the plasma of sperm must be $2.7 \pm 5 \mu\text{mol}$. If the ratio of sodium /potassium increases 1:2.5 , this drastic changes decrease the sperm mobility, sperm viability also. Each molecule or ion plays the crucial role, if they increase or decrease, this imbalancing leads to serious problems in our body. Zinc and iron participate in the redox reactions in our body. Zinc and magnesium are act as stabilisers an also coenzyme of SOD, which protects us from the harmful effect of free radicals or ROS on sperm. Deficiency of zinc causes decrease level of testosterone, decline the number of sperms, reduce the viability of sperm and thus reduces infertility. (17) Excess of zinc in the semen decline the activity of oxygen radicals, reduces the sperm motility.

Selenium also plays the crucial role with respect to infertility. Selenium is an essential microelement and takes at very low amount and if the limit exceeds then it produces toxic effects. (18) (19) Selenium participates in forming mitochondrial shield in the sperm cell, also influences the sperm viability. Selenium also helps in the destruction of ROS. Elements like cadmium, lead, mercury, nickel, chromium, vandium, alter the

testicular functions and destroy the vascular endothelium of leydig cells , sertoli cells and also alter their function. (20)

Due to daily exposure of traffic fumes, industrial fumes, perfumes, pesticide and even dust of our room, having toxic mixture which affects the male's fertility. (21) (22) (23) (24) Because this toxic mixture enhances the production of ROS. These ROS are negatively affected on our body especially causes infertility. Some studies suggest that the system's defence against these ROS are overloaded or if the production of ROS is high, then this will lead to disease like conditions. (25) (26) (27) These ROS's production alters the process of spermatogenesis. This ROS's production is also enhanced by our lifestyle our eating habits and so on. Spicy and oily foods are also greatly influencing the production of always. A lot of antioxidants are formed in our body and responsible for the destruction of these ROS. Fruits and vegetables, juices, soyabean, citric fruits like lemon and orange are rich in antioxidants. Dairy products and vegan products are good source of antioxidants. (28) (29) (30) (31) (32) (33)

Genetic Effect in Infertility

We discussed above, the effects of elements in an infertility. Along with elements, there are a lot of genetic defects leads to infertility. Genetic defects like chromosomal aberrations, include the numerical and structural aberrations of autosomes as well as allosomes, impaired the function of testis end as thus infertility. (34) (35) (36) Klinefelter's syndrome in which males have one extra copy of X chromosome (44 + XXY)

and thus they are infertile. Turner's syndrome in which females have loss of one copy of X chromosome (44 +X0) and thus they are also infertile. (37) (38) There are many genetic conditions like Edward's syndrome in which one extra copy of 18th chromosome (trisomy of 18th chromosome) and patau's syndrome in which one extra copy of 13th chromosome (trisomy of 13th chromosome) and Down's syndrome in which one extra copy of 21st chromosome (trisomy of 21st chromosome) and thus they are also infertile. Kallman's syndrome is caused by the mutation in KAL1 gene which is located on the long arm of X chromosome i.e., Xp22.3 and it is mostly found in males. This KAL1 gene is responsible for the production of extracellular matrix anosmia - 1, that helps in the migration of nerve cell precursors and also causes disorder of reproductive systems like hypogonadism and anosmia. (39) (40) (41) (42) (43) (44)

Partial fertility is only maintained in mosaicism condition. (35) (41) On the other hand, male infertility is also caused by microdeletion of Y chromosome, mutation in those genes which are have potential for the development of sexual characters of males, for instance Genes on Yp11.2 (short arm of Y chromosome) have Amelogenin gene (on AMELY locus). This gene is a homolog of X chromosome Amelogenin gene (on a AMELX locus) and thus these acts as a biomarker for examining the sexing in the forensic works. (45) (46) SRY gene on Y chromosome in humans, which is responsible for maleness and is also responsible for the testis development. TDF, also causes testis development.

Azoospermia is a physiological condition in which a completely lacking of sperm cells in

the semen which are ejaculated by orgasm. (47) This azoospermia condition takes place due to the undevelopment of testis, obstruction in the reproductive tract and also low production of sperm cells, and a major cause is deletions in AZF region on Y chromosome. (48) This AZF region is located on the long arm of Y chromosome i.e., Yq11. This AZF region have genes that are responsible for the process of spermatogenesis and other various reproductive process. This AZF region are of three kinds: AZFa (means Proximal), AZFb (means Intermediate), AZFc (means distal). Mutation in AZFa causes Azoospermia or oligozoospermia and also causes SCOS. Mutation in AZFb causes Azoospermia and/or also failure of maturation of sperm cells, usually at spermatocyte/spermatid stage (No sperm cells in the testis in these patients). Mutation in AZFc causes Azoospermia and also many seminal damage (Ejaculate low amount of semen in these patients).

Cystic fibrosis is the condition in which mutation in CFTR gene which are located on 7th chromosome. This Cystic fibrosis is an autosomal recessive mode of inheritance. This CFTR gene mutation is occurs by the deletion of 3 nucleotides that codes phenylalanine at position 508 of that protein i.e., F508del. This results in the secretion and/or production of thick sticky mucus in all organs like respiratory tract, causing recurring pneumonia, bacterial and/or viral infections; alimentary canal, causing Cholelithiasis, blocking of salivary gland and also reproductive tract, by the accumulation of thick sticky mucus in the reproductive ducts and thus causes obstruction. (48)

Age Effect on Infertility

Parenting is the important phase of individual's life, because parents – do – be can feel themselves good and also provide stability (financially and emotionally) to rear their children. It is a great pleasure, right, prerogative, responsibility, faithfulness, loyalty, devotion and allegiance, which comes in various forms at the different age and/or stages of life. Moreover, ageing also affecting the fertility of males, but the research is going on and it is not fully understood to date. Therefore, the count of sperm cells as well as sperm viability decreases with age of males, because of declining the rate of architecture of testicular lining. Declining the rate of fecundity as well as increase the rate of disturbed pregnancy takes place with the passage of time or age. Age influences the health of child also. However, altering the patterns of gene expression and/or epigenetics in the sperm of ageing person may affects the wide variety of neurocognitive disorders, metabolic dyshomeostasis across the generations. A lot of physiological problems like obesity, type II diabetes mellitus, arterial hypertension, late onset hypogonadism and so on, are also takes place. Therefore, reduction in the count of sperm cells, sperm cell viability, Sertoli cell, leyding cells. Infertile couples in males, takes ART and also a lots of other treatment methods.

Conclusion

The infertility is altered by the dietary habits. You should high consumption of fruits and

vegetables, vegan products, dairy products like milk, curd, butter, yoghurt and so on for the better outcomes of fertility. Because fruits and vegetables have high amount of anti-oxidant properties which neutralises the oxidative stress i.e., ROS. You should take vitamin A, vitamin D, vitamin C, vitamin E, folic acid, Iron, Iodine etc. for the best way to maintaining the fertility. The genetic counselling is the better way for the Management of genetic disorders. Infertile couples in males, takes ART and also a lots of other treatment methods.

Abbreviations

ROS : Reactive Oxygen Species.

DDT : Dichloro-diphenyl-dichloro ethane.

SOD : Superoxide dismutase.

SRY : Sex Determining gene on Y chromosome.

TDF : Testis Determining Factor.

AZF : Azoospermia factor.

SCOS : Sertoli Cell only Syndrome.

CFTR : Cystic Fibrosis Transmembrane conductance regulator.

ART : Assisted Reproductive Techniques.

Conflict of Interest : The author declares no conflict of interest.

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CHAPTER-44

Few-Classical Applications of Operations Research

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Abstract:

Operations research is a branch of applied mathematics where issues are first formulated mathematically and then solved. This area of study grew throughout the preceding years parallel to the increase in computing capacity. Operations research is now widely used by businesses to develop their operational, tactical, and even strategic decisions. Assignment, scheduling, routing, pairing, dividing, and other duties within a given time and/or space framework are frequently the issues Operations research is a branch of applied mathematics where issues are first formulated mathematically and then solved. This area of study grew throughout the preceding years parallel to the increase in computing capacity. Operations research is now widely used by businesses to develop their operational, tactical, and even strategic decisions. If it is effective, it results in substantial expense reduction and/or profit growth. Assignment, scheduling,

routing, pairing, dividing, and other duties within a given time and/or space framework are frequently the issues addressed.

Introduction:

The British/Europeans refer to "operational research", the Americans to "operations research" - but both are often shortened to just "OR" - which is the term we will use.

Another term which is used for this field is "management science" ("MS"). The Americans sometimes combine the terms OR and MS together and say "OR/MS" or "ORMS". Yet other terms sometimes used are "industrial engineering" ("IE") and "decision science" ("DS"). In recent years there has been a move towards a standardization upon a single term for the field, namely the term "OR".

Operation Research is a relatively new discipline. The contents and the boundaries of the OR are not yet fixed. Therefore, to give a formal definition of the term Operations Research is a difficult task. The OR starts when mathematical and quantitative techniques are used to substantiate the decision being taken. The main activity of a manager is the decision making. In our daily life we make the decisions even without noticing them. The decisions are taken simply by common sense, judgment and expertise without using any mathematical or any other model in simple situations. But the decision we are concerned here with are complex and heavily responsible. Examples are public transportation network planning in a city having its own layout of factories, residential blocks or finding the appropriate product mix when there exists a large number of

products with different profit contributions and production requirement etc.

O.R. Tools and Techniques:

Any applicable tools or methodologies that are available are used in operations research. The most widely utilized tools/techniques include electronic computation, cost analysis, and mathematical methods. However, linear programming, game theory, decision theory, queuing theory, inventory models, simulation, and other related methodologies have received significant attention from operations researchers. Nonlinear programming, integer programming, dynamic programming, sequencing theory, Markov process, network scheduling (PERT/CPM), symbolic Model, information theory, and value theory are some more common tools in addition to the approaches mentioned above. There are numerous additional tools and methodologies for operations research.

1.1The Vehicle Routing Problem:

A fleet of vehicles serving a group of clients with known requests are designed with a set of minimum cost routes that originate and end at a central depot as part of the VRP with time windows. To ensure that the vehicle capabilities are not exceeded, the customers must be assigned to the cars precisely once. It can be expanded into the VRP with time windows (VRPTW), where, in addition to the pre-existing requirements, the service at a customer must start within the time frame determined by the earliest time and the latest time when the customer approves the commencement of service.

2.1The Airline Planning Problem:

One of the most difficult issues in the field of operations research is the APP. Flight scheduling, fleet assignment, aircraft routing, and crew scheduling are the related issues. The first one aims to maximize predicted profit by selecting a selection of flights with precise departure and arrival schedules. In the second, based on the various capacities and the number of available aircraft, we choose the kind of aircraft to allocate to each scheduled flight in order to optimize the profit. The third one involves assigning certain aircraft to specific flights while maintaining maintenance standards. In the final one, we establish crew schedules that satisfy the limits and cover all scheduled flights, which is typically done in two parts.: both a pairing and assignment issue. While in crew pairing we generate a set of pairings given the scheduled flights so that the cost of the pairings is minimized and all the flights are covered exactly once, in crew assignment we build monthly schedules for each crew member given the set of pairings such that every pairing is covered exactly once.

3.1The Bus Driver Scheduling Problem:

The challenge of scheduling bus drivers is to ensure that every component of the timetable is covered at the lowest possible cost. Any setting, either a school bus or an urban bus, is acceptable. Each vehicle block, or simply block, is a bus trip that begins at the depot and ends at the depot, according to the bus timetable. There are rest stops along such a block where a driver change is possible. A task is the section of a block that lies between two successive relief points and is always served by a single driver. A piece

of work is made up of numerous related jobs that must all be completed by one driver in a block of time. All of the specifics pertaining to duty (workday) and schedule viability are defined by the internal policies of a bus company and the collective bargaining agreement between the transit operators and the drivers' union. One or more tasks carried out by the same driver constitute a duty. When a task requires more than one piece of work, there are breaks or unworked intervals added in between the portions. A duty's viability is influenced by both the length of the tasks at hand and the duration of the pauses.

It is also limited by restrictions such as caps on the number of tasks that may be completed in a single assignment, the total amount of time that can be worked

Compensated time, or total spread. Additionally, the collective agreement may categorize tasks into different classes and specify limitations on the global manpower time table.

4.1 The Locomotive Assignment Problem:

Optimizing the use of the available fleet of locomotives is one of the many challenges encountered by rail transportation businesses. The train consist that will be utilized on each scheduled train is specified in the equipment assignment plan, which also shows which trains will be covered by the same equipment units. Various types of locomotives are typically used by railways to create train consists. A train consist is a collection of equipment that travels together along a specific section of the actual rail network. The LAP's goal is to allocate a fleet of locomotives to a group of trains while satisfying a wide

range of operational and financial restrictions and optimizing one or more important goals.

5.1 The Shift Scheduling Problem:

Many industries, including retail, healthcare, postal services, transportation, and industrial production, require shift scheduling. Although the method for scheduling workers may differ from one location to another, the overall objective always remains the same. It entails creating a collection of employees' work schedules throughout a specified time period in order to meet the demand for employees caused by a set of activities or occupations. The calculated schedule must be compliant with numerous labor, union, and legal restrictions and must meet the requirements of one or more selection criteria, such as employee wages, the caliber of the work delivered, or employee preferences. Such a timetable must be found, which is a very sensitive task that is best carried out with the aid of optimization tools. In actuality, there is a tremendous level of uncertainty in staff scheduling. Employees may indeed arrive late or leave early, and for some horizons, the observed and predicted demand may diverge.

6. Conclusion:

When the entire process is effective, from the mathematical description of the actual problem to the implementation of the optimum solution, the interaction between mathematics, computer science, and real-world problems has a special and interesting beauty that tastes spicy.

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CHAPTER-45

A Comprehensive Survey on Deep Learning Approaches in Brain MRI for Tumor Detection

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Abstract

Magnetic Resonance Imaging is the best way to identify abnormality in the brain tissues, but has some challenges in confirming whether the abnormal growth of tissues is a cancer tumor or not within a short time by the medical professionals. Reliable Brain

Tumor (BT) Segmentation is essential for proper diagnosis and therapy planning. Since manual segmentation of BT is time-consuming, expensive, and subjective, appropriate automated approaches are generally desired. BT are exceedingly variable in terms of location, shape, and size, and creating automatic segmentation algorithms has been a difficult task for decades. Detecting BT is a difficult task for doctors without a tissue biopsy. It takes a long time to confirm where it is a cancer tumor; also, the biopsy is a painful process for the patient. Image processing is crucial in BT detection. With computer-assisted image analysis, detecting BT in its early stages is possible. Image processing technologies such as imaging scans, X-rays, and Magnetic resonance Imaging (MRI) help doctors identify suspected regions in the human brain. The primary goal of medical image processing is to diagnose authentic and meaningful knowledge exploitation images with the least amount of error tolerance. The main focus of this work is to encapsulate novel facts of analysis using deep learning to focus on the techniques planned in contemporary world literature.

Keywords: *Brain Tumor detection, Image processing, image analysis, Deep learning*

Introduction

Image processing is used a lot in many different areas of medicine. In the early detection and treatment of various diseases, looking for problems in the image that aren't normal is very helpful. The brain is one of the body's essential organs because it coordinates everything the body does.

Cure Brain Cancer Foundation reported the severe impact of BT globally, which caused an increase in the death rate drastically. In particular, Australians who have an age below forty are more affected mainly by BT than any other malignant issues [1,2]. The severity of tumor is based on its category widely the malignant tumor is classified as High-Grade Tumor (HGT), which is covered both Grade III and IV and Low-Grade Tumor (LGT), which is covered both Grade II and I by World Health Organization (WHO), in which people having LGT can live long years with or without difficulties, but the those who affected with HGT may lose their life within two years [3]. The survival rates for patient with BT is very poor, and treating the disease is very difficult. The HGT mostly developed from LGT if the diagnosis is made earlier with a highly accurate prediction of the possibility of HGT, it may have the possibility to save many people.

The segmentation of BT plays an important role to identify the severity of the tumor and its position for developing the treatment protocol for the particular individual may include its growth monitoring, selection of particular therapy etc.. An adequate algorithm is essential for detecting the exact location of tumor as well as its shape and its impact on the neighbour brain cells. The tumor may have spread in linear or nonlinear way which the proper segmentation procedure should analyse. Also, to get further clarity with tumor and non tumor tissues, the other image modalities are used in clinical trials. T1 Weighted MRI is used to evaluate the normal anatomy. Still, other advanced imaging such as T1 weighted MR image with contrast (T1c), T2 MR Image (T2w – high intensity)

and FLAIR (Fluid-Attenuated Inversion Recovery) MR Images are used for deep analysis such as fat, blood and other fluids structure and its significant changes.

BT segmentation methods are classified into three types based on the human interaction required: manual, semi-automatic, and fully automatic [4]. Manual segmentation of BTs in MR images is a laborious job that takes time and is vulnerable to variability. As a result, during the last two decades, there has been much interest in reliable automatic and semi-automatic segmentation of BTs, resulting in hundreds of distinct algorithms [4]. Many of these algorithms were developed and tested using private datasets. These datasets differ significantly in input data (the imaging modalities utilised), BT kind, and illness stage (pre- or post-treatment). As a result, comparing the performance of the different segmentation methods has proven difficult. Since 2012, a multimodal BT image segmentation (BRATS) challenge has been held in conjunction with the international conference on Medical Image Computing and Computer-Assisted Intervention to solve this issue (MICCAI) [5]., incorporating the applicable criteria that follow.

Overview of Tumor Detection Approach

The classification of BTs from MR images has been studied by many authors using ANN (Artificial Neural Networks), FCM (Fuzzy Clustering Means), EM (Expectation Maximization), SVM (Support Vector Machine), ML (Machine Learning) and Techniques based on Knowledges [6-20]. There are few remarkable works has been discussed here. ANN-based classifier techniques were used by Deng Wu et al. [16] and other researchers,

whereas he did the tumor classification with a successful algorithm with an accuracy of 83% in which quality rate is used individually for segmentation of WM (White Matter), GM (Gray Matter), CSF (Cerebrospinal Fluid) and TR (Tumor Region). More accuracy in the automatic classifier of BT from MR Images is obtained by Wankhade et al. [7] using SVM for classification, Fourier transform (FT) for feature extraction, and Minimal Redundancy-Maximal-Relevance (MRMR) is reduced significantly for a higher accuracy of 98.9%.

Traditional Machine Learning

Traditional ML methods for brain image segmentation can be used for clustering the tumors, either in the normal or abnormal, classification of the tumor severity levels, and deep learning for more details such as the shape and position of the tumors.

The driving force in the process of classification and clustering is the multidimensional feature space. It can be extracted from many MR modalities, and it is the standard acceptable TML technique: intensity and textural characteristics of tumor images can be combined using feature space developed by many authors [10-14] using train classifiers. The next step is to apply a class label that most closely resembles the feature space of the target structure to anticipate the class to which the target structure belongs. In contrast, unsupervised, pixel-based clustering algorithms separate unlabelled images into groups of pixels with comparable attributes without using training photos. A few recent studies [16–20] used machine learning-based techniques

for segmenting brain tissue.

Deep Learning

Due to their superior performance and capacity to automatically capture adaptive characteristics that surpass manually produced features, deep learning-based methods have recently attracted the attention of researchers. Additionally, as feature complexity increased, these features were learned, leading to more reliable feature learning. In recent years, more studies have been planned using a combination of deep learning-based technology and a cutting-edge brain tumour segmentation technique. Convolutional neural networks were used in most experiments because they are good at spotting patterns in images, especially MR images, and have produced encouraging results. As described in more detail in the following sections, deep learning-based segmentation has been applied to 2D, 2.5D, or 3D MR images.

Strength and Limitations of Conventional and Deep learning approaches for BT detection

Two Dimensional (2D) images for Deep learning requirements has been prepared from the three Dimensional (3D) brain image through the image slices method or 2D patches prepared from 3D images, and the same models are used for the input of 2D convolutional kernel[21-37]. Cascade layers of 3 by 3 convolution kernels which is proposed by Fu Hao et al.[21] to reduce overfitting issues by the regions created by segmentations such as region for necrosis, region of enhancing tumor, Edema region and normal tissue regions. This work used a two-convolutional neural network (CNN)

architecture for identifying low-grade glioma and high-grade glioma in its feature maps.

The usage of small kernels resulted in a more complex architecture, which lowered the number of weights in the network and had a substantial impact on overfitting. One restriction is that the user must manually identify the glioma grade during the initial phase, which requires prior medical knowledge. Furthermore, in the study, tissue segmentation was performed as a patch-based task, with the local dependency of labels during pixel classification neglected. Another disadvantage of the proposed method is the BRATS 2015 Challenge dataset's inadequate segmentation of Tumor core regions.

Similarly, Selvaraj D et al. [22] described using a different cutting-edge Cascade CNN model for fully automatic brain tumour segmentation. The study used a 2D CNN cascade architecture to extract local and global contextual characteristics that deal with imbalanced tumor labels and preserve local label dependency during pixel classification. The model, however, has two drawbacks: i) when applied to 3D images, only the regional dependency of the labelled samples was considered, with the appearance and spatial consistency being disregarded. ii) This results in poor segmentation between the brain tumour's enhanced and core regions that are inferior to the entire tumor.

Aboelenein et al. [13] recently proposed a new method for segmenting brain tissue from MR images using a patch-wise U-net architecture to partition the MR image slices into non-overlapping patches. Individual input patches were predicted using the U-net model and corresponding ground truth patches. The model preserved more local spatial

information than the standard U-Net model. The method successfully addressed the flaw, precisely the limited memory issue caused by several down and up sampling phases. The memory problem was related to the storage of parameter values at each stage and the difficulty in retaining local information when the entire image is integrated into the network. Even though the proposed model solved the memory problem, the computational complexity increased during the training phase.

Summary of Tumor detection approaches:

This review includes the comparison of literature as detailed below. Specifically, the survey is on research that created methods for classifying and segmenting brain tumours using traditional ML, CNN, etc. There are few papers are selected for the detailed literature and the data has been extracted which is given in the following table1.

Evaluation of Matrix

Different segmentation techniques in medical image analysis face significant challenges concerning validation and quantitative comparison. Ground truth data is necessary for the validation process' segmented output comparison. There are not enough ground truth data available to evaluate obtained data in humans in a real-world setting. As a result, following MRI acquisition, experts manually create ground truth data for patients. Although this is the only way to confirm that the MRI

Table 1: A comparison of approaches based on a literature review

Sr. No.	Author	Year	Methods	Strength	Limitation
1.	Magadza and Viriri [25]	2021	Convolutional Neural Networks	Deep learning-based brain tumour segmentation approaches, including their building blocks, are discussed in detail.	The survey excludes brain tumour classification techniques as well as traditional machine learning-based tumour classification and segmentation methods. The top-performing

					segmentation models on the BRATs dataset are offered.
2.	Rao and Karunakara [24]	2021	Thresholding, Convolutional Neural Networks	Various brain tumour segmentation strategies have been considered, including thresholding, region expanding, atlas, deep learning, and traditional supervised and unsupervised machine learning.	The majority of the reviewed papers on brain tumour classification were published in 2019 or earlier, except for two pieces of literature released in 2020. While providing their per-

				The effectiveness of tumour classification methods was described understandably.	(mince metrics, the segmentation and classification approaches are not easily distinguished.
3.	Sharma et al.,[23]	2021	Convolutional Neural Networks	Short descriptions of thresholding, traditional supervised, and unsupervised-based segmentation techniques are provided.	A brief overview of deep learning-based brain tumour segmentation and classification. The results of the surveyed literature are not included.
4.	Tiwari et	202	Convolution	A	Literature

	al.[26]	0	al Neural Networks	comprehensive hierarchical classification of brain tumours is presented. Techniques for brain tumour segmentation are discussed, including those based on thresholding, conventional supervised and unsupervised machine learning, and deep learning. Brain tumour classification techniques are	before and including 2019 is reviewed chronologically. A small number of literature on deep learning-based brain tumour segmentation and classification is reviewed.
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				reviewed based on traditional machine learning and deep learning.	
5.	Sathya Narayan N., Vidya T.[2]	2019	Random Forest Algorithm	It provides more accuracy	Complex and noise removal is tough
6.	Tonmoy Hossain et al.[28]	2019	CNN, FCM, Medical Image, segmentatio n, SVM	It provides high computational Efficiency	when the data set contains noise, it does not perform well.
7.	P.Muthu Krishnammal et al. [29]	2019	Convolution al Neural Networks, K-means Segmentatio n	It provides more accuracy	It does not work well with clusters of different sizes and different densities
8.	S.M.Kamrul	201	Pre-	Watershed	Pre-

	Hasan and Mohiudding Ahmad [4]	8	processing by median filter and trilateral filter Segmentation by watershed Segmentation and Scale-invariant features transform (SIFT)	Segmentation provides an excellent result, and at the same time, it is computationally straightforward and less complex.	processing should be carefully done to get accurate results.
9.	Kumari and Saxena[27]	2018	Thresholding, deep learning	A limited literature review was conducted, which included different segmentation	Rather than reviewing the literature on brain tumour classification, the paper focuses solely

				techniques such as thresholding, deep learning, and supervised and unsupervised machine learning techniques.	on the advantages and disadvantages of the classification algorithms. The review did not include the performance of proposed techniques, aside from a brief discussion of brain tumour segmentation techniques. Furthermore, the review work includes
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					literature before 2018.
10.	AnushreeA. Wankhede,D R. A. V. Malviya [7]	201 8	Segmentatio n by K- means algorithm and for feature extraction GLCM, HOG and LBPH, classification by Support Vector Machine (SVM)	Accuracy is high as compared to other techniques	Feature extraction should be carefully done, and it uses many methods

data belongs to an actual patient, manual segmentation is risky, highly subjective, and challenging to repeat (even by the same expert) [14]. Various validation techniques that utilise software simulation and phantoms have been proposed to overcome these restrictions. False visuals are produced by

software simulation to mimic the acquisition process in real life. Similarly, since the ground truth is known, it is possible to independently change and analyse the various acquisition parameters and image artefacts. This kind of validation is quicker and simpler to use. However, the images obtained for software simulation merely approximate the natural images because the software simulation method does not account for all factors that may affect the acquisition of actual pictures. Phantom images produced by MRI scanners are more realistic than those produced by software models. Phantom images, however, cannot be altered. Additionally, phantom imaging and software simulation results are expensive and time-consuming. Various similarity criteria were used to evaluate the overlap between the predicted brain MRI and the provided ground truth image [15].

The Dice coefficient [16] is the most well-known evaluation metric. This volume can compare the quality of two binary label masks. Let us define D_P as the mask generated by a segmented algorithm and D_Q as the mask generated by a human evaluator; the Dice overlap is then evaluated as Equation (1).

$$\text{Dice}(D_P, D_Q) = \frac{2|D_P \cap D_Q|}{|D_P| + |D_Q|} \quad (1)$$

where $|\cdot|$ is the number of voxels. The overlap measure has a value between $[0, 1]$, with 0 indicating no match and one indicating that the two masks are identical. The Jaccard index [17], which is represented as Equation

(2), is also employed as a similarity measure for comparing two binary label masks.

$$\text{Jaccard Index } (D_P, D_Q) = \frac{|D_P \cap D_Q|}{|D_P| + |D_Q| - |D_P \cap D_Q|} \quad (2)$$

The positive projected value (PPV) is the ratio of true positives to the sum of true and false positives. It is also known as precision and is written as Equation (3).

$$\text{PPV } (D_P, D_Q) = \frac{|D_P \cap D_Q|}{|D_P \cap D_Q| + |D_P^c \cap D_Q|} \quad (3)$$

The positive projected value (PPV) is the ratio of true positives to the total of true and false positives. Equation (3) is another name for it and another way to communicate precision. The true positives rate, determined using Equation (4), is the proportion of true positives to the total of true positives and false negatives.

$$\text{TPR } (D_P, D_Q) = \frac{|D_P \cap D_Q|}{|D_P \cap D_Q| + |D_P \cap D_Q^c|} \quad (4)$$

The lesion true positive rate is the ratio of true positives to the sum of true positives and false negatives (LTPR). In the list of lesions, L_P is the 18-connected component of D_P , and L_Q is the 18-connected component of D_Q . It is written as Equation (5).

$$\text{LTPR } (D_P, D_Q) = \frac{|L_P \cap L_Q|}{|L_P \cap L_Q| + |L_P \cap L_Q^c|} \quad (5)$$

where $L_P \cap L_Q$ denotes the overlap of a connected component of D_P and D_Q . It is demonstrated that the lesions of the human evaluator and the

segmentation algorithm are equivalent. Furthermore, the Lesion False Positive Rate (LFPR) is the ratio of false positives to the sum of false positives and true negatives, which may be represented as Equation (6).

$$LTPR(D_P, D_Q) = \frac{|L_P^C \cap L_Q|}{|L_P^C \cap L_Q| + |L_P^C \cap L_Q^C|} \quad (6)$$

Where $L_C R$ denotes the 18 connected components of $D_C P$, the absolute volume difference (AVD) is defined as the absolute difference in volume divided by the genuine volume. It is stated as Equation (7).

$$AVD(D_P, D_Q) = \frac{\text{Max}(|D_P|, |D_Q|) - \text{Min}(|D_P|, |D_Q|)}{|D_P|} \quad (7)$$

The Average Symmetric Surface Distance (ASSD) is calculated as the average of the distances (measured in millimetres) between the lesions in the D_P and the nearest lesions found in the D_Q . It is called Equation (8).

$$ASSD(D_P, D_Q) = \frac{\sum_{p \in L_P} d(r, L_Q) + \sum_{q \in L_Q} d(r, L_P)}{2} \quad (8)$$

where the distance between the lesion r in L_P and the closest lesion in L_Q is denoted by $d(r, L_Q)$. When a value is zero, D_P and D_Q are considered to be the same. More details on similarity measures for validation and evaluation in medical image analysis are available in [13].

Table 2 summarises the metrics for validating brain segmentation at the voxel and lesion levels in terms of the quantity of True Positives (TP), False Positives (FP), and False Negatives (FN) (TPL, FPL, and FNL). Equation(7) defines the Absolute Volume Difference (AVD) as the absolute volume

difference divided by the genuine volume.

Table 2. Summary of the validation measures

Metrics of Segmentation Quality	Mathematical Description
True positive rate, TPR (Sensitivity)	$TPR = \frac{TP}{TP+FN}$
Positive predictive rate, PPV (Precision)	$PPV = \frac{TP}{TP+FP}$
Negative predictive rate, NPV	$\frac{TN}{TN + FN}$
Dice Similarity Coefficient, DSC	$\frac{2TP}{2TP + FP + FN}$
Volume Difference Rate, VDR	$\frac{FP - FN}{TP + FN}$
Lesion-wise true positive rate, LTPR	$\frac{TPL}{TPL + FNL}$
Lesion-wise Positive Predictive Value, LPPV	$\frac{TPL}{TPL + FPL}$
Specificity	$\frac{TN}{TN + FP}$
F1 Score	$\frac{2TP}{2TP + FP + FN}$
Accuracy	$\frac{TP + TN}{TP + TN + FP + FN}$
Balanced Accuracy	$\frac{Sensitivity + Specificity}{2}$

Discussion

Several academics have studied the resampling data method as a potential remedy for the data imbalance issue. Recently, GAN has been used to produce training dataset substitutes. This method oversamples the training dataset with fake samples [16,17]. GAN utilizes structural information from the original in this work.

According to Table 2, approaches for segmenting brain images generally fall into three categories: hybrid, machine learning, and intensity based. These techniques are collaborative and progressive. The overall objective includes segmenting normal brain tissues, brain substructures, tumor and intra-tumor regions. The complexity of the procedure is increased progressively. The fundamental obstacles in segmenting brain structures, trends in segmentation methods, types of segmented brain structures, and computation time can all be grouped under the general heading of "four main areas" in this overview. Despite recent advancements in brain image segmentation techniques, there are still some difficulties.

Challenges

The major challenges in BT segmentation is in developing the unique algorithm which should identify the malignant tissues exactly from the MRI image with its exact shape, position and its severity level using the less computational load with time efficient manner. The existing publications

shows the imbalances between the all the parameters mentioned above. The need of more algorithm is the obvious factor for developing the brain segmentation and its automation for better diagnosis the cancer tissues. In the available literatures some authors are focusing the shape of the affected tissues in which the main difficulties of making the statistical model of the system to segment the exact shape of malignant tissues it can be mostly solved by the pixel comparing filters but it fails suppose if the overlapping between the healthy tissues and affected tissues with the same degree of pixels. In order to overcome this the researchers focusing the slicing techniques and compare the intensity between the slices. The filters coded by the researchers to distinguish the tissues using the variations of intensity around the spatial of the tumors on the MR images taken based on the contrast injection. The data which is captured by the MR machines have some variations due to the hardware non standardization and the bias happed by the machine which is identified by the many researchers but the amount of data in datasheet is not sufficient to develop the successful list of bias field which may occurring due to the Radio Frequency (RF) coil faults. The deep learning-based algorithm reduces the above mentioned issues in the field of brain segmentation, but still it is not developed completely because of the training quantity of MR images. The detailed segmentation is done by the authors [11-22] using CNN, DL methods, U-net methods on MR

Images with the challenges of its performance in terms of time and in quality. There is a huge gap in studying the impact of hybrid technique to reduce the noise and disharmony using the image filters.

Conclusion

There is a requirement of algorithms based on deep learning for segment the brain image in order to detect the abnormal tissues with almost 100% accuracy. The large number of image training is required from the different data set as it could help the development of ML algorithm in the field of medicine for clustering and classifying the severity of tumor in different levels such as high risk, moderate risk, low risk and no risk etc., The success of treating BT is based on the earlier detections. The radio therapy is the way to destroy the tumor but it should not affect the nearby healthy tissues which is available around the malignant tumor, it can be avoided if the optimized algorithm is developed based on the CNN, U-net , AI etc., The technology in hardware side is developing rapidly which may support the computational difficulties and its cost.

Future Direction

The classification and clustering of BT have been done by many authors [23-29] using traditional ML methods. The further level of classification and clustering is required for perfect process of it. In future it is need to be done with less computational cost also creating libraries in python or some other

tool with more trained MR images;

The preparation of MR images for pre-processing is still not standardised for getting the better quality output through the process of segmentation. The many others did the brain image segmentations [5-29] but they have used the random procedure for processing such as grey conversion, masking, image enrichment, binary-grey or grey-binary conversion, image augmentation etc., based on the quality of images or the quality of segmentation. In future the selection of pre-processing may be developed with automated process to select the appropriate techniques.

DL methods are most popular among the many researchers because it can work in many layer and have large space to find the details of the data images using many networks. The DL approaches have powerful encoders and decoders such as ResNet, Inception, MobileNet, Unet, PSPNet, Linknet etc., There is huge development required on the above tools for further improvement in getting the deep details from the processed images.

DL base filter are doing fantastic analysis for the standard MR images but it still not good for the poor MR images and the few Malignant tumor have similarity to the benign tumor. It happens frequently it should be solved by new deep learning based algorithms. The 3D image slicing / patching into 2D which can be used for much more deep analysis and again visualization issues are there because the issues in integrating process of many layer /

slices / patches into the developed 3D models. The image augmentation playing the important role to visualise the region of interest (ROI) as well as proper labelling with accurate annotation for treating the malignant tumor with radiation therapy.

There are some advantages and drawback using ML or Traditional ML as well as random combination of decoders and encoders of DL tools on the MR image. To improve the performance in brain segmentation normally CNN is used with some tolerance on the output. These tolerances have been reduced further with additional computational load by the hybrid segmentation method on the MR image.

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CHAPTER-46

COPPER (II) OXIDE (CUO) NANOPARTICLE SYNTHESIS AND GAS SENSOR APPLICATION

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Abstract

In order to create CuO nanoparticles in reverse micelles (o/w microemulsion), copper sulfate was utilized as a precursor. With the use of this technology, ultrafine metal oxide nanoparticles between 50 and 60 nm in size can be created. In the inverse microemulsion system, copper (II) oxide nanoparticle synthesis was studied. As a result, metal particle nucleation continues in the microemulsion's water capsules. As a surfactant, tween 80 was added. X-ray diffraction (XRD), scanning electron microscopy (SEM), and transmission electron microscopy (TEM) were used to characterize the products. The research offers a quick and effective method for producing CuO nanoparticles at room temperature.

Keywords: CuO, Nanoparticle, Gas Sensor, Reverse Micelle.

Introduction

The unique or improved qualities of nanosized materials are essentially influenced by their size, content, and structure, making their preparation and application important scientific and industrial interests [1-3]. These characteristics have close relation to the manufacturing procedures. Pulsed laser ablation [4], vacuum vapor deposition [5], pulsed wire discharge [6],

and mechanical milling [7] are all examples of physical methods for synthesizing nanoparticles, while microemulsion techniques [9], sonochemical [10], electrochemical [11], microwave [12], and hydrothermal [13] are all examples of chemical methods. Chemical processes can also include biological or biosynthetic procedures [14].

Reverse micelles, also known as surfactant water-in-oil microemulsions, are one such approach. Reverse micelles' nanometer-sized aqueous cores provide a suitable stable environment for the essential chemical processes to make nanoparticles of relatively uniform size. The surfactant layer also functions as a steric stabilizer to prevent the newly produced nanoparticles from clumping together.

Since Boutonnet et al.'s creation of the technology, a wide range of nanoparticles have been created. Eastoe and Warne and Pileni both provide in-depth reviews that detail the history and current use of the water-in-oil microemulsion technology. Below are some of the benefits of synthesizing nanoparticles using a microemulsion:

(a) Nanoparticles of many different materials can be manufactured at room temperature and pressure.

There is no specialized hardware need for this method.

(b) The produced particles can have their size and shape adjusted as desired

(c) It can be used to produce particles in homogeneous solution via any of

the known precipitation reactions.

This research presents a novel and straightforward strategy for the manufacture of CuO nanoparticles using the sol-gel process in nano and micro micelles. Transmission electron microscopy (TEM), scanning electron microscopy (SEM), and X-ray diffraction (XRD) are used to analyze CuO particles' shape, crystallographic structure, surface characteristics, and size. Due to CuO's function in catalysis, in high-T_c superconductors [15–18], and in gas sensors [19–21], copper oxide nanoparticles have garnered a lot of attention. Copper (II) oxide has numerous desirable qualities for industrial use, including electrical, optical, and others. There are several applications for CuO, including photocatalysis, hydrogen storage, solar cells, magnetic ceramics, gas sensors, electrode materials, and solar cells [22–27]. As a means of reducing pollution in the environment, detecting dangerous gases like CO and NO₂ has garnered a lot of attention in recent decades [28]. Nitrogen oxides (a mixture of nitrogen gas and nitrogen dioxide) were among the most dangerous gases to humans [29]. Carbon nanotubes [30], conducting polymers [31], and metal oxide semiconductors (including In₂O₃, WO₃, V₂O₅, TiO₂, and SnO) [32–36] are only some of the sensor materials that have been studied for their potential to detect nitrogen oxides. CuO/SnO₂ and CuO/ZnO are two examples of copper oxide/n-type metal oxide composites that have been investigated as gas sensors for H₂S, H₂, and

CO [37-40]. For instance, CuO nanospheres with a monodispersed structure were found to be sensitive and selective to certain combustible gases [41] by Li's team. In this paper, we detail the production of CuO plates and particles and report on their NO₂- and alcohol-sensing sensitivity. The results indicated that the CuO particles and plates as synthesized had promise as a sensor application for detecting NO₂ gas. Our earlier publication [42] describes procedures and gas sensor equipment that were quite comparable to those used in this study. The ceramic tube of the sensor body was annealed at 500 °C for 4 hours in a muffle stove before being coated with as-prepared CuO particles or plates to create the CuO sensor. After 24 hours of aging at 300°C, the as-fabricated sensors were installed into the gas detection equipment. For thirty minutes, we subjected the sensor chamber to a steady stream of dry air before performing an analysis. Micro injectors delivered a measured amount of NO₂ gas into the chamber, and liquid alcohol was injected onto a heating device to rapidly turn to gas. When the detecting gas was combined with air in a uniform manner, the sensitivity could be determined.

Materials and Methods

Chemicals and apparatus

High-purity solvents and ingredients (CuSO₄·7H₂O, Tween 80, and NaOH) were acquired from Merck and Fluka Chemical Company. No additional

purification of the materials was performed because they were all of commercial reagent quality. Philips Analytical XPERT diffractometer equipped with Cu K radiation ($\lambda = 1.54056 \text{ \AA}$), MINIPROP detector, 40 kV, and 40 mA was used to perform X-ray diffraction. Zeiss EM10C-80 KV, operating at 80 KV, was used for the TEM analysis. A PHILIP XL-30, set to 30 KV, was used to carry out the SEM scanning. Thin layer chromatography (TLC) on silica gel polygram SILG/UV 254 plates were used to determine the purity of the substrates and to track the progress of the reactions.

Preparation of Copper oxide nanoparticles

Tween 80, $\text{CuSO}_4 \cdot 7\text{H}_2\text{O}$, NaOH, soybean oil and distilled water were used in the experiments. Nanoparticles were synthesized by following steps: 0.80 g of $\text{CuSO}_4 \cdot 7\text{H}_2\text{O}$ in water (3 ml) and 6.5% Tween 80 were added into purified soybean oil (80 ml) under mechanical stirrer with 2500 rpm until obtaining a nearly clear emulsion. This solution was referred to as solution A. NaOH (0.45 g) was dissolved into water (2.8 ml) was added into solution A under mechanical stirrer with 2100 rpm for 3.5 h at room temperature and then the reaction mixture was filtrated. The precipitate was washed with absolute water ($3 \times 600 \text{ ml}$) for 4 times. This material was calcinated in electronic oven at 220°C for 5 h. Surface morphologies of the specimens were observed with a scanning electron microscope (SEM, Philips XL-30). The ordered nano structures of CuO can be further confirmed by transmission electron

microscope (TEM, Philips KV-120). The resulting powder X-ray diffraction was conducted on a Philips Analytical XPERT diffractometer using a Cu K α radiation ($\lambda = 1.54056 \text{ \AA}$) with a MINIPROP detector and operating at 40 kV and 40 mA. X-ray diffraction patterns were recorded between $2\theta = 5^\circ$ and 79° with a step of 0.04° and a time of 0.8 s by step. The crystallographic data of the resulting CuO nano powders were collected by using the PC-APD, Diffraction software.

Results

CuO particles were calcined at 200°C , and the resulting XRD patterns are displayed in Figure 1. The CuO powders at the nanoscale are amorphous. Scherrer's formula ($D = 0.89 / B \cos$) was used to determine that the average particle size of CuO nanoparticles was 53 nm. The average particle size, D , the wavelength of the X-rays, B , and the Bragg's angle, were accordingly, B , and. X-ray powder diffraction (XRD) was used to look at the phase composition and structure of the acquired samples.

TEM and SEM pictures of CuO nanoparticles (Figures 2 and 3) showed a cluster of particles with sizes between 50 and 60 nm, indicating that the particles were homogeneous and uniform in size. SEM and TEM pictures are given in Figs. 2 and 3 to characterize the shape of CuO nanoparticles. The collected photos show that our synthesis procedure is a simple way for the manufacture of CuO nanoparticles, with a high supply of homogeneous NPs

having an average particle size of 40-60 nm. The produced nanoparticles are well-structured and resistant to air oxidation when suspended in hydrocarbon liquids.

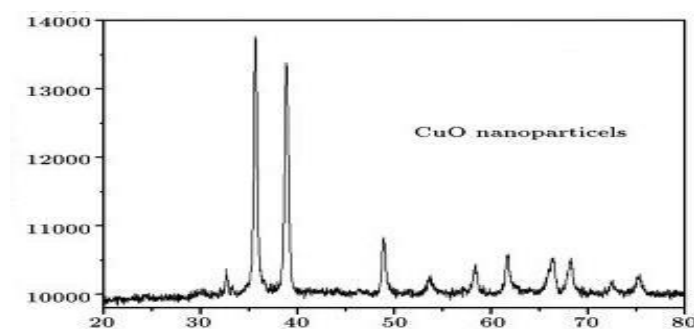


Figure 1: XRD pattern of the CuO nanoparticles.

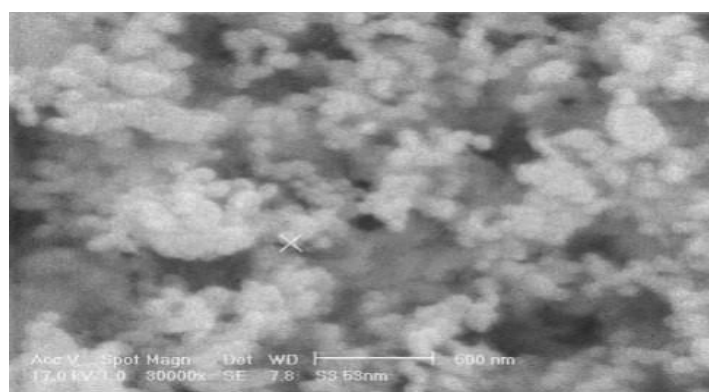


Figure 2. SEM image of the CuO nanoparticles.

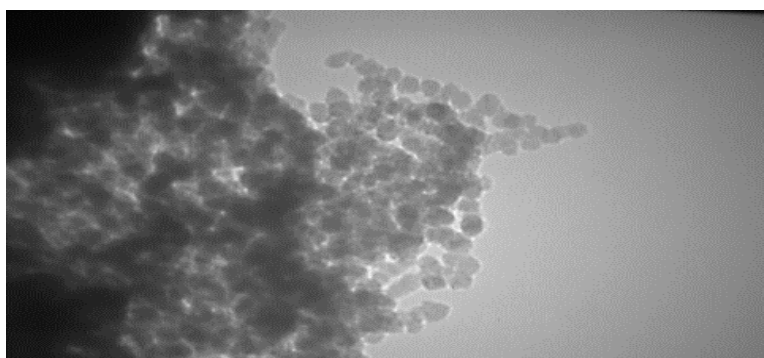
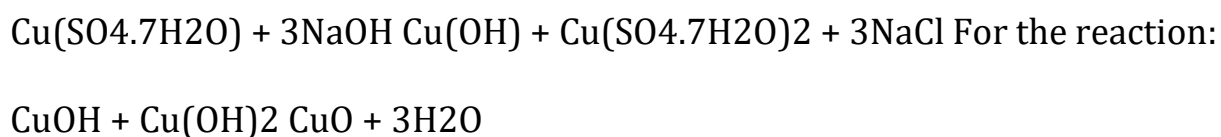


Figure 3. TEM image of the CuO nanoparticles.

Discussion

To avoid excessive grain development and nanoparticle aggregation during copper (II) oxide (CuO) nanoparticle formation, sodium hydroxide was added simultaneously with increasing the stirring time. The complete chain of reactions is depicted here:



The metal salt is first converted into a metal hydroxide such as CuOH or Cu(OH)₂, and then dehydrated to produce an oxo-hydroxide intermediate, which serves as the precursor in the sol-gel process. In this investigation, an emulsion was formed and stabilized by mixing CuSO₄·7H₂O, soybean oil (including Tween 80), and water using a mechanical stirrer. The water solution was distributed throughout the oil phase, and the Tween 80 assembled at the water/oil interface. Although the oil solution had become the continuous phase, hydroxyl groups in the water droplets of the emulsion had diffused to the water/oil interface, where they partially interacted with CuSO₄·7H₂O to create copper (II) oxide.

Conclusion

Water-in-oil at room temperature from a CuSO₄ source is described as an inorganic phase used in this study. SEM, TEM, and XRD have all been used to describe the nanoparticles and show that they are uniform in size, shape, and aggregation distribution, with diameters ranging from 60 to 460 nm.

Researchers in the industrial sector should also take into account the scalability of the process because of the low-cost copper source and the ease with which conditions can be controlled. The method used to synthesize nanoparticles in this study is straightforward and eco-friendly, making it a viable option for widespread use. CuO nanoparticles' ability to sense NO₂ and alcohol was thoroughly studied. In its as-prepared form, CuO was found to exhibit p-type semiconductor behavior. It was determined that 200 and 350 degrees Celsius were optimal operating temperatures for CuO nanoparticles for detecting NO₂ and alcohol, respectively. When compared to CuO nanoparticles, CuO plates demonstrated superior sensitivity. These findings suggested that CuO plates, which are inexpensive and have strong sensing properties and a low working temperature, could be used to detect NO₂ with little energy usage.

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CHAPTER-47

A REVIEW OF THE LITERATURE ON BUSINESS INTELLIGENCE

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ABSTRACT

The expanding Business Intelligence (BI) sector is driving companies to tailor their products and services to meet the expectations of modern consumers. One of the most crucial organizational improvements in the dissemination of knowledge and the foundation of corporate decision making is the widespread implementation of corporate Intelligence systems. Adaptation of BI application and its implementation, BI architects, and enabling elements in BI projects are all essential ways to approach BI literature given the wide variation in BI integration and implementation practices among enterprises. Furthermore, we will discuss how organizational capabilities, such as flexibility and risk management support, and technological capabilities, such as user access, data quality, and the integration of BI with other systems in the firm, are essential for BI success in any decision environment. Finally, this study will explore the theoretical foundations upon which the concept of BI rests. We anticipate that the findings could provide the value and input for businesses who want to introduce a BI app to their operations.

Keywords: Business Intelligence, BI Capabilities, BI Architectures, Enabling Factors

INTRODUCTION

The association landscape of today is complex and ever-changing. There is a

lot of demand on businesses and nonprofits to explain the state of change and new developments to the highest levels of management. Strategic, operational, and tactical decisions are necessary for this, yet they are complex and must be made quickly. Fundamental leadership involves a plethora of facts, figures, and know-how. To achieve modernization, this information must be processed as necessary fundamental leadership and quick, on-time, and continual preparation (Turban et al, 2010). Additionally, the average lifespan of a company has shrunk in recent years. Therefore, a company needs swift and accurate decision making in order to obtain a competitive edge. Indeed, decision makers require high-quality information in order to make appropriate choices under certain circumstances (Farjami, 2015).

The idea of business intelligence (BI) dates back to the 1950s, when a technology known as decision support began to take shape. There are still many businesses that rely on decision assistance in order to create decisions that will provide them an edge over their rivals.

Increased data collecting and improved technologies with higher storage capacity are largely responsible for BI's rapid expansion in recent years. As a result of technological advancements, businesses may utilize BI to save money while storing massive amounts of data. Smartphones, internet histories, social media profiles, and other sources of data provide businesses

with a wealth of information. BI can analyze these records and identify noteworthy tendencies and other patterns (Raisinghani, 2004).

METHODOLOGY

This research will rely on secondary data gathered through a comprehensive literature assessment on Business Intelligence, which includes dozens of articles and other secondary sources. A summary of existing research on Business Intelligence serves as the paper's final section. The primary purpose of business intelligence is to help relevant departments make informed decisions in the face of uncertainty by collecting, organizing, and interpreting data. The debate will center on the topic of uncertainty, information, and game theory as they apply to decision making, and will attempt to establish a connection between the Business Intelligence component and the Thematic School of Thought. In addition, we'll explain why and how the field of Business Intelligence is connected to or expanded upon the School of Thought.

LITERATURE REVIEW

Business Intelligence

Another problem with many definitions is that they become outdated as time passes because of shifts in how things are understood. Take business intelligence (BI) as an example. When the software industry first started working with BI, it was generally thought of as proprietary knowledge rather

than public information. Engineers and programmers continue to rely on BI even after all this time (Solberg Silen, 2015).

Den Hamer (2004) defines business intelligence as "frameworks that gather, transform, and present organized information from multiple sources in order to reduce the time needed to acquire significant business data and enable their efficient use in the management decision making process" (Nofal & Yusof, 2013). According to Tyson (1986), BI is concerned with collecting, analyzing, and presenting data on clients, rivals, markets, technologies, and merchandise. According to Pirttimäki (2007), business intelligence (BI) is a process consisting of a set of activities, driven by the unique information requirements of decision makers and the aim of gaining a market advantage.

Business intelligence (BI) is a framework that helps businesses make better decisions by turning information into data and then learning (Singh and Samalia, 2014). Business intelligence (BI) is defined as a framework that receives, modifies, and displays organized data from several sources. According to the work of Nofal et al. (2013), business intelligence (BI) is "a system and an answer that helps decision makers understand the economic circumstance of the firm."

For the purpose of employing muddled fundamental leadership principles, BI is defined as "a collection of numerical and methodological models for

examination used to extract data and valuable information from raw data" (Vercellis, 2013). "Business intelligence (BI) is a broad category of technologies, applications, and processes for gathering, storing, accessing, and analyzing data to help its users make better decisions," write Wixom and Watson (2010, p.14). Through information mining procedures, simulation and modeling of the real world under a "systems thinking" approach, improved forecasts, and a better understanding of the business progression of any organization, we can improve the bits of knowledge given by BI applications (Raisinghani, 2004).

For standard utilization, traditional data frameworks farewell, but for hierarchical and functional planning, new tools are required for business analysis (Rasoul and Mohammad, 2016). BI aids administrators by breaking down information from various resources in better basic leadership at both tactical and strategic level.

Data, Information, and Knowledge

Constant usage of the words "data," "information," and "knowledge" in the context of business intelligence might lead to misunderstandings about their meaning. Carlo (2009) defines them in a way that sets them apart.

Data: It's shorthand for a formalized classification of both single-entity and multi-entity transactions. Carlo (2009). Businesses love BI because it allows them to make sense of their data, no matter how it's presented, and adapt

their tactics accordingly. There are three main categories of data: structured, semi-structured, and unstructured.

Information in a predetermined format, such as a database or a set of addresses with specific street names and numbers, is called "structured data."

Text, documents, video tapes, webpages, and photos are all examples of unstructured data (Jermol et al., 2003), and they are all difficult for computers to interpret and process. Company data can be accessed in a variety of formats, including customer relationship management (CRM) applications, marketing automation platforms, and social networking sites.

Information is the product of data extraction and processing that seems meaningful to recipients operating within a certain domain.

Information is the building block of knowledge, which in turn is utilized to establish plans of action. Thus, we may say that knowledge is made up of information that is put to use within a given domain, and that it is bolstered by the experience and ability of decision makers in dealing with and solving complicated situations.

Frameworks for Business Intelligence

The following pyramid is used by Carlo (2009) to explain the structure of a business intelligence system.

The data comes from a variety of places, the majority of which are

operationalize systems, but others may include emails or unstructured data. Data warehouses and data marts are used to store and organize massive amounts of data in a standardized way across all queryable systems; this is accomplished using a process known as extract, transform, and load (ETL). Data marts are specialized warehouses that store data specific to one division rather than the corporation as a whole. They are more cost-effective than entire warehouses to install and reduce database complexity.

Data exploration is an unobtrusive business intelligence (BI) investigation that makes use of query and reporting tools and statistical analysis.

Information and knowledge extraction from data is the goal of data mining, which is an active BI methodology.

Using an optimization model, we can zero in on the optimal course of action from a potentially endless number of feasible options.

The decision-making process shifts to the decision-makers when business intelligence methodologies are readily available and widely adopted; these individuals can use the available informal and unstructured information to tailor the recommendations and conclusions reached by mathematical models to their specific needs.

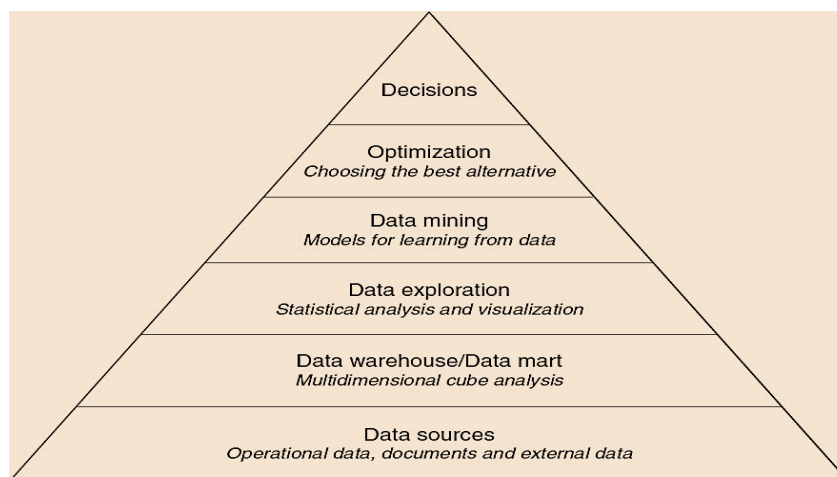


Figure: The main components of a Business Intelligence System (Carlo, 2009:10).

The research shows that the effectiveness of business intelligence (BI) depends on its suitability for decision making within a company (Clark, Jones, & Armstrong, 2007). Scholars have learned, however, that many businesses have a ways to go before they experience the same level of success (Hostmann, Herschel, & Rayner, 2007). Business intelligence (BI) skills are foundational abilities that improve organizations' adaptation to change and performance (Watson & Wixom, 2007).

There is a disconnect between the business intelligence tools an organization has and the way it operates, according to many studies. Research on business intelligence (BI) success has focused heavily on the importance of alignment between BI and business goals (McMurchy, 2008), thus it's no surprise that companies that have seen BI success have worked

hard to ensure that their BI is consistent with their corporate business goals. However, there is limited information about how BI skills contribute to this goal. Despite a body of literature addressing business intelligence (BI) capabilities, little has been written about the role of BI abilities in ensuring a good fit between BI and the decision environment in which it is used. Despite this, many success stories in business intelligence (BI) show how important it is to use BI with the right skills and for the right reasons (Schlegel & Sood, 2007). Oyku et al. (2012) state that business intelligence (BI) can be studied from both an organizational and a technological perspective. Data quality (data standard), technical platforms that can be coupled with other systems in the company, and user access are all examples of what we mean when we talk about technological BI capabilities. Assets like adaptability and shared risks and duties are examples of organizational BI (Ross, Beath, & Goodhue, 1996).

Accuracy of the Data. Traditionally, business intelligence has made use of numerical and/or structured data, which can be quantified and examined by statistical methods and computational machinery (Isik et al., 2013, p.14). When it comes to business intelligence (BI), data quality is paramount, according to Ponniah (2001). According to Kimball et al. (2008), "data quality is the most important factor," and they went on to say that a large enterprise's massive data from many different sources can be integrated into a coherent body to provide a clear view of its business, so that useful information can be provided to the appropriate people at the appropriate time and in the appropriate place to help them make better decisions. High-quality data is information that has been verified for accuracy and completeness. Weak data integrity results from sloppy data management practices, sloppy data maintenance procedures, and mistakes made throughout the migration process. Organizations will struggle to meet customer expectations and comply with emerging information-centric rules if the data they collect is not processed accurately and consistently. Oyku et al. (2012) state that if a company wants to become more agile, it needs to invest in technology that can provide its customers with reliable and up-to-date data. Furthermore, one of the most crucial elements of BI effectiveness is clean and useful data. The quality of the data used by businesses will

continue to be a cause of concern as they incorporate information from more and more sources.

Compatibility with Existing Systems

Since the BI system is a new system for the company, it is essential that it be integrated with the other systems already in place. In order for any system to contribute to the organization, it must be linked to other systems, either physically or functionally, so that they may share information and work together (White, 2005). In addition, the quality of the communication between these systems will have a direct impact on the effectiveness of integration in an organization that uses data from numerous sources and feeds that data into multiple information systems (Oyku, 2012).

User interface

Oyku et al. (2012) argue that not all BI tools are created equal because they offer varied features and capabilities. Whether the company opts for a comprehensive BI suite or a collection of point solutions, it is crucial to match the skillsets of each user group with the appropriate set of tools. While some businesses enforce strict policies on who can access what, others take a web-first strategy and welcome users of all stripes. It is essential that businesses strike a balance that allows BI users to obtain information in ways that are appropriate for the decisions they make using BI.

Adaptability

Flexibility is one of the key factors in successfully running BI in an organization (Oyku et al., 2012), so it's important for businesses to give it some thought when choosing the underlying technology to support BI and when deciding how strictly to enforce business process rules and regulations.

Assistance with Risk Management

When all the criteria are known, for instance, risk management is not necessary, but it is one of the primary supports in BI because it aids in decision making when situations are unknown. Managing risks is essential for any business, but especially those that deal with perilous situations every day (Davenport, 2006). Although uncertainty and risk are inherent in any business decision, BI can help businesses mitigate risk and make more informed decisions. The value of business intelligence depends on the decisions it helps you make.

It is crucial for businesses to be aware of the key indicators of success in adopting BI in order to overcome the challenges or risks that are associated with the BI project while it is being implemented, as stated by Alaskar and Efthimios (2015). Not all BI solutions are successful in all organizations.

Business intelligence project enablers

There are several aspects of a BI project, such as the technologies, analytics, and people resources listed by Carlo (2009), that are more important than others.

Fourteenth Modification: Technologies

Hardware and software technologies have been critical enablers in the evolution of BI systems in the modern enterprise and complex organization. This trend has allowed for the use of sophisticated procedures necessary for employing inductive learning methodologies and improvement models, while yet maintaining processing speeds within a reasonable range. In addition, top-tier graphical perception tactics with live-action animations can be borrowed with ease. Furthermore, every company can now afford to keep terabytes of data for business insight research thanks to the exponential growth in the limit of mass storage. In addition, the system network, whether Extranets or Intranets, has been instrumental in the dissemination of information and education outside of business intelligence. Last but not least, the widespread adoption of data analysis tools is influenced by the ease with which hardware and software from different vendors or developed in-house can be combined.

Analytical Methods

Most businesses rely heavily on mathematical modeling and analytical methods to improve their understanding of existing data and extract useful insights. However, while data visualization in the form of timely and adaptable logical views plays an important role in aiding the decision-making process, it is ultimately only a passive kind of support. Therefore, it is crucial to employ increasingly sophisticated models of inductive learning and optimization to produce dynamic types of support for the decision-making process.

Human Capital

Each individual and the group as a whole contribute to an organization's human resources through their skills and knowledge. Employees' ability to acquire knowledge and use it in a practical manner has a significant impact on the quality of the decision-making process. If a company wants to reap the benefits of a sophisticated BI system, it must place a premium on the ingenuity and resourcefulness of its knowledge workers. Since all businesses have the same access to analytical tools, the only way to get an edge is to hire people who are both mentally agile and open to new ways of thinking and making decisions.

REFLECTIONS ON THE RELATIONSHIP BETWEEN THE ECONOMIC SCHOOL OF THOUGHT AND BI According to Jack (1971), information is a prototypical "collective good," the kind of commodity for which private incentives are expected to lead to under-provision rather than over-provision in the market. According to Richard et al. (1983), information has two important purposes, the first of which is to tell consumers about the quality of the things they are considering purchasing based on the world's physical condition. Another function of information is to help one anticipate the level of rivalry they will face by providing details about the size of the competition, their preferences, and the information they themselves may hold. The belief that decentralized, or without comprehensive knowledge communication among economic agents, efficient production and allocation can be achieved through competitive markets (Radner). The idea that different economic actors enter markets equipped with information that is either not freely available or is available only at a high price could also be emphasized. Any uncertainty, whether or not it is based on probability, is assumed to already exist before the word "information" is used. The strategic alternatives available to traders may also vary greatly when each trader has access to his or her own private source of knowledge or when traders can acquire information at a cost, as discussed by Paul (1981). For instance, a trader may be able to deduce information from the conditions of the deal presented to

him or, more generally, from his observations of the actions of other traders. Costs are based entirely on inherent value. Costlier goods typically have higher quality.

Radner (2011) used decision theory as the major framework for formalizing the theory of teams, which is another perspective from the school of thought under the theme of Game Theory. Making decisions in the face of ambiguity is the subject of decision theory. The extension makes sense given that the heart of the problem is for multiple participants with a shared payout to make a choice under uncertainty with only partial knowledge. In addition, a decentralized organization is what Radner says it is.

Defined as a situation in which the outcome for the organization depends jointly on the several decisions and on some stochastic environmental variables, and in which different decision makers are responsible for different decision variables and make those decisions based on different information. The idea behind business intelligence (BI) is to improve decision making within an organization, and in the same way, data or information from just one or two departments isn't enough to optimize the success of a decision, but data or information from all relevant departments is essential.

Our literature reviews and concept extractions from the schools of thought lead us to the conclusion that the foundations of BI rest in the areas of game theory and information and uncertainty. A key concept in business intelligence (BI) is the use of analytical models based on mathematics and methodology to glean internal company data for the purpose of making risky decisions. To do this effectively, businesses need to allocate resources toward data collection, data transformation, and the dissemination of actionable data or information to relevant departments (Rajnoha et al., 2016). Therefore, this would lend credence to the school of thinking that suggests there are a variety of decision factors referring to a wide range of information needed to arrive at the best possible decision, and that organizations incur large costs in order to get this wide range of information.

CONCLUSION

In spite of business intelligence's relative novelty (it was only coined a few decades ago), the question of whether or not to implement such a system in order to better meet the expectations of today's consumers is increasingly pressing for companies of all sizes. Modern BI helps companies determine the true worth of their data assets and make significant progress in spotting and capitalizing on business opportunities. While many large companies have successfully implemented a BI system, others have struggled. The strategy, human capital, leadership, culture, quality management, and

strategic orientation of a company all play important roles in the successful installation and integration of a business intelligence (BI) system. Success in deploying a BI system in the company depends on having a thorough understanding of the company's technology and management capabilities.

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CHAPTER-48

HUMAN RESOURCE MANAGEMENT (HRM) IN THE RECENT ERA: THE ROLE OF ARTIFICIAL INTELLIGENCE (AI)

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Abstract

Because of developments in artificial intelligence (computer based intelligence) technology, human resources (HR) professionals can now use calculations and AI to streamline their job processes, reduce their biases, and improve their analysis and dynamism. However, several businesses are hesitant to adopt CBI for supplementary use cases due to the persistent drawbacks and shortcomings. Artificial intelligence (computer-based intelligence) can be tremendously useful in human resource management since it can automate time-consuming tasks and reduce bias in the decision-making process. Artificial intelligence can help streamline administrative processes, boost morale in the workplace, and facilitate professional growth. With the use of AI technology, employee participation can be increased, and career-relevant education may be tailored to each individual. Organizations should think about the costs of implementing and sustaining AI in HR, as well as the potential for errors and unintended biases. Human resource management will become increasingly automated, individualized, and data-driven as AI technology develops. As AI continues to alter the landscape of HR management, it's important for managers in that field to be prepared for the difficulties they may face in the near future. Human resources managers typically have concerns about artificial intelligence making their workplaces safer and more transparent. Human resources have a thankless task in the

hiring and orientation of new workers.

Keywords: Talent Acquisition, Artificial Technology, Growth Opportunities, Employee Retention.

Introduction

To argue that the term "artificial intelligence" encompasses a wide variety of cutting-edge tools would be an understatement. In addition, HR experts predicted this outcome. Human resources departments are increasingly turning to artificial intelligence simulations to shed light on personnel decisions including hiring, training, and retention. Besides automating formerly manual tasks like finance and benefits administration, artificial intelligence is also being used for the rapid creation of new agreements, sets of responsibilities, interview questions, and other domains. Predictive analysis and AI can also be used to anticipate outcomes and prepare accordingly. Human resources (HR) are undoubtedly being profoundly impacted by AI. By automating mundane tasks and providing information-rich tidbits of knowledge for more accurate navigation, artificial intelligence (AI) is continually expanding the ways in which businesses attract, produce, and retain talent. Experts in human resources, however, should know that AI shouldn't replace interpersonal communication. For the best results, businesses should have the freedom to balance technological progress with

human input. Making a machine that can learn and improve in response to its surroundings would have far-reaching implications, especially for human resources. This breakthrough will undoubtedly have an impact on a wide range of businesses, although it may be most noticeable in areas such as hiring. Employing managers frequently expend a considerable lot of effort sifting through resumes to locate the best candidate for the open position. Because AI can sift through resumes and identify standout performers based on large amounts of data, it will free up HR professionals to focus on identifying the most promising up-and-comers. Besides recruitment, onboarding is another area where AI has been put to use. An application for a job and a start date are only the beginning of the recruiting process. Workers typically anticipate some form of practical experience before they are considered fully trained for their positions. Artificial intelligence can infer the skills and training needed for each job based on the job description. This will make it easier for HR pros to devise a training regimen that will have new hires contributing immediately. The field of human resources is always evolving to meet new demands. The recruitment and onboarding sector has already begun to be disrupted by the use of AI technology. Given the increasing importance of innovation in today's businesses, it's reasonable to expect that artificial intelligence will play a central role in HR departments.

Objectives of the Study

The present paper is associated with following objectives:

- To know about Artificial Intelligence (AI) and HRM.
- To concise the role of Artificial Intelligence in HRM and its practices.

Operational Definitions

Artificial intelligence, often known as "computer based intelligence," refers to the study and implementation of computational frameworks capable of performing tasks traditionally associated with human intelligence. Capabilities like as learning, common sense reasoning, critical thinking, and language appreciation are all part of this.

The Human Resources team struggles to keep up with the recruitment process. There are several ways in which artificial intelligence can be used to relieve workers of mundane tasks.

Artificial Intelligence and HRM

In today's fast-paced commercial world, artificial intelligence has become an integral aspect of human resource management. In their ongoing struggle to remain serious and powerful, businesses are increasingly turning to AI-driven answers for upgrades in capacity. All throughout the world, HR departments are being revolutionized by artificial intelligence, which is used

information to automated recruitment systems that identify and reward top performers. There's no time for laughter; it's already altering processes across numerous industries, including transportation, diagnosis and therapy, money management, risk anticipation and avoidance, and more. Using AI in HR will lead to noticeably more significant progress in how work gets done. The landscape of human resource innovation will be drastically altered by artificial intelligence. Companies across a variety of industries are beginning to implement AI (or "man-made intelligence"). The application of AI has been extremely beneficial in the field of human resources (HR). Human resource managers make use of a variety of tools and programs to coordinate the recruitment, onboarding, and training of new staff. In the future, artificial intelligence will play a role in human resources, automating some of these processes and allowing employees to better use their time, effort, and resources.

The first area where AI is put to use is in the HR department. Candidates are evaluated throughout the cycle based on a variety of factors, such as their skillset, experience, and cultural fit. When compared to traditional organizing approaches like resume screening and phone screening, AI can assist HR professionals in more accurately recognizing these attributes. The current system that can benefit from artificial intelligence is the on-boarding one. When a rival is a good fit for a vacant position, it's important to bring

them into the company and make them feel welcome. Here's where AI comes in, whether it's through the generation of personalized messages, the organization of meetings, or the very minimum of calling newly recruited team members to invite them. Finally, artificial intelligence can aid in training workers to increase productivity. The true value of AI lies in this area because it allows for evolving critique circles that are specific to each expert. Machine learning can evaluate an employee's strengths and weaknesses based on their specific information (such as location, coworkers, job, and so on) and provide actionable advice for how to proceed. Machine learning has made it possible for managers to provide more accurate guidance to their staff than ever before.

Role of Artificial Intelligence in HRM and its Practices

An "improved employee experience" and more spare time for HR managers are among the benefits of artificial intelligence. Human resources (HR) is crucial to any company since it directly affects the lives of the professionals employed by the company. Employee productivity and well-being depend on a well-lit, secure, and otherwise conducive working environment. Human resources is responsible for making sure every worker feels safe, is given the support they need, and has the resources, training, and understanding they need to perform at a high level. Artificial intelligence (AI), arguably one of

fundamentally advanced the HR department. Most low-value HR tasks are now automated and completed by artificial intelligence, freeing up resources to focus on what really matters. Here are a few examples of how AI is being used in human resource management:

Recruitment and Selection Process

Artificial intelligence can be used to improve HRM procedures like hiring and evaluating candidates. Artificial intelligence (AI) powered systems are used to quickly identify qualified candidates for open positions. It can also be used to ensure that businesses only hire the best candidates by screening out those who don't measure up to predetermined standards. Time and money are saved while the very finest candidates are sought out for each position. Artificial intelligence may quickly and accurately investigate rival data with the help of complex computations and AI abilities. Because of this, it can outrace human spotters in locating the most formidable rivals. Unlike a human recruiter, artificial intelligence may use factors like language analysis, manner of speaking, and appearance to predict how an applicant would behave and what kind of person they will be in the workplace.

Computer-based intelligence further aids selecting representatives by considering hierarchical method, performance data, and market trends when assessing existing and future workforce needs. Using the knowledge of

what skills and behaviors are necessary for each role, artificial intelligence may also aid in the development of realistic and precise benchmarks. Artificial intelligence can aid in enhancing employer branding and reputation by highlighting a company's ethos, values, and competitive advantages across a variety of platforms and mediums. Using artificial intelligence to attract potential competitors can increase the organization's deceptibility and reach, leading to the hiring of more qualified candidates. Simulated intelligence contributes to the mechanization and refinement of the screening procedure by using mathematics and regular language handling to assess resumes, cover letters, and portfolios. Pre-employment screenings, such as those for IQ, character, and skills, can be made more fun and engaging with the use of artificial intelligence. Artificial intelligence (AI)-based possibility screening has the potential to reduce human bias and error while also saving time and money. Artificial intelligence (AI) has the potential to revolutionize the way businesses interact with their employees by providing them with instant access to vast amounts of accurate information.

Onboarding Process

Automating laborious, time-consuming tasks with AI helps quicken the onboarding process. Technology advancements in onboarding allow teams to devote more time to the interpersonal aspects of welcoming a new team

member. Onboarding automation projects may include data set updates, procedure implementation, and removal of frequently asked questions. By automating administrative tasks like creating accounts and giving preparation, artificial intelligence can help speed up the onboarding process. This frees up HR professionals to concentrate on the more nuanced aspects of the onboarding process, such as building relationships with new team members and acclimating them to the company's culture. Artificial intelligence (AI) has the potential to provide customized onboarding strategies based on the unique requirements and preferences of each new team member, thereby increasing both engagement and retention.

Training and Development Process

AI systems play a crucial role in assisting businesses in their efforts to consistently educate their employees. The best methods of education and comprehension can be discovered with the use of artificial intelligence, which can also suggest personalized physical activities. Because of this, workers have a better chance of keeping up with the ever evolving business environment. Artificial intelligence is reshaping the entire learning and development process, allowing preparation and development professionals to deliver more effective and engaging instruction. Companies can save both time and money by using artificial intelligence to ensure that their employees receive the greatest possible learning outcomes. Artificial

intelligence-powered training solutions offer workers on-demand access to a wide range of learning and advancement options. Data-driven AI computations can also evaluate an individual's knowledge, skills, and experiences to provide tailored training that meets each worker's specific needs while also catering to their unique interests and preferred methods of learning. Because of this, workers can get to work right away on honing their skills. This individualized strategy can help with staff retention and motivation while also improving training outcomes.

Through the analysis of performance data and the provision of pertinent criticism, artificial intelligence can also provide tailored training to workers. One example is a computer-driven learning and development tool that analyzes employee performance and identifies specific areas that need improvement while also providing helpful suggestions. With the right kind of specialized training, employees may stay confident in their own abilities and in their company's commitment to their professional growth. Artificial intelligence may also help human resources professionals with training and development by providing data-driven insights. By evaluating data about workers like performance metrics and engagement summaries, AI-powered tools can identify knowledge gaps and development opportunities. This facilitates HR professionals' ability to tailor training and education programs to the specific needs of their workforce.

Employee Appraisal or Performance Appraisal Process

It's that time of year again, when all of the workers must assemble in one room to fill out a performance evaluation. A well-defined performance management framework is an essential component of any successful firm. A management structure's serious areas of strength are a good proxy for the employees' ability to shape the workplace. The effectiveness of the organization's training can also be tracked with the use of this system. The framework will benefit workers as they strive to better align their job performance with organizational goals. Still, traditional approaches to performance management involve steps like identifying the target, conducting a self-assessment, having the manager conduct an examination, having a discussion, and wrapping up. In the current situation, artificial intelligence can help with objective observation by providing feedback on what has been done and what could be improved upon.

Predispositions in employee performance correlations are another area where artificial intelligence can help. Having specific, measurable goals in mind can help with this. Artificial intelligence can also aid in outlining the essential goals for underperforming personnel to fulfill in order to improve performance. In addition, it can aid in providing details about employees' actual capabilities and leading to predictions about which workers would be able to perform well or not. Human resources professionals can use this

information as a powerful tool in their career development planning. Human resource professionals use artificial intelligence to set goals, evaluate team and individual performance, discover new information and make adjustments, and cut down on administrative work. As a result, productivity increases and outcomes improve.

Employee Engagement

Organizational and employee communication can both benefit from the use of AI. For example, AI may be used to conduct intelligent reviews, provide rewards and recognition, and provide ongoing feedback, all of which contribute to a more engaged workforce. Here are a few ways that artificial intelligence might boost morale in the workplace:

- Tools powered by artificial intelligence can improve the employee experience by tailoring training and human resources initiatives to the specific needs and preferences of each individual worker. As a result, morale and productivity in the workplace may improve.

Chatbots and other forms of remote assistance powered by artificial intelligence can provide employees with constant support by promptly responding to their questions and delivering constructive comments. This can lead to higher levels of employee participation by fostering a flexible and reliable workplace.

- Human resources professionals can use artificial intelligence to drive their assessments of employee data such as engagement summaries and performance metrics. They can then use this information to learn about the workforce and spot any problems. The findings can be used to tailor future employee engagement initiatives and projects to the specific needs and pressures of the workforce.

Additionally, AI can poll employee motivation and engagement through the use of sentiment analysis and regular language processing. Artificial intelligence can also play a crucial role in selecting the optimal group synthesis by measuring and using employee motivation. Managers can also benefit from artificial intelligence's ability to help them motivate their teams by predicting the factors that will affect individual workers. Workers can be more open and honest about their thoughts and stresses thanks to artificial intelligence technology. Human resources professionals and workers alike can benefit from the continuous feedback it provides. Therefore, workers can express their thoughts and concerns without having to schedule a special meeting.

Employee Retention

Keeping talent is one of the most pressing challenges facing businesses

worldwide. Organizations are always trying new approaches and strategies in the hopes of retaining workers for as long as possible. Human resource professionals are primarily responsible for the upkeep of existing staff. In such a hostile work atmosphere, it can be difficult for HR professionals to maintain relationships with their staff. Human resources has been working hard to address this problem by introducing new policies and practices throughout the company. Therefore, AI can help with career planning by keeping tabs on employees' work and conducting surveys to spot any signs of stagnation or depression. Managers and strategists can use this information to better organize and drive creation of new preparation and preparation drives. The bullet elements in the below overview explain how AI helps with expanding employee upkeep.

One of the most important factors influencing employees' decisions to remain with an organization is the potential for professional progress and new doorways. Artificial intelligence can aid in this endeavor by keeping tabs on specialists' output and identifying instances in which workers may be regressing rather than progressing. This data is useful for managers because it allows them to pinpoint underserved areas and provide targeted training initiatives. There are several ways in which artificial intelligence can be used to evaluate workers, such as measuring job satisfaction and productivity.

Managers can also be alerted when an expert is ready for more testing or has

outgrown their current role. Performance management tools powered by artificial intelligence can also suggest opportunities for training to employees. Companies can prevent talent drain and motivate current staff with AI-assisted retention and recruitment strategies. Satisfaction at work depends on a healthy mix of work and play, with many modern workers desiring greater autonomy over how and when they complete tasks. Artificial intelligence can help businesses adapt to changing demands while providing workers with the freedom they crave. AI aids workers in accomplishing this goal by automating time-consuming, repetitive tasks that can be completed significantly more quickly, giving them more time to focus on tasks that call for their own independent judgment, creativity, and initiative.

In today's competitive market, businesses recognize the importance of paying employees fairly for their efforts. The question of how to pay workers fairly arises as a result. Computer-based intelligence (artificial intelligence) can help firms provide employees with equitable and customized compensation packages by parsing large data sets, identifying outliers, and learning from their experiences. Pay and benefits might be adjusted based on the arrangement's evaluation of economic conditions, expert performance, and business outcomes. These agreements allow businesses to specify even more goals, monitor employee progress, and provide

alternative approaches to achieve better outcomes. Employers can use artificial intelligence to improve working conditions, which benefits everyone involved. Artificial intelligence can boost morale through increasing productivity. The automation of routine tasks, the provision of ongoing feedback and training for staff, and the identification of problem areas should all contribute to this goal. Similarly, AI increases worker productivity, decreases error rates, and improves tasks, leading to a more pleasant and satisfying workplace that can accommodate a larger number of workers.

Discussion and Conclusion

Only recently, after being adopted by a variety of companies, has AI been "integrated" into human resources. What really is our situation right now? Despite all the progress that has been made (mostly thanks to the efforts of start-ups) and the fact that the world is increasingly becoming digital, the technology still appears to have significant limitations in the area of human resources. These days, most HR trailblazers rely on AI to help them with a wide range of tasks, from payroll and benefits administration to employee onboarding and evaluations. In the future, AI may be able to make difficult HR decisions like hiring and firing, as well as other tasks like answering employee inquiries and communicating pay and benefits. Despite the many advantages, there are also certain risks associated with using AI in human

resources, such as the devices' limitations and susceptibility to hackers.

By 2030, artificial intelligence is predicted to spark \$13 trillion in global economic activity, according to studies. Deloitte's HR change leader Richard Coombes predicts that artificial intelligence will lead to less bias in both behavior and perception. As artificial intelligence technology evolves, businesses may anticipate increased automation, individualized approaches, and a more nuanced perspective on data within the realm of human resource management. Human resource procedures, such as job advertising, candidate screening, and monitoring worker performance, will continue to benefit from AI's further development and implementation. Human resource professionals will also benefit from artificial intelligence's ability to provide constant data and insights, allowing them to make more informed decisions. Human resource management should also be ready for the creation of new positions and responsibilities in HR, such artificial intelligence morals officers who will ensure that AI calculations are applied in a moral and acceptable manner. As AI is incorporated into HR processes, the role of HR specialists will grow in importance; it will be their responsibility to ensure that AI is used fairly and sensibly.

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CHAPTER-49

RECENT TRENDS IN ARTIFICIAL INTELLIGENCE IN HUMAN RESOURCE MANAGEMENT

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Abstract

Artificial intelligence (AI) is key in human resource management (HRM) in today's competitive business environment. AI has the potential to revolutionize HRM practices by automating mundane tasks, streamlining processes, and providing customized solutions for HR managers. AI can also improve recruitment, training, performance management, and compensation management. By leveraging AI technology, HR departments can become more efficient and effective in managing their employees. With AI-powered solutions, HR departments can provide better employee service while optimizing costs. AI in HRM is becoming increasingly important as it enables organizations to increase efficiency while improving employee satisfaction. AI technologies can help HR departments gain insights into employee engagement and productivity, as they can analyze employee feedback to understand better how they view their work environment and growth opportunities. It enables HR departments to automate the selection

process, making identifying the right candidates for the job easier. The literature review can help better define the current landscape of AI in HRM and provide insights into AI opportunities in HRM.

1.Introduction

"artificial intelligence" (AI) is a technology that enables machines to do tasks intelligently and cleverly. The development of artificial intelligence (AI) is a change that has wide-ranging ramifications, particularly for fields like engineering, business, and the management of human resources [1].

The term "human resource management" (HRM) refers to several actions involved in organizational management as well as related policies pertaining to human resources. Developing an organizational human resources strategy, selecting and recruiting personnel, delivering training and development, evaluating employee performance, managing compensation, and managing employee relationships are all tasks that fall under this category [2].

Artificial intelligence (AI) is essential in human resource management (HRM). AI technologies are being utilized in HRM to streamline various HR activities like recruitment, onboarding, performance management, and others [3, 4]. AI technology can assist HR departments in gaining insights into employee engagement and productivity. This is because HR departments can evaluate employee feedback to understand better how employees view the

growth prospects and the work environment in which they are employed. It helps human resources departments to automate the selection process, which makes it easier to determine which individuals are the best fit for the job. In addition to this, it has the capability of tracking employee performance and ensuring that workers achieve their objectives [2].

AI can assist human resource managers in automating monotonous operations, maintaining personnel records and performance, and making more informed decisions through predictive analytics. AI can also assist human resource managers in analyzing data and developing more effective procedures. HR managers may reduce the amount of work they have to do, boost productivity, and improve their ability to make decisions regarding the future of their firm, all by utilizing AI. In a nutshell, artificial intelligence is changing how HR departments function, and its application will only grow in the near future [1].

2. Definitions and Theoretical Aspects

There are many definitions of artificial intelligence, and different academics have created different definitions for it [5]. The various definitions of artificial intelligence emphasize the concept's capacity to learn, carry out tasks, and think like humans. The field of study known as artificial intelligence focuses on finding ways to program computers to accomplish tasks at which humans excel. By imitating the information processing of

human thoughts and consciousness, artificial intelligence (AI) can explore databases efficiently, extract facts, effectively react to our requests, and deliver the best answers plainly and sensibly [3]. According to [6], [7], the capability of a system to accurately explain external data, derive meaningful skills from that data, and then apply those learnings to finish specific activities and achieve particular goals by flexible adaptation is what is meant by "external data explanation capability." [8] Managing and employing people within a corporation falls within the purview of human resource management, sometimes known as HRM. It encompasses a variety of actions and procedures, including strategic human resource management, human capital management, resourcing management, knowledge management, learning and development, performance management, and employee relations [1, 8].

The application of AI in a company enhances the organization's management processes by making them more agile and accurate, raising the bar for the efficacy and productivity of HR procedures [9]. The different HRM processes, such as human resources strategy and planning, recruiting and selection, training and development, performance management, and compensation management, have been significantly reshaped due to the increasing use of AI technology [10]. A Human Resource Information System, an HRIS, is an extremely important component of human resource management. A human

resource information system (HRIS) is a systematic procedure for collecting, storing, retrieving, and maintaining data that an organization needs concerning the actions of its workers, the characteristics of its organizational units, and its human resources [11]. HRIS is a strong tool that may be used in HR planning, the construction of job descriptions, the design of training programs, the evaluation of employee performance, and other HR-related tasks [10].

2. Literature Review

A conceptual artificial intelligence framework for human resource management was developed in the study [2], based on the six pillars of HRM and the current state of AI technologies. The six dimensions are human resource strategy and planning, recruiting, training and development, performance management, employee relationship management, and wage evaluation. In this study, technologies such as data mining, knowledge discovery, face recognition, natural language processing, intelligent robots, visual scanning, neural network systems, and robot and voice interaction are applied to each of the six dimensions to form and establish respective intelligent decision support, interview, teaching and learning, incentive systems, salary evaluation, and corporate advisory systems. Face recognition is one of the most important aspects of this research. Based on the study's findings, artificial intelligence should be included in business human

resource management using the AIHRM conceptual paradigm.

The authors carried out a comprehensive literature assessment of artificial intelligence (AI) in human resource management [12]. They presented a comprehensive analysis of the applications of AI in the academic literature on HRM. According to what they discovered, the research and practice of HRM have been profoundly influenced by information technology in converting routine and nonroutine HR tasks. This transformation began as an administrative personnel records management function and evolved into the strategic management of people. AI enables machines to execute tasks in the same way people do by integrating different information databases. Human resource managers can use AI to perform productive data analyses and plan their efforts toward desired results by employing various developing technologies that enable machines to perform tasks as humans do. The research produced a one-of-a-kind AI-HRM concept map that explains how AI might be used to comprehend better the decision-making processes involved in HRM. In addition, they provided a deeper knowledge of the ethical challenges associated with AI's applications in HRM. They proposed an indicative preliminary framework for integrating ethical practices and techniques to assist in the transition toward ethical AI.

During the personnel recruiting process, the relationship between the behavioral limits imposed by AI-adopted enterprises and the facilitators of

such companies was explored [13]. The study presented the integration of the TOE model and the transaction cost theory to comprehend the many limitations and potential opportunities better. They employed both online and paper-based surveys to collect data for this study, and they obtained it from HR managers and senior managers familiar with HR in 297 Chinese organizations. The results of the survey show that companies' perceptions of artificial intelligence's complexity act as a barrier to adoption, whereas technological competency and regulatory support act as drivers of adoption. The research shed insight into the moderating effects of transaction costs on the influence of technical complexity and organizations' technological competency.

The purpose of the study [14] was to investigate the various AI technologies employed in HRM practices and the perceptions of these technologies held by the employees. The research was carried out in Chennai using the sociological survey approach, with participants consisting of HR experts and employees working in the IT sector. They discovered that employees did not have a favorable impression of the AI system's attitude toward AI technologies. They provided an overview of the obstacles that prevent the AI system from being implemented in HRM procedures. The study provided a greater understanding of the importance that businesses place on incorporating AI technology in HRM practices such as planning and decision-

making, recruitment, training and development, performance analysis, and work-life balance.

The use of AI technology in HRM was the focus of the systematic search [15] of 45 papers. It was emphasized that intelligent automation technologies provide a new approach to employee management and the advancement of organization performance. These technologies offer various prospects for human resource management. They provided an overview of several significant issues that exist on both a technological and ethical level. They revealed the influence that modern AI technologies are having on HRM. The study went into great detail about the prospects and made several important contributions to theory and practice.

The study [16] aimed to investigate the applicability of AI strategies to HRM in general. The writers offer a concise introduction detailing the essential capabilities of AI approaches and the fundamental requirements of HRM, utilizing the task-technology fit methodology as the basis for the discussion. They chose six different use cases to investigate the possibilities of AI in HRM: turnover prediction, candidate search, staff rostering, HR sentiment analysis, resume data gathering and employee self-service. In addition to this, they investigated as well as summarized the fundamental and exploration-based learnings. [17] looked into the impact that high-performance work systems play in the links between change readiness for AI adoption, the

beliefs of HR managers, and AI apprehension. According to the study's findings, the HR managers' beliefs and levels of worry around AI were highly influenced by the degree to which their organizations were ready to implement AI. They found that those with positive beliefs were more likely to be open to embracing AI, while those who felt greater concern about it were less prepared to implement it. Those who held positive beliefs were more likely to be open to using AI. They combined the HR managers' beliefs, AI anxiety, and perceptions of implementing high-performance work systems within the firm to present insights into the readiness of HR managers to adopt AI.

The purpose of the study [18] is to gain an understanding of how AI is utilized in HRM. The research looked at 23 pertinent papers found in the Scopus online database between 1991 and 2020. According to the findings of the study, nine different HRM activities could benefit from the application of AI technology, allowing businesses to enhance their levels of efficiency and effectiveness to meet the needs of their customers better.

The primary objective of the qualitative research [4] was to describe how AI has been incorporated into various HR operations and the implications this integration had had on firms, employees, and HR. The research helped shed light on the rapid expansion of artificial intelligence's use in human resources, particularly regarding various HR processes and activities such as

the hiring process, onboarding, and training. They provided light on the function that AI plays in assisting HR managers in focusing on strategic work rather than mundane and low-value add duties, which was one of the main points of their research. They presented an overview of how AI may assist in streamlining and reorganizing HR tasks for increased efficiency and agility in the workplace.

3. Opportunities of Artificial Intelligence in Human Resource Management

The management of human resources has several potentials for the application of artificial intelligence. These opportunities include but are not limited to, human resources strategy and planning; human resources recruitment and selection; human resources training and development; human resources performance management; and human resources compensation management. These opportunities will be described in more detail in the following section.

3.1. Human Resources Strategy and Planning

Planning for the use of human resources strategically is the beginning point for human resource management. Managers use artificial intelligence (AI) technologies to help decision-making processes to achieve effective strategic planning. Tools for data mining and knowledge discovery are used to collect data from both internal and external sources. This helps to summarize the information, which is necessary for comprehending the present state of

affairs regarding human resources and for predicting, evaluating, and adjusting the company's future management. A report containing the necessary information is compiled with the assistance of the statistics and modification features of the intelligent decision support system [14].

3.2. Recruitment and Selection

Recruiting and Choosing Candidates. Because it can provide decision support systems that help map the most suitable professional profiles for a given position and reduce the average time it takes to complete recruitment activities, artificial intelligence can be a strong instrument in recruitment and selection. Artificial intelligence can help map the most suitable professional profiles for a position. The decision support system could be developed using fuzzy logic, artificial neural networks, case-based systems, expert systems, or genetic algorithms. AI can be utilized to construct a virtual assistant that can respond to questions posed by candidates, evaluate the actions and talents of candidates in real-world scenarios, and assist in matching union candidates and corporations [19]. Regarding recruitment and selection, AI makes it feasible to develop a model of the ideal candidate by cross-referencing information about a company that has been profiled in the past. This approach then compares candidates for new openings regarding tests, experience, and information regarding the overall curriculum. It is helpful to analyze each candidate in terms of how favorable

they are for filling a vacancy in the company [20].

3.3. Training and Development

Artificial intelligence (AI) is a key component in maintaining the current rate of technological advancement. During the process of training, the robot instructor of the training can use the visual scanning system to monitor each student's daily learning progress, accurately calculate the overall level of attention of all of the students, use data analysis to retrieve teaching events of different stimulation levels and adjust the degree of relaxation and the teaching rhythm based on the student's feedback. During training, the robot instructor can also use the visual scanning system to retrieve teaching events of different stimulation levels. In addition, with big data analysis, corporate training can decide which employees need to learn from the enormous knowledge base, create a customized employee curriculum, and utilize technology to test and assess the employees' levels in an all-encompassing manner. AI instructors can also become all-around helpers, able to do tasks such as assessing learner data and creating high-quality reports on learner progress. AI instructors will rethink the fundamental logic behind the instructional design as employees enter the learning objectives, important points, and archives. The artificial intelligence tutors will finish the course for you automatically [3].

3.4. Performance Management

Management of Your Performance

The: Employee performance management is an HRM practice of critical significance. Along with the information gathered and analyzed on the workers' performances on the job, the performance appraisal model can also be incorporated into the system [2]. In an intelligent decision support system, using 360-degree performance evaluation approaches as scientific methodologies can allow for automatic and successful employee performance reviews. The intelligent decision support system is provided with the employee performance evaluation criteria and any other relevant data to produce performance evaluation findings [10]. At the beginning of the year, the business objectives for each division of the corporation can be mapped out and written down. After that, the system can conduct an all-encompassing analysis and evaluation based on individual performance goals, department manager evaluations, peer feedback, and other criteria [2].

3.5. Compensation Management

Compensation Management Direct, monetary payment, or indirect benefits to the employee can both count as forms of employee compensation. Not only does "compensation" relate to monetary payment, but it also encompasses other perks and privileges employers provide for their workers in exchange for their services. The effective management of remuneration can lead to

increased levels of organizational productivity [21]. Management of compensation is an essential component of human resource management (HRM), and it has a tight connection to the performance of employees. It refers to establishing an employee's pay following a predetermined set of guidelines and policies. An effective compensation management system can support improving individual and group performance. The use of AI technologies can assist in ensuring fairness in the management of compensation. [10] Using big data as input, artificial neural networks can be designed to be used as intelligent decision support systems, which can then be used to construct a fair compensation evaluation system.

5. Discussion

AI technologies have increasingly transformed all the various HRM practices, such as human resources strategy and planning, recruitment and selection, training and development, performance management, and compensation management. According to studies, various AI technologies such as data mining, knowledge discovery, face recognition, natural language processing, intelligent robots, visual scanning, artificial neural network, and robot and voice interaction technologies are applied to HRM practices to form and establish intelligent decision supports, teaching and learning, incentive, salary evaluation, and corporate advisory systems.

The role played by HR managers during the integration of AI into HRM

routines has been seen as extremely crucial. AI adoption is affected by HR managers' beliefs and concerns about AI. HR managers with positive beliefs were more likely to adopt AI technologies in their organizations, while those concerned were less willing to adopt AI technologies. HR managers can focus on strategic work by AI assistants in performing productive data analyses and organizing activities toward desired outcomes by utilizing various emerging technologies that enable machines to perform tasks like humans do through the integration of several databases of knowledge.

Most of the research findings highlight the AI technologies' contribution to streamlining and reshaping HRM practices for better efficiency, productivity, and decisions about the organizations' future.

6. Conclusion

In human resource management, applying artificial intelligence technologies can bring greater economic benefits. Improving human resource management efficiency through AI technology will become an important trend in the future development of human resource management.

AI technologies have increasingly transformed all the various HRM practices, such as human resources strategy and planning, recruitment and selection, training and development, performance management, and compensation management. The literature review can help better define the current landscape of AI in HRM and provide insights into AI opportunities in HRM. It

focuses on the current state of AI in HRM and its potential applications in human resource management practices such as human resources strategy and planning, recruitment and selection, training and development, performance management, and compensation management.

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CHAPTER-50

PHOTOCATALYTIC APPLICATIONS OF COPPER OXIDE NANOPARTICLES

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Abstract

In the present work, copper oxide (CuO) nanoparticles are synthesized using co-precipitation process. The precursor is dissolved in DI water and NaOH is added and the precipitate is centrifuged 5 times with DI water. The resulting product is dried for 18 hours at 100° C and calcination is carried out in the Muffle Furnace. Using Fourier transform infrared (FTIR) spectroscopy, and field emission scanning electron microscopy (FESEM), photocatalytic tests, the synthesized nanomaterials were characterized. The XRD results showed that CuO polycrystalline monoclinic structure. FESEM experiments have shown the formation of regular-shape and uniform-size crystallites. The Cu, O elements present in the nanoparticles that confirm the CuO nanoparticles without any impurities are shown by the EDAX spectrum. Photocatalytic experiments have shown that the copper oxide NPs under visible light irradiation (300 W) degrade the MB dye pollutant effectively.

Keywords: copper oxide, nanoparticle, photoreactor

1. Introduction

The main environmental dangers are natural dyes. Due to their stability against oxidising agents [1,2], it is not a simple method to extract them from the dye containing waste water. Methylene blue (MB), [3,4], is among the numerous organic dyes found in waste water. Acute exposure to MB dye in humans is reported to cause tissue narcosis, heart attack, jaundice, and so on [5]. A number of inexpensive adsorbents such as fly ash, metal sulphides (Ag_2S) and metal oxides (TiO_2 , Cu_2O) are already used to treat contaminated water [4-7]. A chemical solution, such as the adsorption process [6,7], is an effective and reliable way to remove harmful dyes from contaminated water. Semiconductor nanoparticles are currently commonly used in the removal of different organic dyes. Cu_2O NPs have an outstanding role in photocatalysis using visible irradiation among the various semiconductor metal oxide photocatalysts [6,8]. These NPs are mainly used because of their economical and up-scalable synthetic routes, band gap (2.17 eV) in the visible region band gap engineering, and tendency to adsorb oxygen that helps to scavenge the image-generated electrons so that green chemical oxygen can easily restrain electron-hole pair recombination at the interface.

The nanostructures of metal oxides with various morphologies have applications in many fields. The possible p-type semiconductor is copper

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oxide (CuO) and, owing to its excellent properties, attracts considerable interest. In multiple applications such as catalysis, solar energy conversion, gas sensor and field emission [9-12], CuO has monoclinic structure with a band gap of 1.2 eV. Synthesis, however will enhance these novel properties that have shown excellent efficiency compared to bulk counterparts in CuO nanostructures. Nanowire, nanorod, nanoneedle, nano-flower and nanoparticles are synthesized in different nanostructures of CuO. CuO nanomaterials' physicochemical properties are strictly dependent on their size and morphology. Thus a variety of attempts are made to prepare special nanostructures. CuO of different sizes and shapes is an important material in metal oxide nanostructures, exhibiting superior optical, and catalytic properties [13] and thus finding applications in gas sensing [14], magnetic storage [15], catalysis [16,17] and conversion of solar energy [18,19]. So far, various copper oxide nanostructures are synthesized. In recent decades, various methods of producing CuO nanoparticles of various sizes and shapes have been suggested, such as thermal oxidation, sonochemistry, combustion and rapid precipitation [20-22]. CuO nanoparticles therefore exhibit exciting properties [19], as compared with their bulk materials. For CuO nanoparticles synthesis of different sizes and shapes, a variety of physical and chemical methods are being produced. Different preparation methods

are used to synthesize CuO nanoparticles that have their own benefits and disadvantages [12]. Many techniques, such as sol gel, hydrothermal, flame spray pyrolysis, combustion and co-precipitation methods, are used for the synthesis of CuO nanoparticles [13].

Nanoparticles of CuO are used primarily as antimicrobial agents. Due to their antimicrobial ability, over 99.9 per cent of Gram-positive and negative bacteria are used to destroy in hospitals within 2 hours of being exposed if a dosage is adequate. Studies have also shown that the use of CuO decreases hospital-acquired illness and health-care costs in healthcare facilities. Bed sheets with CuO NPs are considered as one of the most interesting medical care technologies as they eliminate microbial attachments and possible microbial infections in hospitals. It has a wide variety of applications including antibacterial and antimicrobial, thermoelectric, magnetic storage media, gas sensors, ceramic resistors, near-infrared filters, polishing and gas sensors. In the present work, copper oxide nanoparticles are prepared using solution combustion method and characterized using XRD, FESEM, FTIR to analyze its microstructural properties. CuO nanomaterials are also used for degradation of MB dye using photocatalytic studies.

2. Materials and Methods

2.1 Materials

The materials such as copper Nitrate trihydrate, NaOH and DI water are used in the CuO synthesis. The precursor materials are AR grade and are used directly without any further purification. copper nitrate trihydrate was dissolved in DI water, allowed to stir for 10 minutes. NaOH was dissolved in distilled water (Maintain pH=11) and is added in drops to the precursor solution and stirred for 60 minutes. Then Centrifugation was carried out for 5 times with distilled water. The resultant product is dried at 100°C for 18 hrs.

2.2 Method – Co-precipitation

In this technique, the size of the materials can mainly be controlled. The synthesis involves reaction in a suitable solvent between critical materials. Until precipitation reaction, the dopant will be added to the precursor solution. Surfactant is used to preserve the separation between the formed particles. The precursors involved in this process are cheaper in market and the process is the most economical route. The final product is highly pure with well-defined and controlled size of nanoparticles, nanorods and nanotubes.

2.3 Characterization Techniques

X-ray diffractometer with CuK α radiation (1.5418 Å) (Rigaku, Japan) is used

to analyze the structure of the sample. The sample is scanned for a 2θ (20-90°) range with a step size of 0.02°. For chemical analysis, the FTIR spectrometer, (Spectrum Two FTIR / ATR spectrometer) of 400-4000 cm^{-1} wavenumber range with a resolution of 0.5 cm^{-1} , is used to confirm the chemical bonds in the sample. The sample is non-conducting in the current analysis, which is why a very thin gold layer of around 10 nm is sputter-coated for conduction. A field emission scanning electron microscope (FESEM) (Carl Zeiss microscopy ltd, UK & SIGMA) was used to analyse the morphology and composition. HEBER (MP4000) photo reactor is employed for the photocatalytic studies of copper oxide NPs using Copper oxide is used as a catalyst in the present work, and its photocatalytic activity is studied with visible light (300 Watts) using the photoreactor (HEBER, MODELHVAR-MP400).

Results and discussion

3.1 X-ray diffraction (XRD) Analysis

Figure 1 shows the XRD pattern of copper oxide NPs, indicating the polycrystalline nature. XRD pattern from the copper oxide NPs was compared with standard JCPDS for the indexing the grain orientation. It shows the reflections at angles 32.6°, 35.53°, 38.70°, 46.65°, 48.75°, 53.5°, 58.25°, 61.46°, 65.81°, 66.26°, 68.0°, 72.38°, 75.25° and 80.27° corresponding to the (110),

(002), (111), (202), (020), (113), (311) and (221) reflections of monoclinic CuO phases (JCPDS 45-0937). Scherer's formula is used to evaluate the crystallite size

$$D = \frac{K\lambda}{\beta \cos \theta}$$

The strong (002) reflection of anatase phase is used to estimate the crystallite size and found to be 41 nm [23].

FTIR Spectroscopy analysis

FTIR spectrum was recorded in the wavenumber range 4000–400 cm^{-1} . FTIR spectrum of CuO nanoparticles is shown in Figure 2. FTIR spectrum exhibits vibrations about 581, 681, 854, 955, 1162, 1366, 1565, 2134, 2849, 2927 and 2981 cm^{-1} , confirming the formation of highly pure CuO nanoparticles [24].

Field emission-scanning electron microscopy (FE-SEM) studies

Fig. 3 shows the FE-SEM images of copper oxide NPs. It shows the surface morphology of copper oxide nanoparticles. The images clearly show the well-defined formation of dense

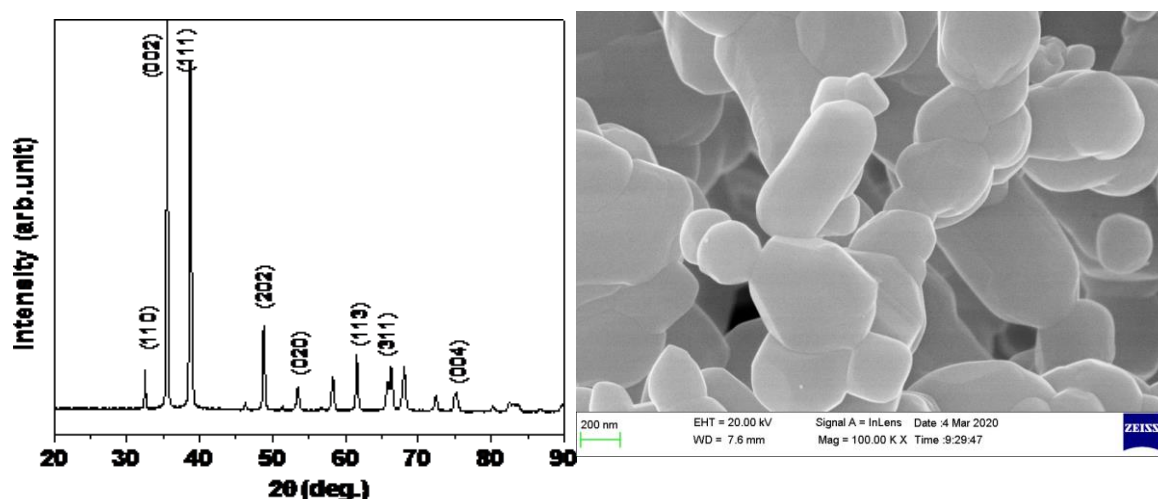


Figure 1. XRD pattern of the Copper oxide (CuO)nanoparticles

spherical crystallites with uniform shapes and size. It shows that the CuO NPs are uniform size and shape with porous nature. The EDS results (Fig.4) show that there are only Cu, Oxygen elements, indicating the presence of CuO NPs without any impurities [24, 25].

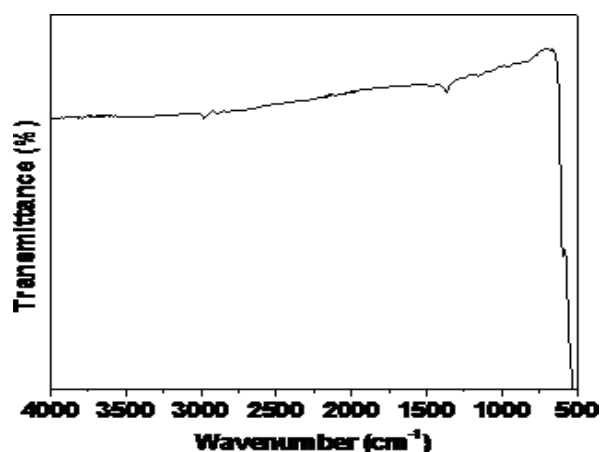


Figure 2. FTIR spectrum of the copper oxide nanoparticles

Dyes used in the textile industries have a complex structure and are thus immune to most deteriorating environmental conditions. At present,

the two main industrially viable techniques available for the waste water treatment. 1. adsorption and 2. biological treatment. Due to economic viability, ease of design, adsorbent recycling and non-existence of harmful residues, the adsorption method is a desirable process. The degradation of MB dye with CuO NPs as a catalyst is shown in Figure 5. Visible light irradiation (300 W) and prepared CuO nanoparticles used as a catalyst are used to study the

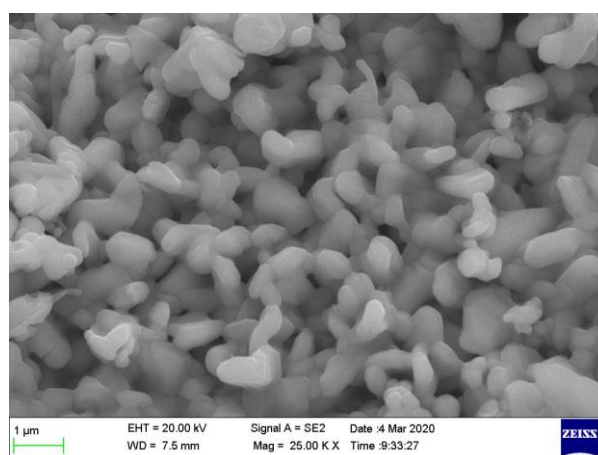


Figure 3. FE-SEM images show the surface morphology of copper oxide nanoparticles

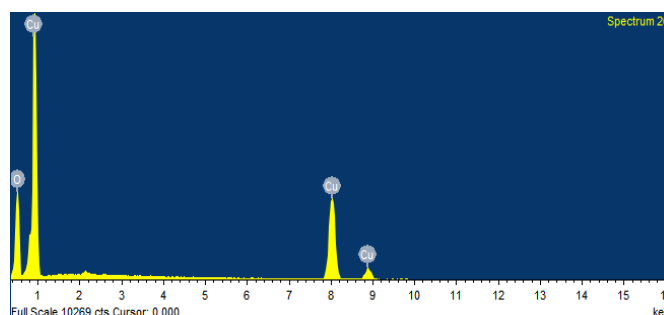


Figure 4. EDAX spectrum of the copper oxide nanoparticles

photocatalytic behaviour of MB dye in an aqueous solution. To the MB dye of 10 ppm concentration, 1 g / L catalyst under stirring was applied. The solution was held in a dark position for 30 minutes before light rotation. The visible lamp is located in the middle of the photo reactor. In the photo reactor, the steady flow of water is arranged to keep the temperature steady throughout the experiment. A magnetic stirrer is constantly used to blend the solution perfectly. Then, with the UV-Visible spectrophotometer, the visible light is turned on and the sample absorbance is found every 30 minutes. The sample is kept for up to 150 minutes under visible light. The percentage of absorption of each individual material was determined using the formula:

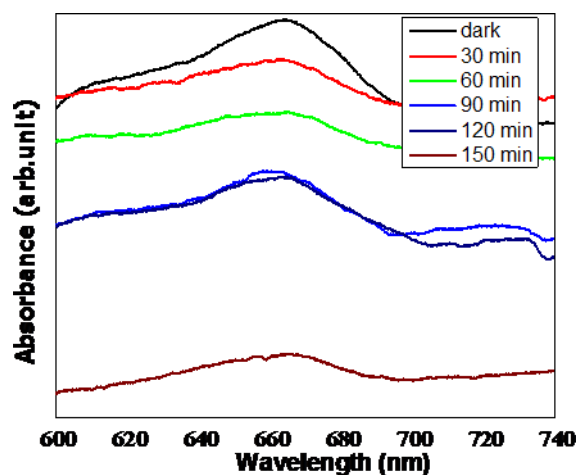


Figure 5. Photocatalytic studies of CuO nanoparticles under visible light irradiation

Percent of degradation = $(A_o - A_t) / A_o \times 100$ percent

Where at dark condition and after the time t respectively, A_0 and A_t are absorbance of the dye. The experiments are conducted to determine the effect of visible radiation catalysts on MB dye degradation. The figure shows that the strength of MB dye is highest in the dark state. The absorbance level of MB dye decreases as time progresses. The absorption is low after 150 min, suggesting the pollutant degradation within 2 hours under visible radiation.

The catalysts showed a steady increase in MB adsorption under visible light and initially left 30 minutes to reach the equilibrium of the adsorption. Due to reduced crystallite size and enhanced surface area, the adsorption of MB on CuO nanoparticles. According to the strong catalytic activity of CuO nanoparticles, adsorption capability increased every 30 minutes and the MB dye solution became colourless after 150 minutes [25].

Conclusion

Copper oxide NPs are successfully synthesized by co-precipitation process using copper nitrate trihydrate and NaOH as precursors. To research the microstructural, optical and photocatalytic properties, the prepared copper oxide nanoparticles are defined. The characterization is achieved with the XRD, FTIR, FESEM, and photoreactor. A polycrystalline monoclinic structure of copper oxide was indicated in the XRD studies. The well-defined

formation of crystallites with normal shapes and sizes of the nanoparticles

was demonstrated by FESEM results. Photocatalytic experiments have shown that the copper oxide NPs under visible light irradiation (300 W) degrade the MB dye pollutant. After 150 minutes of visible light exposure, the degradation performance is ~ 68 %. The CuO NPs can be used for pollutant degradation and other applications linked to the environment.

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CHAPTER-51

NANOTECHNOLOGY APPLICATION IN AGRICULTURE

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Abstract

Nanotechnology is emerging out as the greatest imperative tools in recent agriculture and predictable to become a driving economic force in the near future. At the same time Nanotechnology employs different chemical agents and novel delivery systems to implement crop productivity and potentials to decrease use of bulk agrochemicals, Nanotechnology may afford keener solutions for the current problems in the field of agriculture. Direct applications of nanotechnology in agriculture include delivery of agrochemicals and nutrition, pesticides, nano-scale carriers, smart packing, nanosensors, veterinary care, fisheries and aquaculture, detection of nutrient deficiencies. Nowadays Nano-fertilizers are increasingly been used as alternates to bulk fertilizers and reduce pollution of soil and water by different agrochemicals. Nano-fertilizers facilitate the slow and steady release of nutrients and thereby reduce the loss of nutrients and enhance the nutrient use efficiency.

Nanotechnology improves the nutrient use efficiency and reduces costs of environmental protection, slow-release fertilizers are the excellent replacement to soluble fertilizers. This work focused on the applications of nanotechnology in agriculture sector improvement, especially in the area of plant nutrition and plant protection.

Keywords: Agriculture; Nano Application; Slow Release Fertilizers; Plant Protection; Smart Packing

Introduction

Agriculture is considered the backbone of most developing countries, with more than 60% of the population dependent on it for their livelihood. In the same times there are many challenges facing agriculture sector, like climate change, non-reasonable use of resources and usage too much chemical fertilizer [1]. "Nanotechnology is the art and science of manipulating matter at the nanoscale" the design, characterization, production, and application of structure, device, and system by controlling shape and size at nanoscale [2]. Nanotechnology is developing as the sixth revolutionary technology in the current era. It is considered as an emerging field of science widely subjugated in many scientific fields and supposed playing the main role in the field of agriculture and food science in next era, but till now there is lack in scientific studies about its application in agriculture in the worldwide [3].

Plant nutrition is crucial for agriculture production and crop quality, and about 40% to 60% of the total world food production depends on the application of fertilizers [4]. Nanotechnology is working with the smallest possible particles which increase hopes for improving agricultural productivity through encountering problems unsolved conventionally, the nanotechnology applications have the potential to change agricultural production by allowing better management and conservation of inputs of plant and animal production. Nano- technology provide a great scope of novel applications in the plant nutrition fields to achieve the future request of the rising population because nanoparticles have exclusive physicochemical characters i.e. high surface area, high reactivity, and tunable pore size.

What is nanotechnology?

Nanotechnology is a new scientific approach that includes the use of materials and equipment capable of using physical and chemical properties of a substance at molecular levels to explore the biological and material worlds in nanometer-scale and use it in various carriers from medicine to agriculture [5]. Nanotechnology is the science and technology of tiny things, the materials that are less than 100 nm in size. One nanometer is 10^{-9} meters; Nano- technology combines solid state physics, chemistry, chemical engineering, biochemistry, biophysics, and materials science.

Nanoparticles

Nanoparticle is defined based on the size at which fundamental characters different from those of the corresponding bulk material. Nanoparticles overlap in size with colloids, which ranges from 1 nm to 1 mm in diameter [6]. Also, the physical properties of nanoparticles are different from the properties of the bulk material [7].

Methods of Nanoparticle Production

The Nanomaterials prepared through two basic methods (Top-down depending on size reduction from bulk materials) and Bottom-up system where materials are synthesized from atomic level (according to Royal Society and Royal Academy of Engineering).

Nanotechnology Application in Agriculture

“Top-down” systems: where tiny manipulations of little number of atoms or molecules fashion elegant patterns, through mechanical-physical methods like grinding, milling and crushing for producing nanoparticles, this method use for producing Nano composites and Nano-grained bulk materials like metallic and ceramic nanomaterials in extensive size distribution (10 - 1000 nm).

Bottom-up system: in ‘Bottom-up’ building up, numerous molecules self-assemble in parallel steps, as a function of their molecular recognition characters, this processing produces more complex structures from atoms or molecules, also, this method produce a uniform controlling sizes, shapes and size ranges of nano materials. Higher charge density and higher reactivity of nanoparticles due to small size [10].

1. As the surface area increases in comparison to volume, the activity of the atoms on the surface of the particles becomes more than the inside the particles.
2. As a result of large surface to volume ratio, the nanoparticles had more strength, increased heat resistance, decreased melting point and different magnetic properties of Nano-clusters
3. Differences in the exposed surfaces of different nanoparticles lead to variances in atomic distribution across the nanoparticles, this, in turn, affect

the electron transfer rate kinetics between metal nanoparticles and corresponding adsorbed species.

4. Nanoparticles have higher catalytic activity when they are present in tetrahedral structure followed by cubic and spherical structure, recognized for the improvement of chemical re-activity at the sharp edges and corner of the former [11].

Nanomaterials and Agriculture

Nanomaterials often have chemical, physical, or biological properties that are different from those of their larger counterparts and due to their different properties, nanomaterial may pose different safety issues than their larger counterparts. There has been main attention in using nanotechnology in agriculture and the food system due to great potential as it can improve the quality of different products, also, with the rapid advancement of nanotechnology since the last decade of last century, controlled preparation of Nanomaterials with desired morphology and size, and newly established concepts and methodology have underpinned the solid bases to solve the unsolved questions in nutrient uptake.

Direct applications of nanotechnology in agricultural production and products generally embrace delivery of various agrochemicals, the study of plant disease mechanisms and genomes improvement [12]. Usually this

method used for preparing most of the nano-scale materials (1 - 100 nm), it

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is plays an essential role in the production of nanostructures and nanomaterials. Also, there are some other methods for produce Nanomaterials like attrition and pyrolysis, and biological synthesis of nanopar- ticles.

Some unique features of nanoparticles

In nano-world, materials less than 100-nanometer size behave completely different, the rules that manage the behavior of the ele- ments of our known world start to give way to the rules of quantum mechanics, and everything changes. There are various advantages that nanotechnologies offer due to the unique functional properties of nanoparticles and materials like:

There are various positive effects of Nanomaterials in Agricul- ture like:

In nano-world, materials less than 100-nanometer size behave completely different, the rules that manage the behavior of the ele- ments of our known world start to give way to the rules of quantum mechanics, and everything changes. There are various advantages that nanotechnologies offer due to the unique functional properties of nanoparticles and materials like:

- (1) The higher solubility of nanoparticles in suspension.
- (2) The higher surface area and particle size of the nanopar- ticles, which facilitates penetration of seed coats and subse- quently emerging roots.
- (3) Better bioavailability of molecules to the seed radicals [13].

Nanotechnology Application in Agriculture

The properties of nanomaterial for agricultural applications

The model Nanomaterials for agricultural applications are supposed to have the following properties:

1. Providing actual concentration and controlled release of fertilizers or pesticides in response to certain conditions (TiO₂ Nano particles used as plant fertilizer for Mung bean to enhance crop production) [14]
2. Improved targeted activity [15].
3. Lower Eco harmful with safe and relaxed transport.

Nanomaterials usage in agriculture

Nanomaterials have many usages in all stages of agricultural production, in different forms and various procedures such as:

1. Nano-fertilizer for balance crop nutrition [16,17]
2. Crop improvement (Zinc Nano fertilizer used to enhance crop production of *Pennisetum americanum*) [18]
3. Plant protection ingredients (pesticides, fungicides, weedicides) [19]
4. Weed management.
5. Nano pesticides [20]
6. Nano sensors [21]

7. Post-Harvest Technology [22]
8. Bioprocessing (bio synthesized) nanoparticles for agricultural use [18]
9. Bio sensors for Aqua culture [23]
10. Nano biotechnology (Analysis of gene expression and Regulation) [24]
11. Monitoring the identity and quality of agricultural produce [25]
12. Precision agriculture: Precision agricultural techniques might be used to promote increase crop yields but not damage soil and water, decrease nutrients loss due to leaching and emissions, in addition to enhance nutrients long-term incorporation by soil microorganisms as shown in (Figure 3).
13. Seed technology.
14. Water management [27]
15. Plant growth regulators [28]
16. Soil management [29]
17. Agricultural engineering aspects [30]
18. Food technology [31].

Some applications of Nanotechnology in Agriculture

- a. Crop improvement
- b. Increase efficient fertilizers and pesticides

- c. Soil management.
- d. Plant disease detection.
- e. Water management
- f. Analysis of gene expression and Regulation
- g. Post-Harvest Technology.

Potential Risks of Nanotechnology

There are some negative effects of Nanomaterials on biological systems and the environment caused by nanoparticles, like chemical hazards on edible plants after treatment with high concentration of Nano Silver, also, in some cases, nanomaterial generated free radicals in living tissue leading in DNA damage, therefore nanotechnology should be carefully evaluated before increasing the use of the nano agro_materials [32].

Conclusion

Nanotechnology consider a novel key to growing agricultural production through implementing nutrient efficiency, improve plant protection practices, also, nanotechnology may have real solutions for various agriculture problems like improved crop varieties, plant protection, detect diseases and monitor plant growth. Nanotechnology offers generous visions

for the development agricultural sector through advanced applications and

the probability of products and increases global crops production volume to feed the world population in next decades. Promising results and applications are already being developed in the areas of nano nutrients, implement crop productivity, protect plants (herbicides and pesticides), nano-packing and Nano sensors.

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CHAPTER 52

EXPLORING THE “RELATIONSHIP BETWEEN CORPORATE GOVERNANCE AND FINANCIAL PERFORMANCE”

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Abstract

Despite the fact that measures of corporate governance have been brought around three decades ago, its full compliance is still rare in various companies in India. So, this study is the first attempt to get more details on this domain in Indian context. “Small and medium enterprises in India” have great potential but they are still untapped and one can leverage the resources, raw materials, workforce, and government support by channelizing properly. A lot of studies have focused on the “impact of corporate governance on financial performance of the company. Hence this

study has investigated the relation between corporate governance and financial performance” of listed Indian firms.

To fulfil this objective, this study is based on “empirical evidence collected through online survey using a self-structured questionnaire which consists of open-ended questions designed on 5-Point Likert scale. The survey form was distributed among 195 participants and 153 responses have been collected through Google Form. After collection of data, SPSS 22 software has been used for analysis and interpretation to conclude findings. To the best of our knowledge, this study is the first attempt to discuss the relationship between corporate governance and financial performance in Indian companies. Hence, this study makes tremendous contribution to existing knowledge on corporate governance in India” and adds scope for future studies. The findings will also help regulators, practitioners, and policymakers to boost corporate governance in India.

Keywords: *corporate governance, financial performance, Indian firms, Indian companies, small and medium enterprises*

Introduction

“Corporate governance” is a combination of several “practices and policies” serving as a norm for all corporates to have effective control mechanisms.

Corporate governance refers to the structures and process with which a company is governed and controlled with accountability, legitimacy, and competence to policy structure “(Handa, 2018; Al-ahdal et al., 2020). In addition, the global fiscal crisis has also focused on the value of corporate governance (Saggar & Singh, 2017). Corporate governance has become the centre of attraction for a lot of researchers because of various corporate failures (Antwi et al., 2021).

The concept of corporate governance has been important especially for developing nations because of weaker structure of governance. So, a strong corporate governance structure is needed with managerial excellence and high transparency to fix corporate malpractices in order to appeal foreign investors (Al-ahdal et al., 2020).” The concept of “corporate governance” took place as an aftereffect of frauds like Satyam scam and “Big Bull Harshad Mehta” scam. When it comes to internal control, India has suffered due to poor corporate management and ignorance (Arora & Singh, 2020). The “Confederation of Indian Industry (CII)” was brought to introduce some corporate governance codes of conduct along with “Ramakrishna Commission on Public Sector Undertakings (PSUs)” for good corporate governance (Al-Homaidi et al, 2021).

On the basis of recommendation from the “Birla Committee, the leading capital market regulator, SEBI accepted including a new clause “Clause 49”

for corporate governance practices. SEBI has also approved some amendments to the clause to further enhance listing agreements with voluntary and important provisions in case of listing companies before the enactment of “Companies Act, 2013” (Kamath, 2019). According to Clause 49, all relevant aspects of corporate governance should be disclosed like concerned party transactions, ownership structure, compensation structure, board structure, internal audit, etc. The Companies Act 2013 was enacted and later provided the corporate governance practice (Srivastava et al., 2019).

1.1 Background

Corporate governance is defined as an approach adopted by the board of directors to improve shareholders' value while observing managers' conduct for managing the firm on regular basis (Gompers et al., 2003). Corporate governance is also defined as a tool for making organizations disciplined (Cadbury, 1992). It is the final aim to provide value to long-term investors while considering their well-being when managing and directing the firms' affairs to improve business prosperity and corporate accountability. While a good corporate governance keeps track on firm's activities and promotes proper corporate environment, poor corporate governance causes wastage of resources, corruption, and negligence (Abor, 2008).

Financial performance is defined as the overall health of a company (Bhunias et al., 2011).” According to Kinyua (2019), financial performance refers to the breakdown of review of firm’s development when it comes to evaluate business governance and success of the firm. These days, overall performance of the company is perceived as its body given that a strong performance boosts the overall company’s growth. The financial performance of the firm can be calculated with its financial statements. A company can provide accurate information to help in management’s efforts if it is doing well.

The benefits or utility obtained by the shareholders with the ownership of shares of the company can be perceived as a performance measure or company’s value. Financially successful companies usually have high share prices. These companies attract a lot of investment and improve their odds of expansion. Companies use traditional indicators of performance to determine their success level like profitability, which can either be comparative or historical (Kinyua & Ochieng, 2022). There are also some other ways of company valuation like “present value, discounted cash flow, equity cash flow, and weighted average cost of capital (Urhoghide & Omolaye, 2017).”

Literature Reviews

Khatib & Nour (2021) conducted a study on “188 non-financial Malaysian firms for 2019-20. All firm characteristics like governance, firm performance, liquidity, dividend, leverage, etc. were affected by COVID-19 and there was no significant difference between pre- and post-COVID performance. In addition, there is a significant positive impact of board size on firm performance. They split the sample on the basis of year. But it is observed that board size is not the matter of concern in uncertain period, while diversity of the board seems to be enhancing overall performance of the firm at the time of crisis in comparison to previous year. Audit committee meetings and board meetings are supposed to have a negative impact on firm performance before and after the pandemic. The limitation of this study was lack of studies on empirical evidence on the effect of the pandemic on corporate governance and firm performance.

Alodat et al. (2022) determined the impact of board of directors, ownership structure, and audit committee on firm performance. Overall, agency theories and dependency on resource have covered the excellent performance of firms with stronger “Corporate Governance (CG)” over the ones with lack of governance. They used empirical approach with construction of extensive corporate governance measures on 81 non-financial firms from 2014 to 2018 listed on the “Amman Stock Exchange”.

They identified significant and positive relationship between audit committee and board of directors with measures of firm performance like Tobin's Q and "return on equity (ROE)." Both institutional and foreign ownerships resulted in a positive and significant relationship with return on equity in ownership structure. On the other hand, there was negative and insignificant relationship between both types of ownerships and firm performance in terms of Tobin's Q.

New issues of corporate governance have got a lot of attention of researchers for over 3 decades because of rising economic crisis worldwide. Danoshana & Ravivathani (2019) considered the effect of corporate governance on the performance of listed financial companies in Sri Lanka and suggested the ideal CG practices to improve performance of listed companies. They used "Return on Assets and Return on Equity" as key variables to define firm performance. Meanwhile, board size, audit committee, and meeting frequency of the company are variables measuring CG. They selected the sample of 25 listed financial companies for 2008 to 2012. They found positive impact of CG variables like board size, firm performance, and audit committee size.

Farooq et al. (2022) studied the relationship between firm performance and governance in context of important firm characteristics like firm size. They classified the sample firms as small or large as per total assets. The CG index

is based on 29 provisions of governance like board committee, audit committee, compensation, and ownership structure of the firm to measure the quality of governance. Higher index means higher quality of governance. Firm profitability is calculated with market value and accounting measures. They used the “2-stage least square (2SLS)” method to avoid the constant equation bias. CG seems to have a positive effect on market indices and accounting return based on Tobin’s Q, but it has a small impact on ROE. Implementing better governance resulted in higher profitability for larger companies than smaller ones which didn’t have these principles. So, implication for smaller firms is to improve their CG structure to have more profits.

Koji et al. (2020) explored the relation between financial performance and corporate governance of publicly listed non-family and family manufacturing firms in Japan. They took data from 2014 to 2018 from Bloomberg of 1412 companies, including 551 family and 861 non-family companies. It is found that family firms performed better than non-family firms in terms of Tobin’s Q and ROA with univariate analysis. Family firms outperformed non-family counterparts in terms of Tobin’s Q on multivariate analysis. When considering ROA, there was a negative impact of family ownership on firm performance.

2.1 Research Gap

Considering the above literature, it is found that majority of studies were conducted on the impact of corporate governance on firm performance. Even though there are studies on the association between CG and financial performance of the firms, they are not conducted in Indian context.” Hence, this study will fill this knowledge gap and provide most important insights to practitioners and research community to open further research path in this direction.

2.2 Research Question

- Is there a “relationship between corporate governance (CG) and financial performance”?
- What are the measures to improve corporate governance?

2.3 Research Objectives

- To find out the “relationship between corporate governance (CG) and financial performance”
- To suggest effective measures to improve corporate governance

2.4. Hypothesis

H1 – There is a “significant association between corporate governance (CG) and financial performance”

H0 – There is no “association between corporate governance (CG) and financial performance”

3. Research Methodology

This study is based on “empirical evidence collected from employees and managers of corporate companies to understand the relation between corporate governance and their financial performance. An online survey was conducted through Google Form” which is distributed among 195 participants and accepted 153 responses from the participants.

The survey data has been analysed using SPSS 22 software and interpreted through Excel spreadsheet. In order to solve the hypothesis, Pearson’s Correlation test has been conducted and Reliability Analysis was done to test the reliability of questionnaire.

4. Analysis of Study

4.1. Demographics

There are 48 (31%) participants who are aged 30 to 40 years, 40 (26%) participants were aged 20 to 30 years, 30 (20%) participants fall in the “age group of 40 to 50 years, and 35 (23%) participants are over 50 years old (Table 1) (Figure 1).

Table 1 - Age Group					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20 to 30 years	40	26.1	26.1	26.1

	30 to 40 years	48	31.4	31.4	57.5
	40 to 50 years	30	19.6	19.6	77.1
	Above 50 years	35	22.9	22.9	100.0
	Total	153	100.0	100.0	

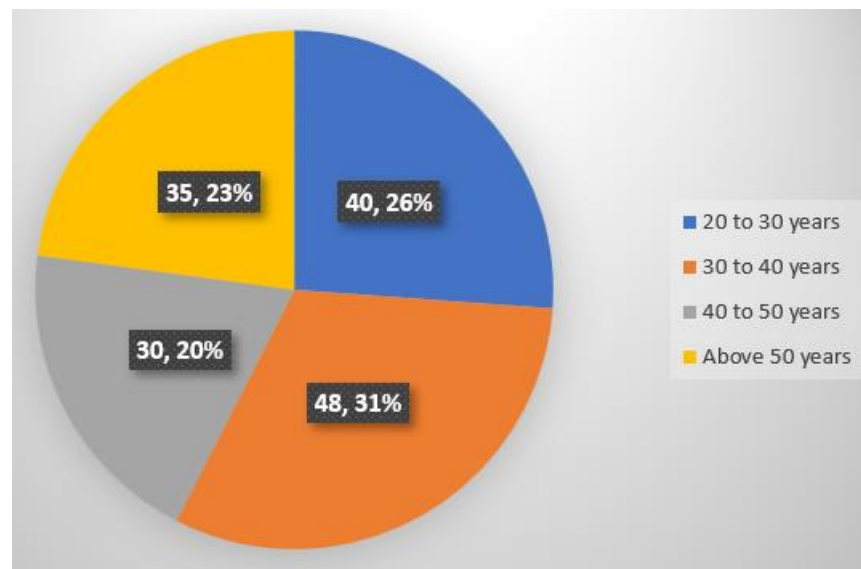


Figure 1 – Age Group

There are 92 (60%) participants who are male in this study, while 61 (40%) participants are female (Table 2) (Figure 2).

Table 2 – Gender				
	Frequen cy	Percent	Valid Percent	Cumulative Percent

Valid	Female	61	39.9	39.9	39.9
	Male	92	60.1	60.1	100.0
	Total	153	100.0	100.0	

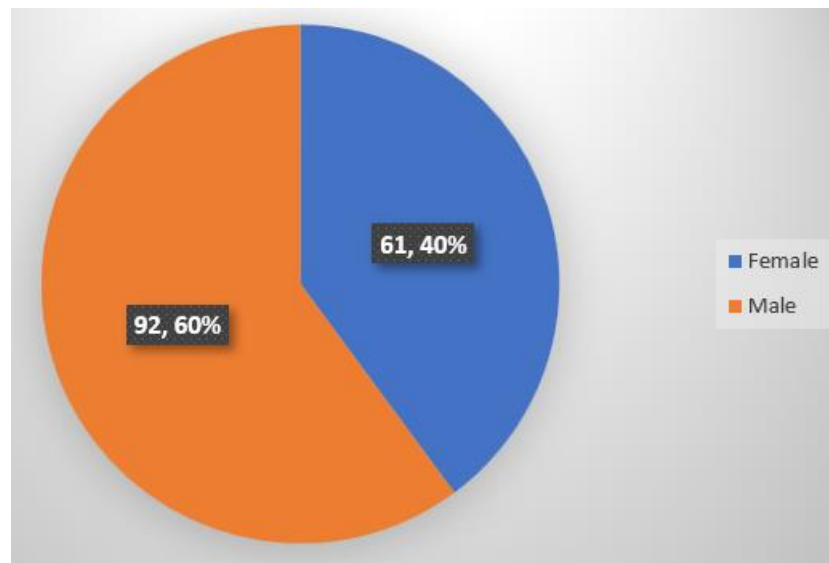


Figure 2 – Gender

There are 43 (28%) participants who belong to public listed companies, 40 (26%) participants belong to private companies, 35 (23%) participants are employed in listed companies, and 35 (23%) participants are employed in state-owned companies (Table 3) (Figure 3).

Table 3 - Nature of Company				
	Frequen cy	Percent	Valid Percent	Cumulative Percent

Valid	Listed	35	22.9	22.9	22.9
	Private	40	26.1	26.1	49.0
	Public	43	28.1	28.1	77.1
	State Owned	35	22.9	22.9	100.0
	Total	153	100.0	100.0	

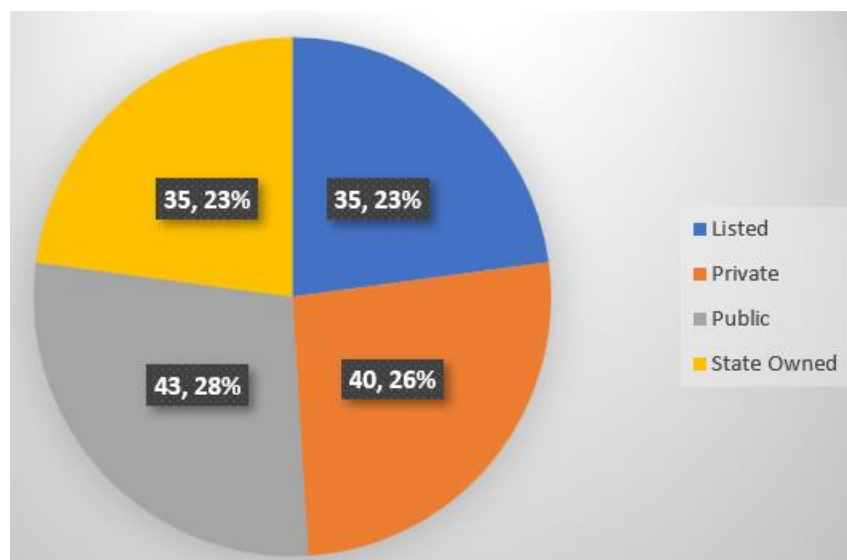


Figure 3 – Nature of Company

There are 95 (62%) participants who said that their companies have 150 or more employees, 48 (31%) participants claimed that their companies have less than 50 employees, and 10 (7%) participants who claimed that their firms have 50 to 150 employees (Table 4) (Figure 4).

Table 4 - No. of Employees

		Frequen cy	Percent	Valid Percent	Cumulative Percent
Valid	150 or above	95	62.1	62.1	62.1
	50 to 150	10	6.5	6.5	68.6
	Below 50	48	31.4	31.4	100.0
	Total	153	100.0	100.0	

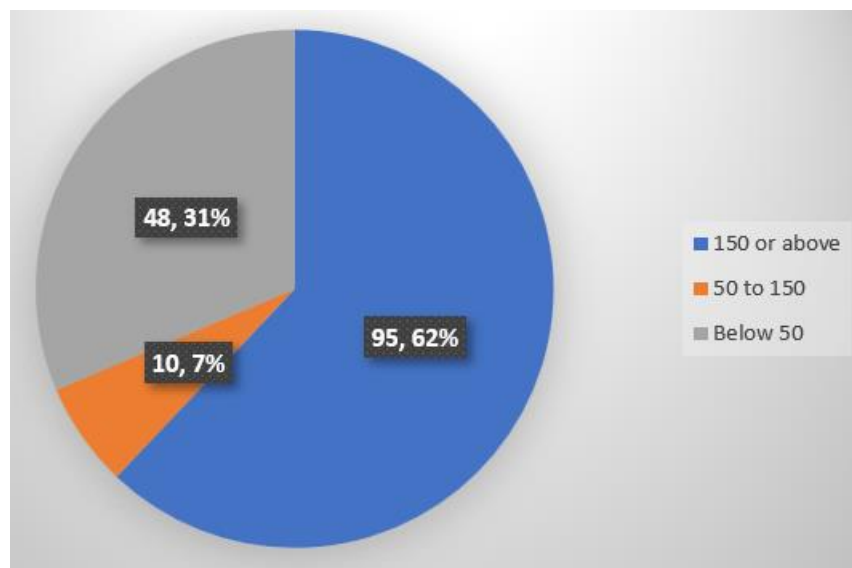


Figure 4 – No. of Employees

4.2. Corporate Governance

In this study, 93 (61%) participants strongly agree and 12 (8%) participants agree that their senior management and board of directors are familiar with the voluntary code of corporate governance, while 28 (18%) participants

disagree, 16 (11%) participants strongly disagree, and 4 (3%) participants neither agree nor disagree (Table 5) (Figure 5).

Table 5 - Senior management and Board of Directors are familiar with the voluntary code of CG					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	16	10.5	10.5	10.5
	Disagree	28	18.3	18.3	28.8
	Neutral	4	2.6	2.6	31.4
	Agree	12	7.8	7.8	39.2
	Strongly Agree	93	60.8	60.8	100.0
	Total	153	100.0	100.0	

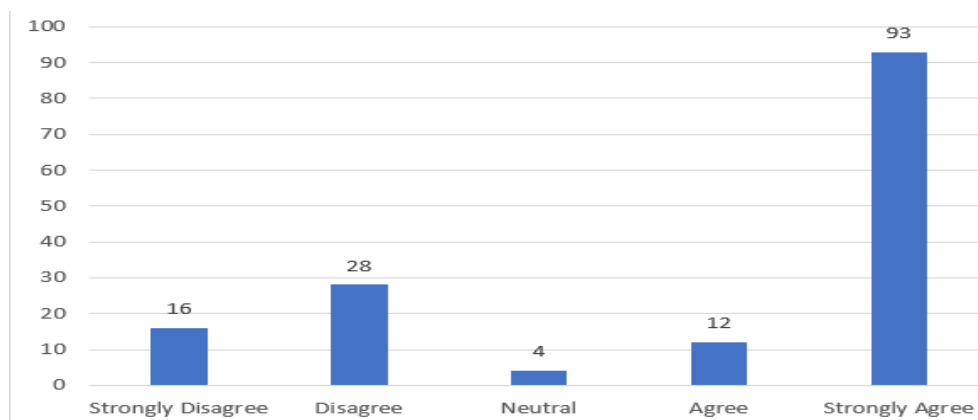


Figure 5 – Senior management and Board of Directors are familiar with the

voluntary code of CG

In this study, 105 (69%) participants strongly agree and 16 (11%) participants agree that their firm has proper code of ethics, while only 10 (6%) participants disagree, 10 (7%) participants strongly disagree, and 12 (8%) participants neither agree nor disagree (Table 6) (Figure 6).

Table 6 - Your firm has proper code of ethics					
		Frequency	Percent t	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	10	6.5	6.5	6.5
	Disagree	10	6.5	6.5	13.1
	Neutral	12	7.8	7.8	20.9
	Agree	16	10.5	10.5	31.4
	Strongly Agree	105	68.6	68.6	100.0
	Total	153	100.0	100.0	

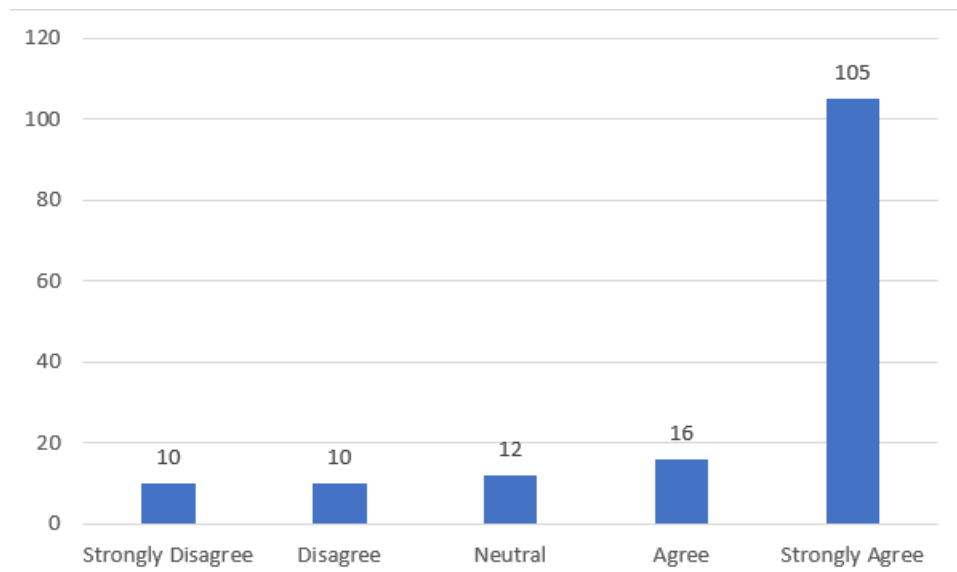


Figure 6 - Your firm has proper code of ethics

There are 77 (50%) participants who agree and 25 (16%) participants who strongly agree that their firms have a designated officer who is responsible to ensure compliance with corporate governance policies, while only 15 (10%) participants disagree, 6 (4%) participants strongly disagree, and 30 (20%) participants were not sure (Table 7) (Figure 7).

Table 7 - Your firm has a designated officer responsible to ensure compliance with CG policies of the company					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	6	3.9	3.9	3.9
	Disagree	15	9.8	9.8	13.7

	Neutral	30	19.6	19.6	33.3
	Agree	77	50.3	50.3	83.7
	Strongly Agree	25	16.3	16.3	100.0
	Total	153	100.0	100.0	

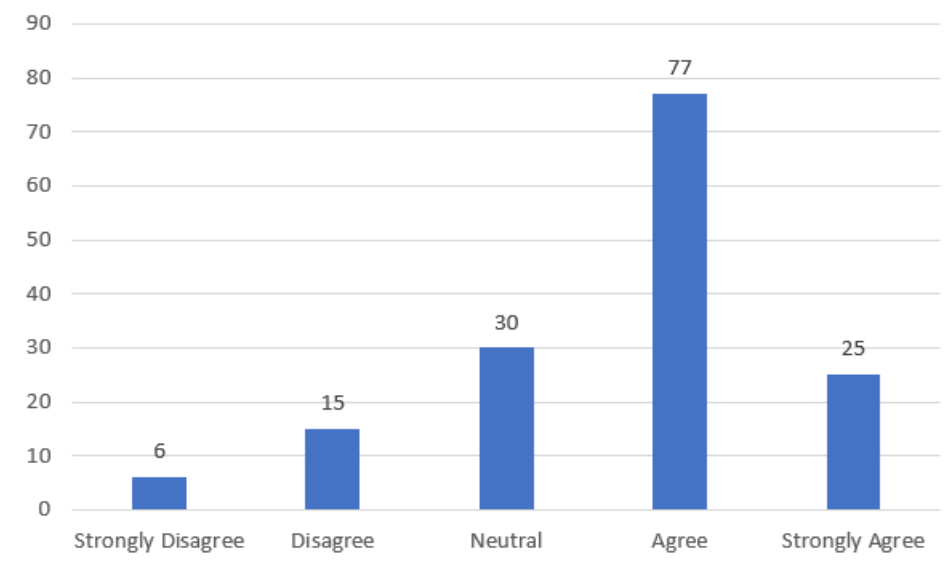


Figure 7 – Your firm has a designated officer responsible to ensure compliance with CG policies of the company

There are 52 (34%) participants who strongly agree and 49 (32%) participants agree that external audit of their firms align with “International Standard of Auditing (ISA)” guidelines, while 20 (13%) participants were not sure, 16 (10.5%) participants disagree, and 16 (10%) participants strongly disagree (Table 8) (Figure 8).

Table 8 - External audit of the company aligns with “International Standard of Auditing (ISA)”					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	16	10.5	10.5	10.5
	Disagree	16	10.5	10.5	20.9
	Neutral	20	13.1	13.1	34.0
	Agree	49	32.0	32.0	66.0
	Strongly Agree	52	34.0	34.0	100.0
	Total	153	100.0	100.0	

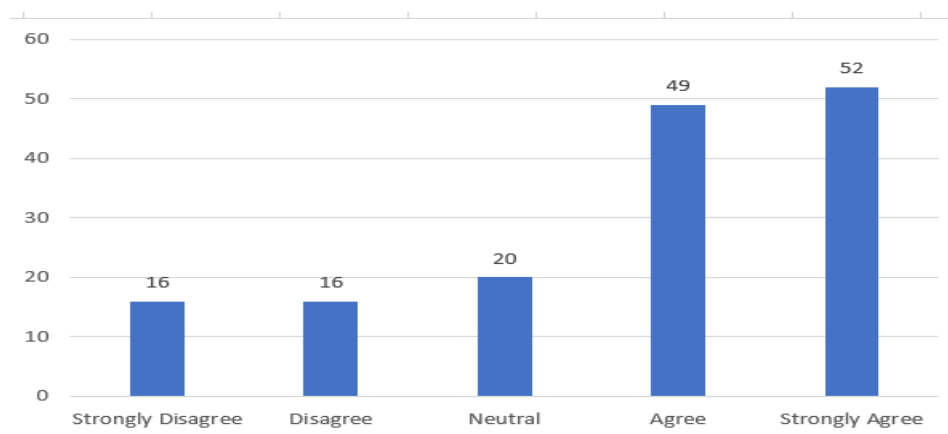


Figure 8 – External audit of the company aligns with “International Standard of Auditing (ISA)”

4.3. Financial Performance (FP)

There are 116 (76%) participants who strongly agree that their company is doing financially well in the market to attract investors and 12 (8%) participants agree, while only 14 (9%) participants disagree, 5 (3%) participants strongly disagree, and 6 (4%) participants were not sure (Table 9) (Figure 9).

Table 9 - Your company is doing financially well in the market to attract investors					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	5	3.3	3.3	3.3
	Disagree	14	9.2	9.2	12.4
	Neutral	6	3.9	3.9	16.3
	Agree	12	7.8	7.8	24.2
	Strongly Agree	116	75.8	75.8	100.0
	Total	153	100.0	100.0	

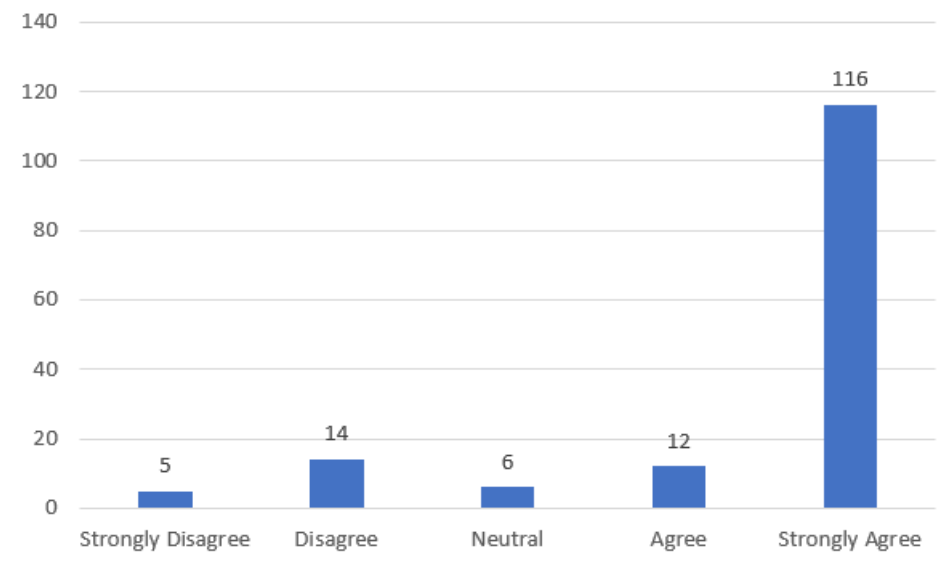


Figure 9 – Your company is doing financially well in the market to attract investors

There are 91 (60%) participants who strongly agree and 6 (4%) participants agree that their company discloses important transactions on timely basis like balance sheet, annual report, and party transactions, etc., while 31 (20%) participants disagree, 21 (14%) participants strongly disagree, and 4 (3%) participants were neutral (Table 10) (Figure 10).

Table 10 - Your company discloses key transactions on timely manner like balance sheet activities, party transactions, annual report, etc.				
	Frequency	Percent	Valid Percent	Cumulative Percent
		t		

				t	
Valid	Strongly Disagree	21	13.7	13.7	13.7
	Disagree	31	20.3	20.3	34.0
	Neutral	4	2.6	2.6	36.6
	Agree	6	3.9	3.9	40.5
	Strongly Agree	91	59.5	59.5	100.0
	Total	153	100.0	100.0	

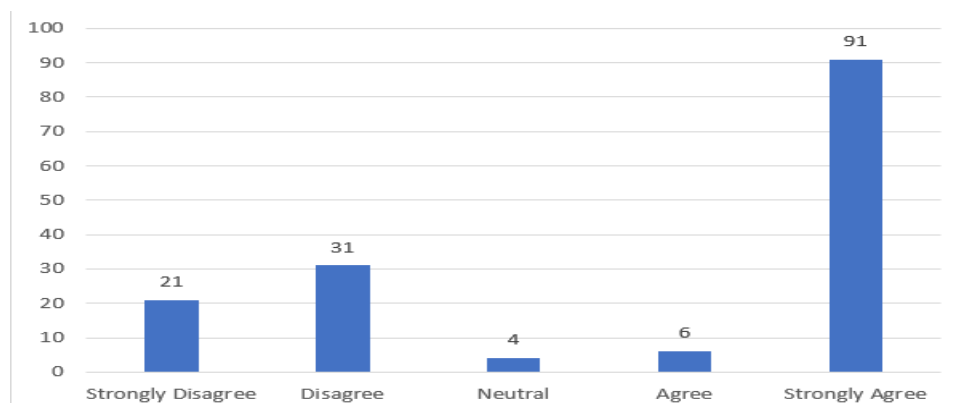


Figure 10 - Your company discloses key transactions on timely manner

like balance sheet activities, party transactions, annual report, etc.

There are 84 (55%) participants who strongly agree and 6 (4%) participants agree that their company holds regular meetings with securities analysts, while 33 (22%) participants disagree, 22 (14%) participants strongly disagree, and 8 (5%) participants were not sure (Table 11) (Figure 11).

Table 11 - Your company holds regular meetings with securities analysts

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Strongly Disagree	22	14.4	14.4	14.4
Disagree	33	21.6	21.6	35.9
Neutral	8	5.2	5.2	41.2
Agree	6	3.9	3.9	45.1
Strongly Agree	84	54.9	54.9	100.0
Total	153	100.0	100.0	

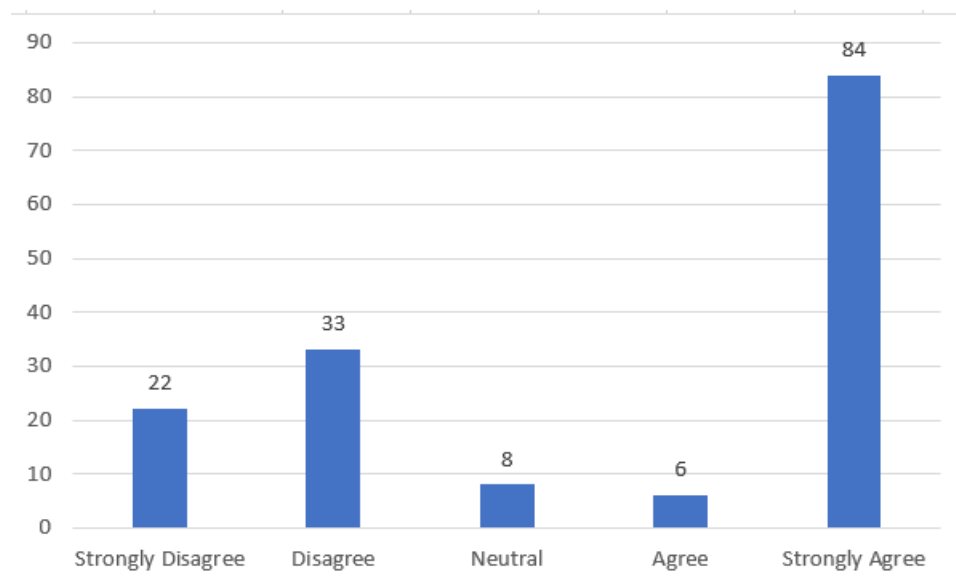


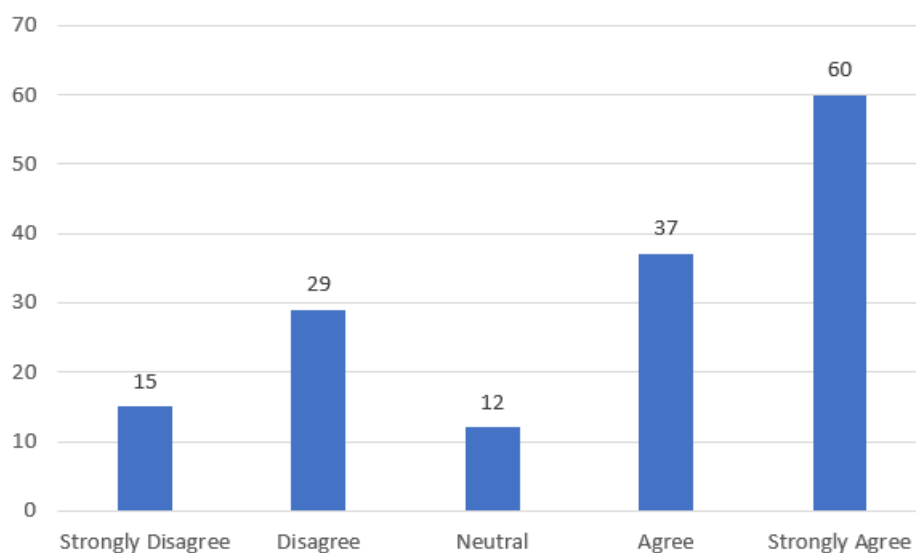
Figure 11 – Your company holds regular meetings with securities analysts

There are 60 (39%) participants who strongly agree and 37 (24%) participants agree that their company have protection measures to protect minority shareholders' interest, while 29 (19%) participants disagree, 15 (10%) participants strongly disagree, and 12 (8%) participants were not sure (Table 12) (Figure 12).

Table 12 - Your company have protection measures to protect minority shareholders' interest				
	Frequency	Percent	Valid	Cumulative

				Percent	Percent
Valid	Strongly Disagree	15	9.8	9.8	9.8
	Disagree	29	19.0	19.0	28.8
	Neutral	12	7.8	7.8	36.6
	Agree	37	24.2	24.2	60.8
	Strongly Agree	60	39.2	39.2	100.0
	Total	153	100.0	100.0	

Figure 12 – Your company have protection measures to protect minority shareholders' interest



4.4. Relationship Between Corporate Governance and Financial Performance

When it comes to determine the relationship between “Corporate Governance (CG)” and “Financial Performance (FP),” Pearson’s Correlation test was conducted. In addition, Reliability test was conducted using IBM SPSS 22.0 software. There are four variables each for both CG and FP. Table 13 illustrates the value of Cronbach’s Alpha for both Corporate Governance and Financial performance, i.e., 0.654, which is ranging from 0.6 to 0.7, which means all the items were reliable for tests.

Table 13 - Reliability Statistics	
Cronbach's Alpha	N of Items
.654	2

Table 14 illustrates the correlation between Corporate Governance (CG) and Financial Performance (FP) of the firms. It is observed that the value of Sig. (2-tailed) for both CG and FP is 0.000 (i.e., $p < 0.005$). Hence, there is a significant correlation at 0.01 level, which approves H1.

Table 14 – Correlations between CG and FP

		CG	FP
Corporate Governance (CG)	Pearson Correlation	1	.487**
	Sig. (2-tailed)		.000
	N	153	153
Financial Performance (FP)	Pearson Correlation	.487**	1
	Sig. (2-tailed)	.000	
	N	153	153
**. Correlation is significant at the 0.01 level (2-tailed).			

5. Results

In this study, it is observed that there is a significant correlation between corporate governance and firm performance ($p < 0.005$) after performing Pearson's correlation and collecting survey data. In addition, it is also found that improvement in corporate governance practices also led to improvement in financial performance of the firm," according to the questions asked from the participants. On the basis of those responses, here are some of the measures to improve corporate governance for the board members and management –

- Board should admit that corporate governance should not be restricted to compliance. Both board and management should hold good relationship by understanding major functions and positions of one another.
- Board plays a vital role in forming and adopting strategic decision of the organization. Board's contribution is ranging from approval to development. Hence, each board should choose the appropriate role to clarify with the management.
- Boards and managements should keep track on organizational performance and ensure legal compliance. This way, corporate decision-making should be consistent with organizational strategy. There is a need to identify the "Key Performance indicators (KPIs)" and build proper measures to ensure success.
- Boards mostly appoint, work, review, and replace the CEO and other members. The relationship between CEO and board is important for proper corporate governance.
- In addition, boards should ensure that the directors of the company are well-informed. Directors should be provided with needed information with measures like site visits, briefings, presentations, and individual programs.

6. Conclusion

Despite having one of the best corporate governance laws in the world, the adherence of Indian companies is still the matter of concern. With exposure to various financial scams, trust on corporate ecosystem and its financial stability has always been affected among the shareholders. So, it is important to build confidence and trust among the investors by complying with proper corporate governance practices. This study is an attempt to build relationship between corporate governance and good financial performance of the organization. However, small sample size makes it harder to generalize the findings of this study. Further longitudinal studies are needed to generalize findings. However, this study has opened further research path for future studies on this area.

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CHAPTER 53

THE CHANGING ROLES OF WOMEN AND THE IMPACT – A QUALITATIVE STUDY

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Abstract

The role of women has been a dynamic and evolving aspect of human society throughout history. While it is true that women have often faced societal norms and expectations that limited their opportunities and influence, it is equally true that women have consistently challenged and reshaped these roles. Across time and era, women have demonstrated resilience, determination, and the capacity to adapt to changing circumstances. From

advocating for suffrage and equal rights to breaking barriers in fields traditionally dominated by men, women have continually asserted their presence and capabilities. While gender equality remains an ongoing struggle in many parts of the world, the history of women is a testament to their enduring strength, resilience, and ability to shape the course of human progress.

Keywords-women, change, barriers, responsibilities

Introduction

The role of women remains rooted into perpetuity across time and era. Despite the fact, it has taken centuries to unfurl women's role into different shapes and forms a new horizon. There are some bailiwick where women of bygone days were fettered to the societal structure and system and also aspirations of others which would whittle the rules and regulations of their existence or life. In order to come out of this embroilment and muddle state, women had to fight for their liberty in order to define their roles, which had new occupation, new responsibilities along with their pre-defined ones. The role of Indian women has varied from that of a divine to that of a *devdasi*, from being untainted to being crude, from being superlative to being browbeaten or being oppressed. With changes in attitude, awareness and sensitivity of family and the society as a whole, the role of Indian woman has undergone remarkable transformations and metamorphosis. They

attempted to free themselves from the shackles of centuries (Kollan) particularly in the context of modernization and urbanization (Srivastava, 1978; Ramanna, 1984). The 'flat world' ushered plethora of employment opportunities and mobility of resources and widened scope of activities with high speed of flow of information.

Objectives :

- i. To study the transformation of women.
- ii. To study the tasks assigned to a women and its impact.
- iii. To study Professional Women in changing environment.

Metamorphosis –The role of women:

It is difficult to trace the metamorphosis in the role of women in a watertight compartment. However, certain specific features may be seen in the functioning of the women over the period. Women in fifties managed income generating entrepreneurial activity in absence of male member and gave up her, own education and other aspirations for her family and thus took enormous courage to break through social maps and coding.

Women in sixties got higher education and took up activities for self-occupation and engagement, behind which the seeds of aspirations to discover self and to have economic choices.

Women in seventies joined the mainstream economy, which was marked by women opting for self employment and regarded work was an integral

aspect of their life. Further, income generation and career choice were significant in the context of social system and occupation.

The Women sections of nineties were a different breed of women. They acquired high self esteem and have proved that they are able to deal with situations with due diligence. Besides, they raised voice against mis-match in marriages, physical violence, demands for dowry and other forms of harassments. (Kollan & Parikh, 2005)

In the new millennium, women participation was wide reckoning, particularly with the advent of IT, spread of financial verticals, unprecedented growth of telecom sector and emergence of outsourcing industry. Many of the industries were headed and guided by women who are seen as pioneers.(eg:-Padmshree warrior, Kiran Mazumdar Shaw, Prof Indira Nath, Kalpana Morparia,Vinita Bali,Shehnaz Hussain,Dr Nita Goel,).

The aforesaid discussion clearly portrait a sea changes in the roles and responsibilities of women with the passage of time. They joined the mainstream economy at the same time vein with their male counterparts. The flip side of this episode cannot be overlooked with the opening up of new front in their functioning, the domain of responsibilities has widened. The work place demands professionalism while family maintains age old stands. Besides, harassment, discrimination, mental agony, job stress is some of the added features in the functioning of professional women. The career goals,

aspirations for higher position, self-development are needed to be weighted with discharging multifarious duties towards family and work. This has landed professional women in a peculiar situation with the time scale.

Multitasking women and stress:

Women are multitaskers as they need to stick to the dual challenges at home and work. They have and continue to display the vibrant part of their character of being multidimensional skilled.

From the socialization perspective, in many societies women are taught to be caregivers and collaborators placing a greater emphasis on relationships. They thereby tend toward the lower right hand quadrant making concessions on the substance for the sake of the relationships. This is what is found by Linda Babcock in her studies in Reddy (2011).

In one-off negotiations, women may win in certain situations at the expense of their relationships, but by doing this their willingness; ability to produce good results over times erodes and hence find themselves in situation where they generate terrible results at work and terrible relationships (Reddy M., 2011).

A Study at Deutsch bank, according to the internal research revealed that female managing directors who left the firm to work for competitors were doing so not to improve their work life balance but as they were offered bigger jobs externally, when they weren't considered internally (Lbarra,

nancy, & silvia, 2010). Women don't go for negotiating their salary as it could result in negative social consequences, which for women, tend to be about as important as the material benefit at stake, according to Linda Babcock, a professor of economics at Carnegie Mellon University in Reddy (2011). Women lose as much as 42 million over the course of their careers by not negotiating that initial salary. "Women worry about social consequences of their asking" said Babcock in an interview with INSEAD knowledge.

Sources of stress in the lives of working women emerged from a lack of time to attend to multiple roles, presence of children (6-12 years) in the family and added responsibility at work in the form of promotions. (Surti & Sarupriya, 1983; Shukla & Varma, 1996; Khanna, 1992). Boles & Babin (1996) indicated that Work Family Conflict is related to a number of negative job attitudes and consequences including lower overall job satisfaction and greater inclination to leave a position (Grovalynn et al. 1988) (Grovalynn, 1988)

Other problem faced by employed women are those associated with finding tolerable, easy on the pocket access to child and elderly care (Reskin & Ross, 1992). These roles tend to drain them and cause stress or inter-role conflict. (Marks, 1977; Aryee, 1992). (Aryee, 992) (Marks, 1977)

Multiple roles and its Impact:

Super (1980) identified some life roles that in reality, most individuals have

to play at various stages of their lives but rather than following a transitional sequence from one role to another, women are required to perform an accumulation of disparate roles, each with its unique pressures. (Kopp & Ruzicka, 1993). Kopp & Ruzicka (1993) articulated that women discharging two or three responsibilities as a partner, mother and paid employee were happier than those occupying one or none. Baruch & Barnett (1986) found that women need to play multiple roles of mother, wife, employee etc. and were less depressed and had high self esteem than women who were not married, unemployed or childless. Further they established positive association between multiple roles and good mental health (when a woman like her job and home life). Radhika & Jaiprakash (1987) in Henry & Parthasarathy (2010) found that dual-earning couples in India have a poorer quality of marital life compared to single-earning couples.

Contrary to such achievement as complemented by the studies both home and abroad (Ruff, 1995) (Buddhapriya, 2009) confirmed that professional women are pressurized by the various aspects of their roles as compared to their male counterparts. Besides they became victims of discriminations at workplace which often led them to quit their present assignment. The gravity of the situation may be seen from the fact that there is a steep rise in women attrition rate in India (48%) compared to the Asia Regional (29%) (Inderfurth & Khambatta, 2010).

Studies in abroad and India revealed some facts with regard to the physical and mental health and wellness of a women employee. Due to fact of women attending multiple roles, women faced physical and mental ailments (Marks,1977&Aryee,1992) ,which resulted in depression (Khanna, 1992) insomnia(Hughes and Glinsky), anxiety(Khanna, 1992) asthma (Khanna, 1992) loss of appetite (Hughes & Galinsky, 1994)colitis(Khanna, 1992) ,overindulgence and back pain (Hughes & Galinsky, 1994) On the other hand, Baruch & Barnet (1986) and Doress-Worters (1994) revealed the fact that women with multiple roles reported better physical and psychological health

(i)Work family variance

An employee is essentially connected and engrossed with her job. This is required to compensate as and when the employee can over the weekend or on days or late nights when she does not need to be busy with her paid occupation. It is expected that she should give time to herself and her family. Work-life balance is the preservation of a balance between errands at work and at home. Work and family have increasingly become hostile spheres, equally voracious of energy and time and responsible for work-family conflict (Coser, 1974). These conflicts are intensified by the "cultural contradictions of motherhood", as women are gradually more encouraged to seek self-fulfillment in demanding careers; they also face pressures to forfeit

their aspirations for their children. In view of "intensive parenting", childrearing and their development (Hays, 1996), "Maternal wall bias" (Williams and Cuddy) have aptly described the relation to discrimination is a name given to the type of discrimination on the subset of employees who belong to the cadre of caregivers or working mothers. The study revealed that the chances of working mothers of being hired have reduced by 79% and a woman is 50% as likely to be promoted as a childless woman. (Williams & Cuddy, Sept 2012). Recent research (Benard, Paik, & Corell, 2006) (Erin Cech, 2012) shows that even when women sustain their professional ambitions, motherhood often triggers strong and unconcealed workplace bias, as they are less likely to be interviewed, hired (Correll, Stephen, Paik in HBR, 2012), promoted and also appraised less positively giving her less pay. (Williams & Cuddy, Sept 2012)

Similarly Amy Cudddy, Fiske and Peter Glick in (HBR, 2012), found that a women candidate had a child was judged to be less efficient to become a consultant and the hiring chances reduced significantly. Interestingly those mothers who left their job assign the reason that they would like to devote more time to their family concealing the fact of hostile workplace environment. This is considered as a bad news for the companies as the real reason for the employee leaving the job would never be highlighted as even in the feedback in exit interviews, they sustain the same reason of family

priority, in order to remain employable (Williams & Cuddy, Sept 2012). Moreover, Companies have started paying for their biases against working mothers who sue them for being discriminated at workplace. "Maternal wall" discrimination is one element of the largest class action suit ever filed in United States, *Dukes v. Wal-Mart*, and *Velz v. Novartis Pharmaceuticals*, a case that merged maternal wall bias and other gender discrimination issues, where the jury awarded the plaintiffs approximately \$250 million. Further, "Maternal Wall bias" engrosses discrimination by women against women. *National Computer System*, a jury awarded \$625,000 to a top performing saleswoman, who faced hostility after she had a baby. The women supervisor may have felt she had something to prove in a way no male supervisor would have done. (Williams & Cuddy, Sept 2012) . Studies reveal that most private sector employers are stingy with maternity leave: most companies offer as little as three months' worth of paid leave as maternity benefits (Mothers at work, 2012). Wipro has increased the maternity leave from six months to one year. All the top IT companies are today offering work-from-home policies for women, and some even are open to relocate them to a city of their choice if their husbands get transferred. (Singh & Singh, 2009). Further, some large companies have unwritten reservations about hiring women, in anticipation of maternity benefits that they would have to shell out. Moreover, the unorganized sector,

of course, offers no benefits apart from daily wages. (Mothers at work. , 2012). These perhaps, compelled 50 percent women among India's 500 largest companies give up their careers before they turn 30. Boles & Babin (1996) that indicated that Work Family Conflict is related to a number of negative job attitudes and consequences including lower overall job satisfaction and greater inclination to leave a (Grovalynn et al. 1988).

(ii) Career growth:

Career is the course or progress of a person, which may be a distinct portion of his/her life. (Oxford English Dictionary). Career is the evolving progression of a person's work experiences over time. Here work can mean for the ways in which people around, organization and societies are seen and experienced (Arthur, Douglas, & Lawrence, 1989). Career reflects the relationship between people and the providers of official position namely institutions and organizations and how these relationships fluctuate over time. Van Maanen (1977) said studying of career needs the study of both individual, organizational and societal change.

Women are being discriminated in the business world especially when it comes to evaluation of leadership skills (Ibarra & Obodaru, 2009). A study of thousands of 360-degree assessments collected by Instead's executive programs over last five years depicted that women have outshone men in most of the leadership aspects except in envisioning- the talent to identify

new opportunities and trends in the environment and give the organization a new direction.

This issue was further explored with successful female executives, which raised to another question which asked if the reputation of being a visionary really acclaimed by the women professionals? When a CEO of a leading service company was questioned with regard to this issue, she declared the pillar of her leadership style was a to “stay close to details”, or else it would lead her to be captivated to people who would play politics.

The answer ‘how to lengthen the career for women’, 10 career enablers were identified, where women were interviewed for the study highlighted top 3 enablers- flexible working arrangement, mentoring and sponsorships and skill building initiatives. These could make a difference between women staying or leaving the organization.

Studies in abroad (Ibarra, carter, & silva, sept 2010) reveal that Organizations are trying to find ways to retain their female talents by providing mentoring and women specific programs. Although women are mentored they are not promoted. A Catalyst study of more than 4,000 high potentials shows, in spite of women getting more mentorship than men, still promotions in case of women are lesser than men (men get 15% more promotions than women (Ibarra, carter, & silva, sept 2010) as women are perceived as “Risky Appointments” for roles which are generally male

dominated. Further, studies (HBR Jan-Feb 2010) in (Ibarra, carter, & silva, sept 2010) revealed the fact that women are less likely to win the CEO tournaments in their own firms in spite of the fact that nearly twice women are hired than the males from outside the organization. Studies in India depict almost the same scenario with a little adverse color where percentage of women directors has increased from 1.66%(1995) to 3.63%(2007), which is much lower to any advanced countries like Canada(15%), USA(14.5%), UK(12.2%), Hong Kong(8.9%), Australia(8.3%) .Again when compared to men directors, which was almost constant with 1.19% (from 1995-2007); percentage of women directorship has increased from 1.045 (1995) to 1.34%(2007). (Chandrashekhar & muralidharan). There are some IT companies Like GE , Accenture who are coming up with some strategies of attracting and retaining women employees. Accenture's had introduced a new global theme "defining success your-way". Accenture has created a unique program to support their women employees by introducing women's mentoring programs –which pairs female executives with senior executive mentors and also include virtual workshop and provide networking tips to help ensure the advancements of women at Accenture. Likewise GE has several global affinity networks that help made the workplace conducive for growth and development of diverse talent. At GE India, the most important affinity network is the women's network which includes-a) Career

Development b) Women's Initiative on learning c) Business innovation d) Attracting talent through re-start. e) New mother's program f) gender sensitizing training. (Jagannatha, 2012)

Professional Women and changing environment:

Professional Women in varying environment are sufficiently meeting the demands arising from workplace, society etc. Overall development includes the health, work dynamics where in the compensation strategy, promotional techniques, career growth opportunities such as sponsorships may be importantly noticed. In a study of top-performing CEOs, for instance, the women were nearly twice as likely as the men to have been hired from outside the company. (Lbarra, nancy, & silvia, 2010) .Lbarra et al (2010) articulated in the finding that women are less likely to come out as winners in their firms own CEO tournament. Catalyst survey(2008) of more than 4,000 full time employed men and women-high potentials who graduated from top MBA programs worldwide from 1996-2007—shows that the women are paid \$4,600 less in their first post MBA-jobs, occupy lower-level management positions and have significantly less career satisfaction than their male counterparts with the same education, when we take into account factors like-their industry ,prior work experience, aspirations and whether they have children. (Lbarra, nancy, & silvia, 2010).2008 Catalyst follow up Survey in 2010 reveals that the men have recieved 15% more promotions

than women. The two groups (men and women) have similar number of lateral moves(same-level job assignments in different functions, designed to give high potentials exposure to various parts of business).But men were receiving promotions after lateral moves; for the women, the move were offered in lieu of advancements. Absurdly ,just when women are most likely to need sponsorships—as they shoot for the highest level jobs—they may be least likely to get it. Women are still perceived as '*risky*' appointments for such roles. (Lbarra, nancy, & silvia, 2010).According to Kumar(2012) , in Economic Times said that attitude also shapes the extent of success .It is also said that imaginative and creative mind creates a fascinating balance for one can see and create possibilities and harmony in evey area of her life.Sources of stress in the lives of working women emerged from a lack of time to attend to multiple roles, presence of children (6-12 years) in the family and added responsibility at work in the form of promotions. (Surti & Sarupriya, 1983;Shukla & Varma, 1996; Khanna, 1992).

The most common outcome of stress for the working woman was found to be poor mental and physical health resulting in depression, anxiety, asthma and colitis. (Khanna, 1992).Business culture ensure overall development of Women Employees

Conclusion:

The changing roles of women in society have had a profound impact on

various aspects of their lives, including health, careers, and family dynamics. As women have increasingly entered the workforce and pursued diverse careers, their economic independence and opportunities for professional growth have expanded. This has not only improved their financial well-being but also enhanced their self-esteem and sense of empowerment. However, these shifts have also presented challenges, including the delicate balance between work and family responsibilities, potentially impacting their mental and physical health. The evolving roles of women have led to greater awareness of the importance of self-care and work-life balance. Additionally, changes in family structures and expectations have influenced women's choices regarding marriage, motherhood, and caregiving. In sum, as women's roles continue to evolve, society must support policies and practices that ensure their health, career advancement, and family well-being are mutually enriching rather than conflicting aspects of their lives.

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CHAPTER 54

PHARMACOLOGICAL ACTIVITY AND MEDICINAL USES OF *ADHATODA VASICA*

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ABSTRACT

The present survey of this plant reveals that *Adhatoda vasica* Nees belonging to family Acanthaceae, commonly known as Adosa, is found many regions of India and throughout the world, with a multitude of uses in traditional Ayurveda. Vasica is most well-known for its effectiveness in treating respiratory conditions. The fresh leaves of Vasica are chewed, sometimes with ginger, by yogis, or sadhus, because of their stimulant effect on the respiratory system. Vasica is an antispasmodic and expectorant, and has been used for centuries with much success to treat asthma, chronic bronchitis, and other respiratory conditions. Larger trials are required to prove it's all activities before it is recommended in future for clinical use,

but it carries a great potential to be developed as a drug by the pharmaceutical industry. In this paper general medicinal uses and pharmacological activities of various parts of the plants have been revived.

Keywords: *Adhatoda vasica*, Adosa, Antispasmodic, Vasicine, Expectorant, Abortifacient and Anti- tubercular activity.

1. Introduction

Adhatoda vasica Nees belonging to family Acanthaceae, commonly known as Adosa, is a small,

evergreen shrub found many regions of India and throughout the world, with a multitude of uses in traditional Ayurveda. Vasica is most well-known for its effectiveness in treating respiratory conditions. The leaves of Vasica are shows stimulant effect on the respiratory system. Vasica shows an antispasmodic and expectorant effect, and has been used for centuries with much success to treat asthma, chronic bronchitis, and other respiratory conditions. The powdered of herb, boiled with sesame oil, is used to heal ear infections and arrest bleeding. Boiled leaves are used to treat rheumatic pain, and to relieve the pain of urinary tract infections. It is also believed to have abortifacient properties. It is used in some parts of India to stimulate uterine contractions, thus speeding childbirth [1].

2. Vernacular names

Hindi : Adosa, adalsa, vasaka

Sanskrit : Amalaka, bashika,

Bengali : Basak

Tamil : Adatodai

Marathi : Vasuka

Telugu : Adasaram

Malayalum : Ata-lotakam

3. Plant Description

Adhatoda vasica Nees. belongs to the medicinal family Acanthaceae. It is an evergreen shrub of 1-3 feet in height with many long opposite branches. Leaves are large and lance-shaped. Stem herbaceous above and woody below. Leaves opposite and exstipulate. Flower spikes or panicles, small irregular zygomorphic, bisexual, and hypogynous [2]. It has capsular four seeded fruits. The flowers are either white or purple in colour. Its trade name Vasaka is based on Sanskrit name [3]. Inflorescences in axillary spicate cymes, densely flowered; peduncles short; bracts broadly ovate, foliaceous. The leaves, flowers, fruit and roots are extensively used for treating cold cough, whooping cough, chronic bronchitis and asthma, as sedative, expectorant and antispasmodic [4].



1



2



3

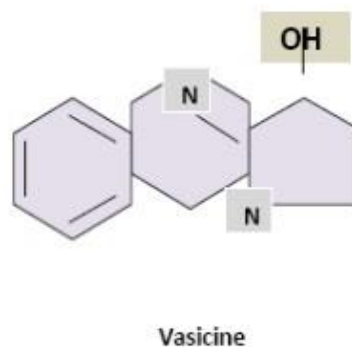
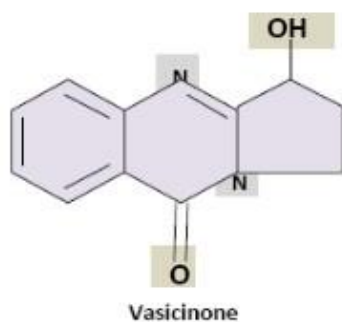
Fig 1: Whole plant

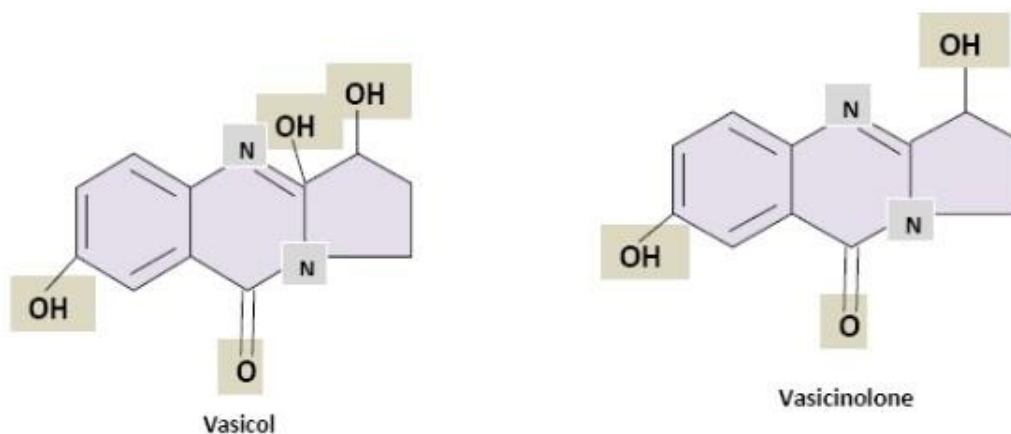
2-Fresh leaves

3- Dried leaves

4. Phytochemistry

The vast variety of pharmacological uses of Adhatoda is believed to be the result of its rich concentration of alkaloids [5, 6]. The prominent alkaloid found in Adhatoda leaves is the quinazoline alkaloid known as vasicine [7]. In addition to vasicine, the leaves and roots of Adhatoda contain the alkaloids l-vasicinone, deoxyvasicine, maiontone, vasicinolone and vasicinol [8]. Research indicates that these chemicals are responsible for Adhatoda's bronchodilatory effect [9, 10].





5.

Pharmacological Activity

5.1 Anti-asthmatic and bronchodilator activity

Adhatoda has been used in traditional medicine to treat respiratory disorders. Both vasicine and vasicinone the primary alkaloid constituents of Adhatoda are well established as therapeutical respiratory agents [11]. Extracts of Adhatoda's leaves and roots are useful in treating bronchitis, and other lung and bronchiole disorders, as well as common coughs and colds. A decoction of the leaves of Adhatoda has a soothing effect on irritation in the throat, and acts as an expectorant to loosen phlegm in the respiratory passages. To evaluate the antitussive activities of Adhatoda extract in anesthetized guinea pigs and rabbits and in unanesthetized guinea pigs showed the plant to have a good antitussive activity [12]. Recent investigations using vasicine showed bronchodilatory activity both *in vitro* and *in vivo* [13].

5.2 Wound healing activity

For the purposes of the study, wounds were created along the vertebral columns of buffalo calves, and alcoholic and chloroform extracts of *Adhatoda* in a powdered form were applied. As compared to control animals, the calves treated with *Adhatoda vasica* showed significantly improved healing. *Vasica* improved breaking strength, tensile strength, absorption and extensibility in the wound repair tissue. In addition, the levels of elastin, collagen, hydroxyproline, hexosamine and zinc were greatly increased in the animals treated with *Adhatoda*. The alcoholic extract of the herb was found to be the most effective [14].

5.3 Anti-ulcer activity

Adhatoda vasica was studied for its anti-ulcerogenic activity against ulcers induced by ethanol, pylorus, and aspirin. *Adhatoda* leaf powder showed a considerable degree of anti-ulcer activity in experimental rats when compared with controls. The highest degree of activity was observed in the ethanol-induced ulceration model [15]. These results suggest that in addition to its classically established pharmacological activities, *Adhatoda vasica* has immense potential as an anti-ulcer agent. Further research showed that a syrup of *Adhatoda* improved symptoms of dyspepsia [16].

5.4 Cholagogue activity

In laboratory experiments on cats and dogs, *Adhatoda vasica* was found to increase bile activity when the animals were given an intravenous dose of 5 mg/kg. In dogs, the amount of excreted bile increased by 40-100%. The animals also showed an increase in bilirubin excretion [17].

5.5 Anti-allergy activity

The extract containing the alkaloid vascinol and 20% vasicine inhibited ovalbumin-induced allergic reactions by about 37% at a concentration of 5 mg [18]. Vasicinone has been shown to be a potent anti-allergen in tests on mice, rats and guinea pigs [19].

5.6 Anti-tubercular activity

A chemical constituent of *Adhatoda* alkaloids, vasicine, produces bromhexine and ambroxol – two widely-used mucolytics. Both of these chemicals have a pH-dependent growth inhibitory effect on *Mycobacterium tuberculosis*. Indirect effects of *Adhatoda* on tuberculosis include increased lysozyme and rifampicin levels in bronchial secretions, lung tissue and sputum, suggesting that it may play an important adjunctive role in the treatment of tuberculosis [20, 21].

5.7 Abortifacient and uterotonic activity

Adhatoda vasica has abortifacient and uterotonic properties, making it useful for inducing abortion and for stimulating uterine contractions in order to speed childbirth [22]. Studies on human subjects have shown

that the alkaloid vasicine has significant uterotonic activity. This action appears to be influenced by the presence or absence of certain estrogens. In research on the activity of vasicine in stimulating uterine contractions, human myometrial strips taken from the uterus of both pregnant and non-pregnant women were treated with *Adhatoda*. The herb was found to induce uterine contractions, with effectiveness similar to the drug oxytocin [23]. During the research period, the anti-reproductive properties of *Adhatoda vasica* were anecdotally confirmed by local women [24]. Animal studies have also demonstrated *vasica*'s abortifacient properties. Aqueous or 90% ethanol plant extracts were given orally to test rats and guinea pigs for 10 days after insemination. Leaf extracts of *Adhatoda vasica* were 100% abortive at doses equivalent to 175 mg/kg [25]. *Adhatoda vasica* was also shown to have an abortifacient effect on guinea pigs, with effectiveness varying depending on the stage of pregnancy. The effects were more marked when estrogens were used as a priming influence, indicating that the actions of vasicine was probably mediated via the release of prostogladins [26].

5.8 Insecticidal activity

Adhatoda vasica has been used for centuries in India as an insecticide. Its leaves have been shown to control insect pests in oil seeds, in both laboratory and warehouse conditions [27]. Research has shown

Adhatoda's alkaloid, vasicinol, to have an antifertility effect against several insect species by causing blockage of the oviduct. Research has also proven Adhatoda's effectiveness as an insect repellent [28].

5.9 Anti-bacterial activity

A leaf extract was investigated for antibacterial activity using the paper disc and dilution methods. *In-vitro* screening showed a strong activity of Adhatoda's alkaloids against the bacteria *Pseudomonas aeruginosa*. Significant antibacterial activity against the Gram-positive bacteria strains *Streptococcus faecalis*, *Staphylococcus aureus*, *Staph epidermidis* and the gram-negative *E. coli* were also noted [29].

6. Conclusion

Adhatoda vasica possesses numerous biological activities proved by many experimental studies. It represents a class of herbal drug with very strong conceptual or traditional base as well as a strong experimental base for its use. Thus, this plant has great potential to be developed as drug pharmaceutical industries, but before recommending it for clinical use in these conditions, there is a need to conduct clinical use in these conditions, there is a need to conduct clinical trials and prove its clinical utility.

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CHAPTER 55

ENZYMATIC APPROACHES AND ITS APPLICATIONS

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ABSTRACT

Numerous enzymes have been widely used in biotechnology, pharmaceutical and industrial processes. As biocatalysts are able to accelerate the reaction and keen to make certain enzymes applicable in academic, industrial and commercial fields, which has resulted in rapid progress of enzyme engineering in recent years. Biocatalysis has evolved

more and more into a broadly applicable tool for chemical synthesis and manufacturing as documented in many books.

KEYWORDS: Biotechnology, Pharmaceutical, Enzyme engineering, Biocatalysis.

INTRODUCTION:

Enzyme catalysis has been scaled up for commercial processes in the pharmaceutical, food and beverage industries, although further enhancements in stability and biocatalyst functionality are required for optimal biocatalytic processes in the energy sector for biofuel production and in natural gas conversion. Enzymes are generally made of protein molecules except ribozymes. Enzyme molecules are highly specific to the substrates and convert them into products. They are active only in certain range of temperature and pH. The word enzyme was first coined by a German Scientist Wilhelm Kuhne in the year 1878. Application of enzymes in the process of food processing is a very old practice, which has been used by our ancestors and these include a very simple process. Enzymes are used by the food industries for processing raw materials for the production of numerous and common products such as bakery products, dairy products, meat products, fruit products, beer and wine. Enzymes are broadly used in the production of alcoholic beverages and certain food products.

Food processing industries:

Application of enzymes in the process of food processing is a very old practice, which has been used by our ancestors and these include a very simple process. Enzymes are used by the food industries for processing raw materials for the production of numerous and common products such as bakery products, dairy products, meat products, fruit products, beer and wine. Enzymes are broadly used in the production of alcoholic beverages and certain food products. In the alcohol industry, the use of enzymes for the production of fermentable sugars from starch is also well established. Over the past decade, there has been an increasing interest in fuel alcohol as a result of increased environmental concern, higher crude oil prices and, more acutely, by the ban in certain regions of the gasoline additive methyl *tert*-butyl ether (MTBE), which can be interchanged directly with ethanol

Other than the production, these enzymes are also used in improving the quality of food products, such as improving the quality of the food, taste, flavour, colour, etc. The applications of enzymes include:

1. Addition of α -Amylase and glucoamylase for improving the quality of the food.

2. Addition of peroxidase for the colour and nutritional quality of the food.
3. Addition of lipase, xylanase and glucose oxidase for the improvement of the flavour.

In the modern world through biotechnology enzymes used in the food industry are extracted directly from the plants and animal sources and are also obtained by microbial fermentation.

Enzymes are highly efficient biocatalysts researched for industrial-scale catalysis because of their several distinct advantages that range from their operation in milder reaction conditions, to their exceptional product selectivity, and to their lower environmental and physiological toxicity (Choi *et.al*, 2015)

The pharmaceutical, food and beverage, detergent, and biofuel industries have reaped the advantages of enzyme catalysis in commercial-scale applications, while other industries, such as natural gas conversion and fine chemical production, are only recently considering their use in industrial-scale chemical production, the benefits of biocatalysis are often multifaceted, and as such, enzymes are attractive catalysts owing to mild reaction conditions, high product selectivity, and low environmental impact, and thus have been employed for both simplified chemical synthesis routes and improved chemical process economics (Bommarius, A.S.; Paye, M.F, 2013).

The detergent industry:

Their use as detergent additives still represents the largest application of industrial enzymes, both in terms of volume and value. The major component is proteases, but other and very different hydrolases are introduced to provide various benefits, such as the efficient removal of specific stains. Enzymes allows detergents to effectively clean clothes and remove strains. They remove certain stains, such as made by grass and sweat. Constantly, new and improved engineered versions of the 'traditional' detergent enzymes, proteases and amylases, are developed. These new second- and third-generation enzymes are optimized.

Without Enzymes, a lot of energy would be required to create high temperatures and vigorous needed to clean cloths effectively. Alkaline proteases—which are effective in the removal of protein stains and the cleaving of damaged cotton fibers—isolated from microbial sources comprise significant portions of multiple detergents produced and sold at commercial scale by manufacturers like Novozymes SA, Kao Corporation, and GenecorInternational (Kumar, D, 2008).

Industrial applications of enzyme catalysis

S.No	Sector	Enzymes	Applications
1.	Pharmaceuticals	Nitrile hydratase, transaminase,	Synthesis of intermediates for

		monoamine oxidase, lipase, penicillin acylase	production of active pharmaceutical ingredients
2.	Food Processing	Trypsin, amylase, glucose isomerase, papain, pectinase	Conversion of starch to glucose, production of high fructose corn syrup, production of prebiotics, debittering of fruit juice
3.	Detergent	Protease, lipase, amylase, cellulase	Stain removal, removal of fats and oils, color retention
4.	Biofuels	Lipase, cellulase, xylanase	Production of fatty acid methyl esters, decomposition of lignocellulotic material for bioethanol production
5.	Paper and Pulp	Lipase, cellulase, xylanase	Removal of lignin for improved bleaching, improvement in fiber properties

Textile Industry:

In the textile industry a completely new enzymatic activity has recently been introduced. This industry is under considerable environmental pressure owing to its large energy and water consumption and subsequent environmental pollution. One of the most energy- and water-consuming steps in the processing of cotton is the scouring step, the removal of various remaining cell-wall components on the cellulose fibers performed at high temperature and under strong alkaline conditions.

Pharmaceuticals Industry:

Enzyme catalysis has been successfully used for the production of pharmaceutically active chemicals at the industrial scale. The most significant advantages enzyme catalysis holds over conventional catalysis are the high regio-, chemo-, and stereoselectivities at which enzymes convert substrate to product. Chemical conversion of cellulose to glucose requires the use of diluted acids and high temperatures, which implies high energy inputs to result in the generation of a significant amount of unwanted by products. The enzymatic conversion of starch to high fructose corn syrup is a well-established process and provides a beautiful example of

a bioprocess in which the consecutive use of several enzymes is necessary. The enzymes utilized in the starch industry are also subjected to constant improvements.

A more ideal approach is the use of cellulase, i.e., a mixture of hydrolytic enzymes that act synergistically in the conversion of cellulosic material, for the selective enzymatic hydrolysis of cellulose to glucose, which requires longer reaction time but leads to improved yield from the subsequent fermentation due to a low generation of unwanted byproduct (Yue, F, 2009). The economically viable scale-up of cellulase-catalyzed cellulose conversion to glucose for bioethanol production is limited by poor biocatalyst recovery, slow enzyme-catalyzed reaction rates, and low biocatalyst stability under industrial operation conditions (Khorshidi, K.J,2016).

Many pharmaceuticals requires the introduction and subsequent removal of protecting groups from pharmaceutically active ingredient intermediates to ensure adequate product selectivity. The use of appropriate enzymes not only obviates such steps, but has also been shown to yield higher enantiomeric excesses of desired stereoisomers (Huisman, G.W.; Collier, S.J ,2013). Sitagliptin is a dipeptidyl peptidase-4 inhibitor that prevents an increase in the blood-retinal barrier and inhibits diabetes-induced tight junction disassembly (Savile, C.K, 2010).

Enzymes for the feed industry:

The use of enzymes as feed additives is also well established. For example, xylanases and β -glucanases have been used throughout the past decade in cereal-based feed for monogastric animals which, contrary to ruminants, are unable to fully degrade and utilize plant-based feeds containing high amounts of cellulose and hemicellulose.

Enzymes for organic synthesis:

Chemical synthesis is an area where the use of enzyme catalysis has long been seen as having great promise. Even so, the chemical industry has been slow to implement enzyme-based processes and the use of enzymes in the chemical industry is still low compared with other industries. At present, however, we are seeing very significant growth in this area and enzyme-based processes are now, finally, being widely introduced for the production of a diversity of different chemicals.

CONCLUSIONS AND PERSPECTIVES:

As outlined above, enzymes are currently used in several different industrial products and processes and new areas of application are constantly being added. Thanks to advances in modern biotechnology, enzymes can be developed today for processes where no one would have expected an enzyme to be applicable just a decade ago. Commercial-scale enzyme catalysis has been implemented in several industries such as pharmaceutical and foods

with recent trends for biofuel production and natural gas conversion. Product yield in such industries was shown to be governed by enzymatic catalysis being implemented in milder process conditions and under less energy consumption, with reduced waste generation, exceptional high product selectivity to result in improvements in process economics and environmental sustainability. Future implementation prospects will need to account for the structure-function relationship both at the level of the enzyme and optimized product yield at low implementation costs and with conjunction of experimental and computational approaches for an integrated combinatorial strategy.

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Proceedings of National Seminar on **CONVERSION OF RESEARCH INTO PATENT**

*NAAC Sponsored Two - Day National Seminar
24th & 25th April, 2023*



Editor
Dr. M. Sridevi

Organized by:

**Internal Quality Assurance Cell (IQAC)
S.K.S.D. Mahila Kalasala Degree & PG (A)
(Re-Accredited by NAAC with "B++" Grade)
TANUKU, W.G. Dist., Andhra Pradesh**

Seminar Proceedings of NAAC Sponsored Two Day National Seminar *(In Collaboration with SBI, Tanuku)*



Edited By

Dr. M. Sridevi



Internal Quality Assurance Cell (IQAC)

S.K.S.D. Mahila Kalasala (UG & PG) (A)

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Sri. Karuturi Ramakrishna

M.Sc, M.Phil, M.Li.Sc.

Principal & Seminar Chairperson

Message

I extend a warm and hearty welcome to all the participants and guests to the NAAC sponsored twoday National Seminar on **“Conversion of research into patent”** organized by Internal Quality Assurance Cell (IQAC).

Smt. Kondepoti Sarojini Devi Mahila Kalasala was established in the year 1982 by Sri Venkata Krishna Educational Society.

The college is located in these serene outskirts of the Tanuku town sprawling across 8.2 acres incomplete greenery and pollution free environment. Tanuku town is one of the important educational, industrial and cultural hubs of West Godavari district of Andhra Pradesh. The college is a landmark in the map of Tanuku. The Founder of the college, Sri Chitturi Subba Rao established the college in the memory of his beloved sister with the vision of “Women Empowerment with Value Based Education”. The college has successfully completed 40 glorious years in its long voyage from the seedling stage to the banyan stage where there have been many milestones reached. The accreditation by NAAC at B++ grade is a testimony to the best performance of the college. Today’s seminar by IQAC is one of such attempts.

A Knowledgeable society sustains and grows from good to better and from better to best only through sharing of information.

iv » ...

I hope that National Seminar on “Conversion of Research into Patent” being organized by Internal Quality Assurance Cell (IQAC). of our college provide a platform for the students, scholars and teachers to exchange their experiences and the outcome which creates awareness to the challenges being faced by all in day-to-day life.

I hope that by the end of these min are achand every participant would find himself / her self at a different level of understanding and there by making the seminara success.

Sri. Karuturi Ramakrishna



Prof. Kolla Siva Rama Krishna

Former Vice Chancellor

Gitam University, Visakhapatnam

Message

It gives me immense pleasure to note that the IQAC of S.K.S.D. Mahila Kalasala, Tanuku, has proposed to organize a NAAC sponsored two day National Seminar on **“Conversion of Research into patent” on 24th & 25th April, 2023**. This conference will provide excellent academic forum for faculty, researchscholars and experts from various Institutions to showcase the emerging issues.

My best wishes to the organizers, participants and faculty Members of the institution. I wish these minar a grand success.

Prof. Kolla Siva Rama Krishna



Prof. K. Sri Ramesh

Dean, CDC

Adikavi Nannaya University

Rajamahendravaram

Message

I am very happy to note that a NAAC sponsored two day National Seminar on “ **Conversion of Research into Patent** ”is being organized by the Internal Quality Assurance Cell (IQAC) S.K.S.D. Mahila Kalasala, UG PG(A) on 24th –25th April 2023 at Tanuku .

The Conference creates a platform for scientists, faculty, research scholars and experts from industry to share their ideas of finding

My best wishes to the organizers, participants and faculty Members of the institution for successful completion of this seminar

Prof.K. Sri Ramesh



Dr. B. Jagan Mohan Reddy

Associate Professor

Adikavi Nannaya University

Rajamahendravaram

Message

It gives me immense pleasure to note that the IQAC of S.K.S.D. Mahila Kalasala, Tanuku, has proposed to organize a NAAC sponsored two day National Seminar on **“Conversion of Research into patent” on 24th & 25th April, 2023**. This conference will provide excellent academic forum for faculty, researchscholars and experts from various Institutions to showcase the emerging issues.

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Dr. B. Jagan Mohan Reddy

Prof. S. Krishnam Raju

RTD. Principal

NAAC Member

Message

It gives me immense pleasure to note that the IQAC of S.K.S.D. Mahila Kalasala, Tanuku, has proposed to organize a NAAC sponsored two day National Seminar on "Conversion of Research into patent" on 24th & 25th April, 2023. This conference will provide excellent academic forum for faculty, research scholars and experts from various Institutions to showcase the emerging issues.

My best wishes to the organizers, participants and faculty Members of the institution. I wish these seminar a grand success.

Prof. S. Krishnam Raju



Smt. Chitturi Satya Usha Rani

Secretary & Correspondent

S.K.S.D. Group of Colleges

Message

I am immensely pleased to note that Internal Quality Assurance Cell (IQAC) is organizing a NAAC Sponsored two day National Seminar focusing the theme **“Conversion of Research into Patent”** on **24th & 25th April, 2023**. The present seminar is a timely gesture and provides an academic forum for meaningful discussions and spread. I congratulate the convener of the seminar, faculty and the principal for their academic endeavor. I wish these seminar a grand success with a hope that the deliberations and the seminar will definitely enlighten.

Chitturi Satya Usha Rani



Dr. D. Subba Rao

Administrative Officer

S.K.S.D. Mahila Kalasala, Tanuku

Message

I congratulate the IQAC of S.K.S.D. Mahila Kalasala, Tanuku, for organizing a National Seminar on **“Conversion of Research into Patent”** on 24th & 25th April, 2023.

My best wishes to the organizers, participants and faculty Members of the Institution. I wish these minar a grand success.

Dr. D. Subba Rao

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1

Conversion of Research into Patent

G. Amruthavalli Tayaru & Lt. U. Lakshmi **

Can a research article be patented once something a made public (discussed presented or published). It is considered State of the art and is no longer novel. Therefore, it cannot be protected or patented.

One of the main functions of the patent system is to booster, technological innovation by providing an incentive for research and development. The patent system not only in Technology, but also in Litarary, and cultural aspects.

The Patent process in research Methodology is

- 1) A Patentability opinion
- 2) Preparation and filling of the patent application
- 3) Prosecution of the patent application
- 4) Issuance, abandonment, or appeal of the patent application
- 5) Maintenance fees

Types of Patents

There are three types of patents

- 1) Utility
- 2) Design and

* Department of Sanskrit, S.K.S.D. Mahila Kalasala UG & PG(A), Tanuku

2 » ...

3) Plant

The difference between research and patent is, Patent gives an authority to sell the product where as paper gives idea of the work to others to do further research.

A good patented product can be commercialized and gives value over and above a Paper. Research paper is a discussion over your work done. How we know the research is patentable.

1. **Novel** – Unique and new never made public before the date of the filed application.
2. **Useful**- Identifiable benefit
3. **Non-obvious**- To some are working within that filed.

The researches, investors and entrepreneurs are those Identify a problem and work out a solution for the explicit purpose of teaching others.

PATENT LAWS

The History of Indian patent system was established the act VI of 1856 on protection of inventions based on the British Patent Law of 1852.

In 1859 the act modified as act XV Patent monopolies called exclusive privileges, Making selling and using inventions in India and authorizing others to do so for 14 years from the date of filling application

1872 : The patterns & Designs protection Act

1883 : The protection of Inventions Act

1888 : Consolidated as the inventions & Design Act.

1911 : The Indian Patents & Design Act.

1999 : on March 26, 1999 Patents (Amendment) Act, (1999) came in to force from 01/01/1995.

2002 : 2005 also modified the Act.

The Non- Patent literature is defined as scientific publication, Technical Standards, conference proceedings science manuals, Research Reports or any other literary and Scientific papers.

OBJECTIVES OF PATENT

The objective of a patent is to provide a right to an inventor to exclude other from exploiting the patented. Invention therefore, other than the inventor cannot use, make or sell the patented invention without permission from the inventor. This is often referred to as the exclusive right of the invention.

2

Intellectual Property Rights (IPR) in India

Dr. APV Appa Rao, P Ramakrishna Rao*,
KSV Ranga Rao**, P. Rajeswari*,
M S Ranganayakulu*, V Durga Sandhya* & A Rajesh**

ABSTRACT

Intellectual property (IP) is a term referring to a brand, invention, design or other kind of creation, which a person or business has legal rights over. Intellectual Property Right (IPR) is exclusive right is granted by government of India for protection originality of work of inventor. This paper also deals with the history of Intellectual property Rights (IPR), objectives & types of Intellectual property Rights (IPRs). Intellectual property Rights (IPR) provide certain exclusive rights to the inventors or creators of that property, in order to enable them to reap commercial benefits from their creative efforts or reputation. There are several types of intellectual property protection like patent, copyright, trademark, etc. Patent is type of intellectual property that gives its owner the legal right to exclude others from making using, or selling an invention for a limited period of time in exchange for publishing an enabling disclosure of the invention.

Keywords: *Intellectual Property Rights, Patents, Copyright, Geographical Indications.*

INTRODUCTION

* Lecturers in Physics, Sri.Y.N.College (A), Narsapur

** Lecturer in Politics, Sri.Y.N.College (A), Narsapur

Intellectual Property Right (IPR)

Intellectual Property Rights (IPR) is the exclusive rights granted to inventor/creator to use his/her invention/creation for a set time period. Intellectual property (IP) includes novel mind-created works such as inventions, literary works, artistic works symbols, names, images, locations and designs. The different types of IPR are Patents, Copyright, Trademark, Industrial designs and Geographical indications.

OBJECTIVES OF THE STUDY

- Importance of Intellectual Property Rights.
- Overview & History of the Intellectual Property Rights
- Study the various types of Intellectual Property Rights.

HISTORY OF INTELLECTUAL PROPERTY RIGHTS

The basic aim of conferring an Intellectual Property Right upon the person owning the same is to give a social recognition to its holder. This social recognition can further bring economic benefits to its holders. It is just and reasonable to award a person an Intellectual Property Right in the form of “limited monopolistic rights” for his/her labor and efforts. At the same time, exceptions in the form of various licenses are also made so that public interest cannot be compromised. The public interest and personal interests are thus reconciled in the form of limited period duration of these rights and their abuses can be tackled stringently, especially when public interest demands so. Intellectual Property Right is not a new concept. It is believed that Intellectual Property Right initially started in North Italy during the Renaissance era. In 1474, Venice issued a law regulating patents protection that granted an exclusive right for the owner. The copyright dates back to 1440 A.D. when Johannes Gutenberg invented the printing press with replaceable/moveable wooden or metal letters. Late in the 19th century, a number of countries felt the necessity of laying down laws regulating Intellectual Property Right.

TYPES OF INTELLECTUAL PROPERTY RIGHT

- Patents
- Trademarks
- Copyrights and related rights
- Geographical indications

- Industrial designs
- Trade secrets
- Layout design for integrated circuits
- Protection of new plant variety

VARIOUS FORMS OF INTELLECTUAL PROPERTY

- Patents
- Trademarks
- Copyright
- Industrial Designs
- Geographical Indication
- Semiconductor Integrated circuit's layout – Design
- Trade secrets

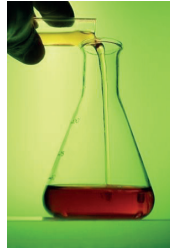
TYPES OF INTELLECTUAL PROPERTY RIGHTS

There are different types of Intellectual property rights in place to best help the individual keep their valuable and unique ideas and use them to their wishes and their choice of places.

a) Patent

Patent is a monopoly right given by the government to an inventor for a period of twenty years. Once granted, a patent gives the inventor the right to exclude others from making, using, selling, importing or offering for a sale of the inventor's invention for the duration specified in the terms of patent. After twenty years the patent falls under public domain there after anyone can use the invention without permission from patentee. Invention can be any new article, composition of matter, machine, process or any new value addition to the above said.

Patents are territorial rights, which means that an invention is only protected in the countries or regions where patent protection has been obtained. In other words, if you have not been granted a patent with effect in a given country, your invention will not be protected in that country enabling anybody else to make , use, import or sell your invention in that country.



Patent right can be shared whenever there are more than one patentees. Patent rights can be

- a) Licensed or sold for a commercial consideration.
- b) A right to initiate legal proceedings against infringement.
- c) The patentee can commercially exploit its potential without fear of copying or imitation without the patentee's permission during the term of patent.

b) Trademark



amazon.co.uk



The term trademark refers to a recognizable insignia, phrase, word, or symbol that denotes a specific product and legally differentiates it from all other products of its kind. A trademark exclusively identifies a product as belonging to a specific company and recognizes the company's ownership of the brand. Trademarks are generally considered a form of intellectual property and may or may not be registered.

Types of Marks

- There are various types of marks namely
- Trademarks (marks used to distinguish certain goods as those produced by a specific enterprise),
- Service marks (Marks used to distinguish certain services as those provided by a specific enterprise),
- Collective marks (marks used to distinguish the goods or services of a person or an association of persons who is the proprietor thereof from those of others.),
- Certification marks (marks used to distinguish the goods or services that comply with a set of standards and have been certified by a certified authority) and

- Well-known marks (marks that are considered to be well-known in the market and as result benefit from stronger protection).

Duration of Trademark

The term of trademark is ten years and it can be renewed life long for every ten years. Trademark can be a word, phrase, logo, symbol, design, image, or a combination of these elements.

c) Copyright

Copyright refers to the legal right of the owner of intellectual property. In simpler terms, copyright is the right to copy. This means that the original creators of products and anyone they give authorization to are the only ones with the exclusive right to reproduce the work.



Copyright is the next type of intellectual property right. It does not protect any ideas or innovations. It covers only tangible forms of creation and original work, such as books, literature, art, etc. The copyright owner gets the exclusive right to sell/publish the work and/or reproduce any literature, music, etc. done by the author, owner, etc.

d) Trade Secret

A trade secret is any practice or process of a company that is generally not known outside of the company. Information considered a trade secret gives the company a competitive advantage over its competitors and is often a product of internal research and development.



A trade secret is a proprietary system, formula, strategy, or any other information which is confidential. It is the reason for the

effectiveness and competitiveness of a business. These are very important as whole survival and competitive edge of company is dependent on secrecy of their trade secret. Some examples of a trade secret are Coca-Cola, Formula one racing teams, etc.

e) Industrial Designs

A design refers to the features of shape, configuration, pattern, ornamentation or composition of lines or colors applied to any article. A design should be new and original. The word “article” refers to any article manufactured and any substance, artificial, or partly artificial and partly natural, and includes any part of an article capable of being made and sold separately. Design office is located at Kolkata.



In principle, the owner of a registered industrial design or of a design patent has the right to prevent third parties from making, selling or importing articles bearing or embodying a design which is a copy, or substantially a copy, of the protected design, when such acts are undertaken for commercial purposes. Industrial designs are applied to a wide variety of products of industry and handicraft items: from packages and containers to furnishing and household goods, from lighting equipment to jewelry, and from electronic devices to textiles. Industrial designs may also be relevant to graphic symbols, graphical user interfaces (GUI), and logos.

f) Geographical Indications

Geographical Indication is an indication which identifies goods as agricultural goods, natural goods or manufactured goods as originating, or manufactured in the territory of country, or a region or locality in that territory, where a given quality, reputation or other characteristic of such goods is essentially attributable to its geographical origin.

In case of manufactured goods one of the activities of either the production or processing or preparation of the goods concerned takes place in such territory, region or locality, as the case may be

- Explanation clarifies that GI need not be a geographical name. Alphonso, Basmati.
- Goods include goods of handicraft or of industry and also foodstuff.



A geographical indication right enables those who have the right to use the indication to prevent its use by a third party whose product does not conform to the applicable standards.

APPLICATIONS OF INTELLECTUAL PROPERTY RIGHT

- Intellectual property right is a government right is granted by government of India for maintaining the quality and standard of drug or drug related product or services.
- Intellectual property right is important to maintain the quality, purity and safety of drug products.
- Intellectual property right is important for determination of product stability and safety.
- Intellectual property right is applicable for industrial, Pharmaceutical, analytical, chemical, drug development, drug synthesis and Manufacturing industries.
- Intellectual property right is applicable for companies, industries, Business and marketing.
- Property right is applicable for industrial, scientific, literary, artistic field.

- Intellectual property right is applicable of NDA, ANDA and INDA analysis of Drug Product or Pharmaceutical Formulations.
- Intellectual property right is applicable for testing, analysis, characterizing, the drug properties and drug quality.
- Intellectual property right is exclusive right is granted by government of India for protection of invention of inventor.
- It is applicable for Protection of originality or novelty of work of author has a function of copyright.
- It is act has certification as well as identification mark for identification of product in would wide market has function of trademark.
- It is important for maintaining protection of patent or business oriented data has function of Trade secrets.
- It is applicable for Maintaining the utility, designing and Novelty of Patented data.
- It is applicable for determination of law of Indian system or Indian legal system.
- It is important for determination simple ornamental or industrial designing and Layout oriented semiconductor devices.
- It is Applicable for determination of Anticipation of data as well as Patent data under prior art or not is conducted by Intellectual property right.
- It is having important application for Indian Patent act 1970, and also determination of Amendment of patent act in 1999, 2002, 2005 and 2006.
- It is applicable for determination of Patent filling and Patent Granting Processes.
- It is applicable for determination of Patent Revocation and Patent Infringements.
- It is applicable for determination of Commercialization and Patent Licensing Processes.

CONCLUSION

Intellectual property is important for a person or company to safeguard. Without proper safeguards in place, one company's ideas can be replicated by another company and used for their profit. Some legal issues can arise from IP, but as long as a company

is on top of the paperwork and has an attorney they can prevent most of the issues or fight them if necessary. Having precautions in place can also help a company keep their trade secrets safe. With the use of a non-disclosure agreement with a non-compete clause can help a company keep their secret intact for their company to use when it is needed. While contracts are put into place to ensure a business will do what is required, a contract breach is possible. The violation can be resolved with employee input as well as mediation to ensure proper resolution for the breach. Using some of the techniques will prevent a company's IP from getting into the wrong hands.

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3

Patents and Publications in India: An Overview

*Dr. L Malleswara Rao**, *Ch. Sundar Singh**,
*Dr. Ch. Kanaka Rao***, *S Somasekhar****,
K Naveen Kumar & M. Shankar**

ABSTRACT

Intellectual property (IP) is a term referring to a brand, invention, design or other kind of creation, which a person or business has legal rights over. Intellectual Property Right is exclusive right is granted by government of India for protection originality of work of inventor. Simple intellectual property right is indescribable formation of human mind. In this intellectual Property right includes in Patent, Trademark, Trades crates, Industrial design, Layout design and Copyright Oriented Rights. It is certification authority and standard authority for certification and identification of product in would wide market. This intellectual property right is the rights given to people over the creation of their minds. Intellectual property refers to creations of the mind, inventions in artistic, literary, scientific and industrial field. It is important application for Protection of invention of inventor and maintaining the quality as well as standard of work of inventor. The present paper describes the basic concept in Intellectual Property Right (IPR), History of Intellectual Property Right (IPR), Type of Intellectual Property Right (IPR) i.e., Patents, Trademarks, Copyrights And Related Rights, Geographical Indications, Industrial Designs, procedure

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of filling the patent application, Trends of Intellectual Property, Publications Vs patent advantages. Patent provides many benefits to the inventor/researcher but in India, researchers prefer publications instead of patenting their work.

Keywords: Intellectual property, IPR, Patent, Publication, Patents in India; Publications in India.

HISTORY OF INTELLECTUAL PROPERTY RIGHT:

The basic aim of an Intellectual Property Right upon the person owning the same is to give a social recognition to its holder. This social recognition can further bring economic benefits to its holders. It is just and reasonable to award a person an Intellectual Property Right in the form of “limited monopolistic rights” for his/her labor and efforts. At the same time, exceptions in the form of various licenses are also made so that public interest cannot be compromised. The public interest and personal interests are thus submissive in the form of limited period duration of these rights and their exploitations can be tackled severely, especially when public interest demands so. It is believed that Intellectual Property Right initially started in North Italy during the Renaissance era. In 1474, Venice issued a law regulating patents protection that granted an exclusive right for the owner. The copyright dates back to 1440 A.D. when Johannes Gutenberg invented the printing press with replaceable/moveable wooden or metal letters. Late in the 19th century, a number of countries felt the necessity of laying down laws regulating Intellectual Property Right.

II. TYPES OF INTELLECTUAL PROPERTY RIGHTS

- Patents
- Trademarks
- Copyrights and related rights
- Geographical indications
- Industrial designs
- Trade secrets
- Layout design for integrated circuits
- Protection of new plant variety

i). Patents

A patent is a government grant of an invention to the inventor in exchange for full disclosure of the invention. A patent is a legal right that allows applicants and assignees to use and exploit their inventions for a set period of time (usually 20 years from filing). For the duration of the patent period, the patent holder has the legal right to prevent others from commercially exploiting his invention.

ii). Copyright

The set of exclusive rights granted to the author or creator of an original work, including the right to copy, distribute, and adapt the work, is known as copyright. Copyright protects the expression of an idea rather than the idea itself.

iii). Trademark

A trade mark (also known as a brand name) is a visual symbol that may be a word signature, name, device, label, numerals, or combination of colors used by one undertaking on goods or services or other articles of commerce to distinguish it from similar goods or services originating from another undertaking. The chosen mark should be able to be represented graphically.

iv). Designs

The features of shape, configuration, pattern, ornamentation, or composition of lines or colors applied to any article, whether in two or three dimensional (or both) forms, are referred to as design.

v). Geographical indications

Geographical Indications of Goods are defined as the aspect of industrial property that refers to the geographical indication referring to a country or a place located therein as being the country or place of origin of that product.

CONCEPTS OF PATENTS:

There are three types of patents:

- 1. Utility patents** may be granted to anyone who invents or discovers any new and useful process, machine, article of manufacture, or composition of matter, or any new and useful improvement.
- 2. Design patents** may be granted to anyone who invents a new, original, and ornamental design for an article of manufacture.

3. **Plant patents** may be granted to anyone who invents or discovers and asexually reproduces any distinct and new variety of plant.

New developments in Intellectual Property Rights:

Intellectual Property Rights are patents, copyrights, trademarks, geographical indicators, protection of undisclosed information, layout designs of integrated circuits, industrial designs and traditional knowledge that are recognized by the Trade Related Intellectual Property Rights agreement (TRIPS) and governed by the WTO (World Trading Organization).

ADVANTAGES OF PATENTS

Patents promote the public good in that patent protection incentivizes inventors

- The introduction of new products and processes benefits society.
- In return for the full disclosure to the public of specifics of the invention, thus progress in science and technology, the inventor is given a limited period of time within which to exploit his or her invention and excluded others from doing so.
- Inventors are incentivized to create new products, and the public benefits from inventions that ultimately will fall into the public domain.

TYPES OF APPLICATION

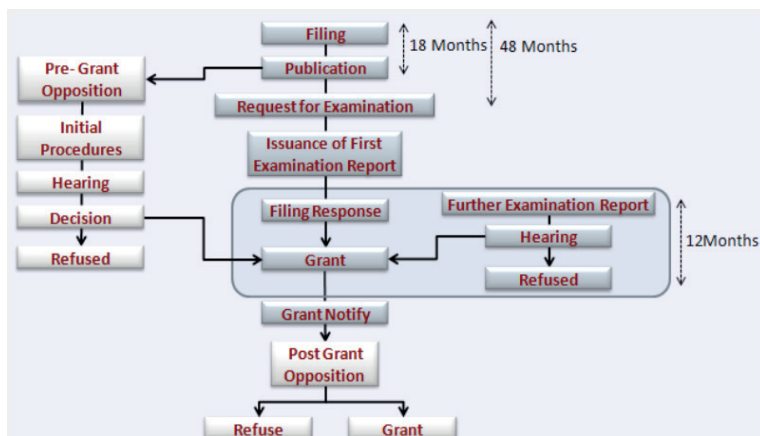
1. Provisional application
2. Utility application
3. Design application
4. Plant application
5. Continuation application
6. Patent Cooperation Treaty (PCT) Application
7. Divisional application.

PREPARING THE APPLICATION

- Title
- Cross-references to related applications
- Background

- Summary of invention
- Brief description of drawing
- Detailed description of the invention
- Claims

PROCEDURE OF PATENT APPLICATION



a). Procedure

A copy of Statement and Evidence together with Notice of Opposition shall be delivered to the Applicant. The applicant shall leave a reply statement and evidence within a period of two Months from the date of receipt of the copy of statement and opponent's evidence. The Opposition Board will give his decision of acceptance or rejection to the applicant.

1. Request for Examination

Within 48 months of the date of filing of application request for examination should be made by paying the fee. The details of the fee are Rs. 4,000 for natural person, Rs. 10,000 for small entity and 20,000 for large entity. Fee for express request examination is Rs. 5,600 for natural person, Rs. 14,000 for small entity and 28,000 for large entity.

2. First Examination Report

The examination of the patent application is carried out on the basis of novelty, inventiveness and industrial application. Then the Patent Examiner sends the First Examination Report to the applicant.

3. Amendment of objections by the applicant

After receiving the First Examination Report (FER), the applicant has to file a response and answers/solutions of Examiner's objections. It should be done within 12 months of the applicant receiving the First Examination Report (FER). If the response is unjustified, the Controller can refuse the grant of a patent or amended claim/s.

4. Grant of patent

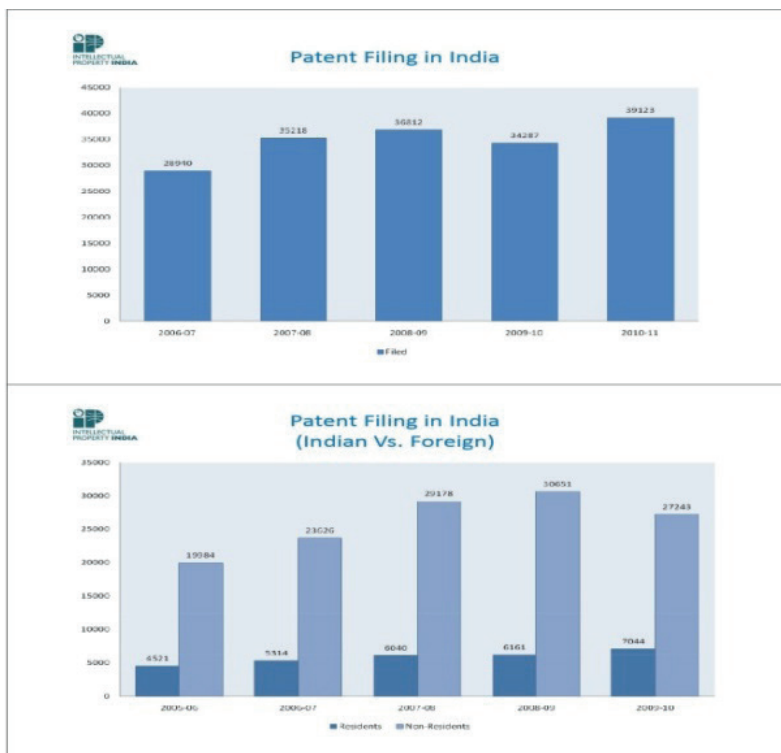
If the applicant responds satisfactorily to all of the objections raised in the First Examination Report (FER) to the controller, the patent will be granted after assigning serial number under the Indian Patents Act, 1970.

TRENDS IN IPR – AT A GLANCE

Filing of applications for protection of various Intellectual Property Rights (IPRs) in Intellectual Property offices under the administrative control of the Controller General of Patents, Designs and Trade Marks (CGPDTM) has been showing consistent growth over the years. This year, overall filing of applications for various Intellectual Property Rights in 2021-2022 is **568049** as compared to the previous year 2020-2021 is **528471**, exhibiting an overall increase of 7.5%. The increasing trend in filing of applications for patents, designs, trademarks, copyright and geographical indications has been observed during this year as compared to last year.

Trends in last five years with respect to filing of IP applications:

Application	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022
Patent	47854	50659	56267	58503	66440
Design	11837	12585	14290	14241	22699
Trade mark	272974	323798	334805	431213	447805
Geographical Indication	38	32	42	58	116
Copyrights	17841	18250	21905	24451	30988
Semiconductor Integrated Layout Designs (SCILD)	02	NIL	Nil	05	01
Total	350546	405324	427309	528471	568049



Trends of Intellectual Property Activities

Patents: During this year, a total of **66440** patent applications were filed exhibiting an increase of about 13.57% as compared to previous year. Domestic filing of patents applications has also increased to **29508**, which is 44.41% of total filing as compared to 41.58% in 2020-21. The trends of last five years in respect of patent applications filed, examined, granted and disposed are given below. Disposal of applications includes patents granted and refused by the Patent Office, as also, applications abandoned and withdrawn by the applicants.

Trends in Patent Applications (in Thousands)

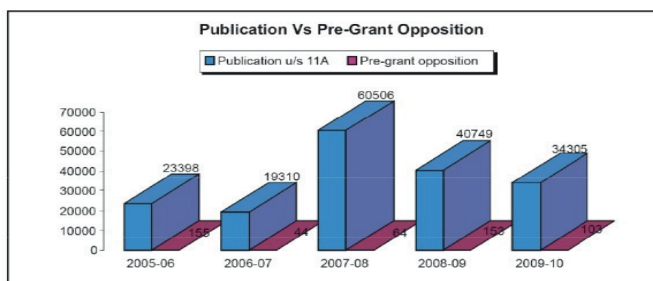
Year	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022
Filed	47.85	50.66	56.27	58.50	66.44
Examined	60.33	85.43	80.08	73.17	66.57
Granted	13.05	15.28	24.94	28.39	30.07
Disposal	47.70	50.88	55.95	52.76	35.99

PUBLICATIONS

Publications afford scientific information which allows the rest of the academic area to assess the research quality. Publications acts as base for new research by application of result. They impact not only the research area but also the society directly or indirectly. The researchers must ensure that their publications are honest, plain, genuine, legitimate, precise, complete and balanced and it should not deceive also should shun careful or vague scientific reporting.



Publication vs Opposition (Pre-Grant)



Source: annual report 2009-10

1. Procedure of publication

Researcher has to make a manuscript to publish their research work in a prescribed format. The format differs from journal to journal. Typically, the normal manuscript format consists of following parts: title page, abstract, keywords, introduction, methods and materials, experimentation, results and discussion, conclusion, acknowledgement, references. Before sending or preparing manuscript, researcher have to select journal for publication by keeping many things in mind such as impact factor, journal's field of interest, publication charges, peer review, duration of publication and open access.

2. Publication Benefits

Mainly of the journals are online, this facilitates other researchers to access i.e. read or see the article from any part of the world. Acceptance of the article typically takes time but once accepted; publication takes very less time. For publishing articles, expenses

are less i.e. publication charges, sometimes free. Less labor is needed to publish, only desired in preparation of manuscript.

TIME FRAME OF THE APPLICATION OF PATENT

In India, there are 7 steps for grant of patent starting from the application of patent.

- Filling of patent application: less than one day
- Publication: 18 Months from filing date.
- Opposition: Pre-grant: within 3 months from the date of publication.

Post-grant: within 1 year after grant of patent.

- Request for examination: within 48 months from date of filling.
- First examination report: within 12 months.
- Amendment of objections by the applicant: within 6 months.
- Grant of patent: 2-3 years.

It takes about 2 year to 3 years and each step should be completed in a specified period. After the specified period, if work not completed/submitted, rejection of application may happen.

PROCEDURE FOR PUBLISHING WORK IN JOURNALS

Lot of online and offline journals are there to publish the research, frequently online. No need to go anywhere for publication. Because of online publication, worldwide one can refer the articles. The publisher proves the hard copy of the article with certificate of publication. Occurrence of publication in journals is generally monthly but some are bimonthly, quarterly or annual. By field of interest also lot of journals are available like engineering and technology journal, pharmaceutical sciences journal, medical journals, science journals, arts and commerce Journals. Apart from these, other benefits are less time taking, less expensive, less labor is needed to publish compared to patenting.

ADVANTAGES PATENTS AND PUBLICATIONS:

i. Patents

1. Online procedure which needs computer expertise
2. Long duration between application and grant of patent

3. Every step needs fee starting from application fee of 1600/- for individual
4. Everything should be done in time frame e.g. provisional application gets 01 year to complete, failing in this, gives rise to loss of time and money.
5. Strong scientific English language is needed especially in case of patent drafting
6. Good writing skills expertise with good English knowledge is necessary in drafting the heart of patent application

ii. Publications

1. Online procedure which needs Basic computer knowledge
2. Short duration between submission and publication
3. Publications charges are usually 1500 to 2000 or sometimes free
4. Publications don't have such risks. Researcher can publish their work in parts.
5. Easy and understandable scientific English language is needed throughout the manuscript.
6. Publication needs writing skills and English but not to that much extent of patent

CONCLUSION

Intellectual property is important for a person or company to safeguard. Without proper safeguards in place, one company's ideas can be replicated by another company and used for their profit. Publication is easy and mandatory too in some cases like for obtaining degree of post graduation and doctorate. Frequency of publication in journals is mostly monthly but some are bimonthly, quarterly or annual. By field of interest also lot of journals are available like engineering and technology journal, pharmaceutical sciences journal, medical journals, science journals, arts and commerce Journals. Apart from these, other benefits are less time taking, less expensive, less labor is needed to publish compared to patenting. A researcher/inventor faces many problems in patenting as compared to publication, the work is authentic, fair and novel, he/she must go for patenting.

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4

The Role of Educational Institutions in Fostering Entrepreneurship Education in India: Issues and Challenges

*E.gowthami**, *K. Sony*** & *Dr. Alluri Venkata
Nagavarma****

ABSTRACT

In Today's economy, Education and employment are the two sides of the coins to lead a life. Unemployment is the major problem for youngster in India. This means that efforts need to be taken to make sure that today students must develop entrepreneurial skills and get the chance to have a 'practical entrepreneurial experience' through education. To support productivity and growth in India, it is essential to invest in education and training. India needs creative and innovative entrepreneurs; and it needs a flexible and resilient work force well equipped with the necessary skills and key competences. It can help students to achieve entrepreneurial learning outcomes - concrete knowledge, skills and attitudes. we should take initiatives and training to impart a entrepreneurial skills through education to overcome the unemployment levels in our nation. Education teaches them how to identify the business opportunities and do a business globally.

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Government has to invest more resource to turn India as "Education Hub". This study reveals the importance of Entrepreneurial education in India and how it should be imparted or inculcated in the minds of the budding entrepreneurs.

Keywords: Educational Institutions, Entrepreneurs, Entrepreneurial Education and Innovative skills.

INTRODUCTION

Entrepreneur, Entrepreneurship, and Entrepreneurship Education The definition of entrepreneurship has been debated among scholars, educators, researchers, and policymakers since the concept was first established in the early 1700's. The term "entrepreneurship" comes from the French verb "entreprendre" and the German word "unternehmen", both means to "undertake". Bygrave and Hofer in 1891 defined the entrepreneurial process as 'involving all the functions, activities, and actions associated with perceiving of opportunities and creation of organizations to pursue them'. There has never been a definite answer to the question of whether entrepreneurship can be taught (Harrison, 2014). As part of the new strategy for job creation, entrepreneurship education holds promise as an integral component in a community's venture support system along with incubators, innovation centers, technology transfer offices, science parks, and venture capital operations (Deshpande & Nandini, 2011). In the 1990s, India exerted greater effort to promote and nurture entrepreneurship. Attempts at various levels have taken place to directly or indirectly promote entrepreneurship. There is a greater supply of potential entrepreneurs in society than what is now being produced by the education system. Whether this nation or any other will be able to solve its economic and social problems will depend on the availability of a continued and increasing stream of creative talent (Ananthan & Arokiasamy, 2011). The attempts fall under three main categories: removal of state-imposed barriers for starting businesses; availability of finances; education and nurturing.

First, entrepreneurship has been encouraged in India by systematic attempts at removal of state-imposed structural and regulatory roadblocks. The granting of licenses and policies on controls and taxation has been cited as one of the major hurdles in setting up and running new businesses. More progressive governments have tried to make it easier for entrepreneurs to

set up businesses. The growth of Bangalore and Hyderabad as hubs for IT companies is a direct outcome of government support in the form of tax holidays for start-ups and sector/region specific sops to start new ventures.

Second, there are attempts to make finances available to businesses. In the current banking paradigm, it is easy for an established businessperson to get loans for starting new ventures or expand current businesses.

However, a new entrepreneur wishing to start a new business finds it very difficult to procure basic funds to setup and run a business. The Reserve Bank of India has urged banks to provide funds to small and new businesses. The government of India is also increasing its efforts in this direction. A third form of support is the development of entrepreneurial talent in educational institutions. India's higher education system generates a large number of graduates every year. However, its economy is not in a position to absorb the graduates passing out, leading to an increase in the educated unemployed. In recent years, India's population has grown very fast. Because of the history of India and its multi-cultural composition, it seems impossible to have a Family Planning policy like that of China in the near future. It is likely that India's population will continue to grow, which will consequently worsen the employment situation. In India, most entrepreneurs were single owners, nil employee, and one-person shows with little growth prospects. The so-called entrepreneurs do business mainly for self-employment and are not the "real" entrepreneurs. Exposure to real-world entrepreneurs is likely to support the transfer of tacit knowledge between entrepreneurs and students (Liithji & Franke, 2002). In order to catch up with the pace of developed countries, India needs many entrepreneurs willing to make their businesses bigger. If the university students with high entrepreneurial potentials get proper training, they will have the best prospects for becoming "real" entrepreneurs. Entrepreneurship is a matter that involves everyone—the government, society, and the educational institutions.

Indeed, entrepreneurship education has truly earned a global status for itself, given that it is now pursued with equal passion even in the developing countries (Arthur, 2012). If Entrepreneurship Education (EE) in India's higher education system cannot completely address major obstacles in the pursuit

of national economic development and employment at least it can offer a start. Therefore learning institutions at all levels are under increasing pressure from government agencies, the public and even students to develop a model of entrepreneurial education that will enhance the spirit of entrepreneurial skills and help us to promote the businesses.

IS ENTREPRENEURSHIP A NECESSITY IN TODAY'S ECONOMY? WHY?

Entrepreneurial education is recognized worldwide as being critical in facilitating economic growth which in turn is essential for addressing unemployment. Investing in entrepreneurial development can create jobs and stimulate productivity. Entrepreneurial education requires investing time and capital. Summarizes the importance of entrepreneurship in the following four advantages: advancement of economic prosperity, combating unemployment, improved future perspectives and the advancement of own initiatives (Mare, 1996). The establishment of new ventures through entrepreneurship fuels economic prosperity and leads to job creation that will combat unemployment. In addition, the prospect of establishing a new venture provides alternatives to job seeking individuals and could enhance creativity and innovation through the advancement of their own initiatives.

Entrepreneurism also helps the economy by creating wealth for many individuals seeking business opportunities. Although this is not the number one reason individuals pursue entrepreneur activities, it plays a major role in our economy. Both a new business and the wealth the owner can obtain will help boost the economy by providing new products as well as the spending power created for the entrepreneur. Without entrepreneurs, our economy would not benefit from the boost they give from added business and ideas. Entrepreneurial Education Ecosystem Promoting student innovation and entrepreneurship Colleges and universities are investing heavily in the development of their students' entrepreneurial skills.

While many students dream of starting the next Facebook or Twitter (both of which were started by students), Universities are more focused on the pedagogical value of entrepreneurship as a set of skills that can be applied across professional environments and activities to supplement the students' classroom experience. Universities are investing both in formal programs

as well as in extra-curricular activities to channel students' interest in solving global problems through entrepreneurship. Examples of formal programs include degrees and certificates in entrepreneurship, while examples of extra-curricular activities include business plan contests, Entrepreneurship clubs, and startup internships. Universities should take steps to encourage research in entrepreneurship through fellowship support and also undertake joint research projects with Indian and overseas universities and institutions (Kishore, 2014). Many universities are even experimenting with on-campus Accelerators, entrepreneurial dorms, and student venture funds. At the very least, these activities provide critical organizational skills to students, and at the very best, may create the next great university spinoff. A framework for building this effective entrepreneurship education ecosystem is surely the need of the hour and it requires a greater focus on knowledge creation to support the framework (Basu, 2014)

Encouraging Faculty Innovation and Entrepreneurship

Faculty and doctoral graduate students conduct the research powering many of the innovations that spawn high-growth startups. However, even at our nation's most entrepreneurial universities, many faculty and graduate students do not always consider the market and societal relevance of their research. To address this issue, universities are putting in place a series of policy changes to encourage more faculty entrepreneurship, which in turn will complement the student entrepreneurship. Youth entrepreneurial development is on the increase in the recent times across the globe (Zimmerer, 2005). These changes include greater recognition of faculty entrepreneurs, integrating entrepreneurship into the faculty tenure and selection process, and increasing

Faculty connections to outside partners – through externships, engagement with business, and targeted resources for startup creation. Finally, universities are actively working with federal agencies to address some of the regulatory challenges around faculty entrepreneurship, in particular, those related to conflict of interest and national security issues (Innovative and Entrepreneur in Higher Education, 2013)

Facilitating University-Industry Collaboration

Businesses and industry benefit greatly from university research and innovation. Universities are constantly looking

for ways to connect their research and students' education to emerging industry interests. In recent years, universities have put greater emphasis on supporting startup companies, while continuing to engage established companies that have traditionally been their licensing partners. Entrepreneurship as a domain of business education has an eclectic nature where the content is derived from diverse disciplines including those of strategy, finance, or marketing (Albornoz-Pardo, 2013). To facilitate greater collaboration and innovation, universities are opening up their facilities, faculty, and students to businesses (small and large) in the hopes of creating greater economic value. Universities are strategically partnering with companies, offering internships and externships, sharing facilities with startups, such as accelerators, and creating venture funds and incentive programs funded by industry, all of which drive increased innovation and product development by university students, faculty, and staff. Engaging with regional and local economic development efforts historically, local economic development has been an important mission of the nation's large universities. Many of America's leading universities, particularly land-grant universities, have always felt a strong responsibility for the betterment of their surrounding communities. These days, universities are increasingly focusing on innovation and entrepreneurship as key contributors to the growth and success of local communities. Universities are requesting the federal government to include commercialization and innovation-driven economic development in their grant programs. Foster a sense of belongingness among the faculty members by arranging academic and non-academic (cultural) forums (Yoganandan & Sowndarya, 2015). In addition, regional economic development planning now often starts with an assessment of a local university's research strengths. In turn, universities are seeking partners to supplement their strengths and overcome their weaknesses through partnerships with community colleges, non-profit economic development agencies, governments, and entrepreneurship groups. Most of the Institutes are having their link with Global Development Forums.

CONCLUSION

Entrepreneurship Education in India plays a vital role in the development of an economy. Education sector has a significant

role to play in the growth of India, because they are breeding grounds for entrepreneurs. They have the potential to develop not only winning qualities but also provide an opportunity to create employment for self and for others. Entrepreneurial Education helps in increasing knowledge base, by identifying opportunities, and by pointing out ways to overcome barriers imposed by one's environment. Educational institutions would create incubators for students to expose their excellence and skills in developing their business. Government should make Entrepreneurial Education as an integral part of curriculum from the school level itself and also have their participation by sponsoring funds for the institutions to invest in the Research and development. Therefore, Indian Government should take appropriate measures to promote and develop entrepreneurial education in India.

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5

Enforcement of Intellectual Property Arbitration Awards: Challenges in India

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ABSTRACT

Intellectual Property Disputes are principally commercial in nature and often have international dimensions because of people protecting their Intellectual Properties or licensing them in multiple jurisdictions. The question which this paper target is whether arbitration is possible in IP disputes? If yes, then in what kind of disputes is it possible? In the past, many legal systems did not allow the arbitration of IP disputes, simply because the rights had been granted by a sovereign power. It was argued that the nature of the rights was such that questions as to validity should only be decided by the authority which issued the right. However, it is now broadly accepted that disputes relating to IP rights are arbitrable, just like disputes relating to any other type of privately held rights like transfer of granted IP rights as in licensing or any other such commercial arrangements. The research work consists of Theoretical and Analytical Study, based on the collection of data from secondary sources. It is an attempt to understand the significance of Arbitration in respect to the disputes related to Intellectual Property Rights in India.

Index Terms— *Intellectual Property, Arbitration Awards.*

INTRODUCTION

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Intellectual Property Rights has seen a wide development across jurisdictions, especially in the area of commercial transactions which includes a wide range of products and services. There are various international treaties and legislations which have enabled the registration and recognition of copyrights, patents, and trademarks. One of the vital issue in the area is that of arbitration of Intellectual Property disputes. Arbitration in Intellectual Property disputes gives due advantage to the parties in the way of discretion in selecting a competent arbitrator, time and cost efficient, and most importantly, confidentiality in the concerned matter of dispute. In addition to this, arbitration in IP matters is promising as often where an international party is involved, the parties to the dispute might be subject to different jurisdictions individually and arbitration provides a flexible, speedy and a common base for adjudication. Because of these reasons, arbitration is widely favoured among international or multinational companies.

The issue in consideration with regard to the intellectual property arbitration lies in the arbitrability of the intellectual property disputes where the right to the intellectual property is given by the sovereign authority and thus, the only competent authority to decide the validity, infringement or interference is the administrative authority. This results in the conclusion that entitlements with regard to intellectual property, and the legal issues which flowed from those rights, could not usefully be referred to or considered by an arbitration tribunal. Another important concern is whether such enforcement of an award would be contrary to the public policy of the country.

Article V of the Convention on the Recognition and Enforcement of Foreign Arbitral Awards specifies the grounds for refusing the enforcement of such award in the case where the subject matter of the dispute is not capable of arbitration under the particular law of the country or in case where enforcement of such an award would be contrary to public policy. Further, Article II(3) of the Convention also specifies that the Courts can refuse to refer the dispute to arbitration if it finds that the agreement to arbitration is incapable of being performed.

Article 36 of the UNCITRAL Model law also provides for grounds for refusing recognition or enforcement of an award, which is also the Article that the Section 48 of the Arbitration and Conciliation Act, 1996 is based upon. This Section 48 of the

Act lays down the condition for enforcement of a foreign award and an award maybe refused in the cases where it meets the requirements of the Section.

The paper shall deal with whether Intellectual Property Rights is arbitrable in India and analyses the extent of it's arbitrability. The major considerations in this particular case would pertain to whether there is an arbitration agreement specifying the dispute to arbitration, whether all the parties to the suit are also parties to the arbitration agreement and finally, whether the relief sought can be adjudicated or granted in an arbitration. These issues are still in the light of uncertainty and are also of immediate concern, which if addressed, would result in growth in the international arbitration with respect to intellectual property disputes.

On one hand, in the process of international economic globalization, most countries are inclined to acknowledge the IPR as private property rights. On the other hand, courts are overburdened by a large amount of commercial disputes. This has resulted in increasing debates and researches, both academically and practically, on alternative dispute resolution methods, and many countries are inclined to adopt a policy favoring and allowing arbitration and further enlarge the scope of arbitrability. With the world more and more dependent upon technology of all types, the continued and growing importance of intellectual property cannot be understated. There has been, and will continue to be, an accompanying explosion in the number and complexity of transactions in which intellectual property is a critical, if not the critical, element. Many of these transactions cross national boundaries; as do the disputes which inevitably arise from them. But international intellectual property disputes present complexities not encountered in either intellectual property disputes which are confined to one country or other international commercial disputes.

POSITION IN INDIA

The Arbitration and Conciliation Act, 1996 was created on the lines of the Model Law on Arbitration of the UNCITRAL (United Nations Commission on International Trade Law). India adopted the Act by repealing the existing three separate arbitration laws with respect to domestic arbitration, international commercial arbitration and the enforcement of foreign arbitral awards. Part I of the Act provides provisions for domestic arbitrations and some provisions such as Section 9 (interim measures by Court),

Section 27 (Court assistance in taking evidence) and Section 37 (appealable orders) also apply to international arbitrations, while Part II of the Act deals with the Enforcement of Foreign Awards.

In Part II of the Act, Section 48 is analogous to Article 36 of the UNCITRAL Model Law. A foreign award can be enforced in a Court in India, unless such an award is not affected by the limitations provided in this Section. In the case of Intellectual Property Rights, the arbitrability of the dispute and whether the enforcement of the award would be in conflict with the public policy are the concerns to be addressed. Section 34(2)(b) of the Act also provides for recourse to a Court for setting aside an award if it finds that the subject matter of dispute is not capable of settlement by arbitration under the law for the time being in the country and of the arbitral award being contrary to public policy of India.

The stand of India towards arbitrability of IP disputes is a little complicated but logical. The policy debate arises because of the distinction between rights in rem and right in personem, also between judgement in rem and judgement in personem. The scope of remedies that should be available to parties in intellectual property arbitration is a source of controversy.

The judgement in personem is in form, as well as substance, between the parties claiming the right; and that it is so inter partes appears by the record itself. A judgment in rem is an adjudication, pronounced upon the status of some particular subject-matter, by a tribunal having competent authority for that purpose. Disputes seeking judgement in rem are thus generally considered to be unsuitable for private arbitration, although this is not a rigid rule. The Apex Court in *Booz Allen Case* has stated that subject matter of arbitration that involves only rights in personem are arbitrable in nature, but no matter involving right in rem, for example, with validity proceedings, where the effect of the award could potentially be to discontinue the existence or enforceability of the monopoly, can be put before any private arbitral tribunal for decisions. However, the Supreme Court also recognized that this rule isn't infallible and that subordinate rights in personem that arise from rights in rem might be subject to arbitration, for example, if the IP disputes arise from commercial arrangements for the use of Intellectual Property, they are arbitrable disputes. While dealing with the similar

issue the bench of the Hon'ble High Court of Bombay headed by Justice G.S. Patel in the case of *Eros International Media Limited v. Telexmax Links India Pvt. Ltd. and Ors*, held that IP Dispute arising out of a commercial contract, like between two claimants to a copyright or a trademark in either an infringement or passing off action, that action and that remedy can only ever be an action in personam and hence such IP disputes are arbitrable in nature.

A. Copyrights

The judicial doctrine that has evolved with regard to the limit of arbitrability is that all disputes relating to rights in personam are considered to be amenable to arbitration and all disputes relating to rights in rem are required to be adjudicated by courts and public tribunals.

In this regard, the Delhi High Court in the matter of *HDFC Bank v. Satpal Singh Bakshi*, observed that 'all disputes relating to "right in personam" are arbitrable and choice is given to the parties to choose this alternate forum. On the other hand, those relating to "right in rem" having inherent public interest are not arbitrable and the parties choice to choose forum of arbitration is ousted'.

In a recent landmark judgment of *Eros International*, an application was moved by the defendant (Telexmax) under Section 8 of the Arbitration and Conciliation Act, 1996, and the question arose whether under law there is a specific bar to arbitration or the arbitrability of such Intellectual Property disputes and whether such disputes are only amendable to jurisdiction of courts. In brief, the background of the case was that Eros (plaintiff) had copyright in several feature films. It executed a term sheet contract with Telexmax (defendant) for granting content marketing and distribution rights in respect of films. The said term sheet had an arbitration clause. Also, while the term sheet contemplated the execution of an agreement within a limited time, however, no such agreement was executed.

Disputes arose between the parties and Eros (plaintiff) filed a suit for infringement of copyright against Telexmax and the subsequent licensees. Eros argued that Telexmax was not entitled to exploit and deal with such content before execution of the agreement. On the other hand, to counter the suit, Telexmax filed an application under Section 8 of the Arbitration Act stating that all disputes (including under the present suit) between Eros

and Telexmax be referred to arbitration in view of the arbitration clause in the term sheet, which aspect came to be decided as part of the decision.

Eros contended that term sheet was not binding and that Telexmax had infringed its copyright and had also sub-licensed this copyright-protected material to the other defendants to the suit. Eros argued that the action against Telexmax was not for breach of a contract, but was a statutory action under the Copyright Act, which is inherently non-arbitrable. Eros also contended that the other defendants were not a party to the term sheet. Telexmax argued that the dispute arising out of the term sheet was purely contractual and not simply an action for copyright infringement. Telexmax further argued that by the suit, Eros sought to enforce a right in personam as opposed to a right in rem. Further, the other defendants, who were not parties to the term sheet, were in the nature of persons claiming through or under Telexmax (under the amended Section 8) and had also filed affidavits agreeing to submit the entire dispute to arbitration. Telexmax also argued that there was no specific bar on the arbitrability of such disputes and relied on the decision of the Supreme Court of India in *Booz Allen & Hamilton Inc v. SBI Home Finance Limited & Ors.*

The Court while deciding in favour of the defendant, observed that provisions of the Copyright Act and the (Indian) Trade Marks Act, 1999 (Trademarks Act) do not oust the jurisdiction of an arbitral panel, they only seek to ensure that such actions are not to be brought before the Registrar or the board. Further, where there are matters of commercial disputes and parties have consciously decided to refer these disputes arising from that contract to a private forum, no question arises of those disputes being non-arbitrable. Such actions are always actions in personam, one party seeking a specific relief against a particular defined party, not against the world at large. Eros' action is in personam as it is seeking a particular relief against a particular defined party.

This decision makes it abundantly clear that although under trademark and copyright law, registration grants the registrant a right against the world at large and it is possible that an opposition to such an application (before the Registrar) would be an action in rem, however, an infringement or passing off action binds only the parties to it.

B. Patents

In case of Patents in India, Arbitration is available as a means to resolve disputes but is not widely used. However, arbitration is not available to determine matters of invalidity, as the Patent Office does not recognize arbitral awards in this respect. Only the disputes arising out of contracts between parties, like patent licensing disputes, can be subject to arbitration.

The significance of arbitration in the area of Intellectual Property is the ensured confidentiality of subject matter of dispute among the parties. But in a country like India, the difficulty arises in balancing the interests of the parties in maintaining confidentiality, and the interests of the public, thereby, preventing the arbitration of disputes involving rights in rem or third-party interests. The confidentiality conflicts with the public interest especially, in having the outcome of revocation proceedings be published. The answer to this criticism is that any award which is against the public policy of India can be challenged before the appropriate court of law, arbitral awards relating to patent infringement or validity could be denied as being against public policy or patently in violation of statutory provisions.

Challenges with respect to confidentiality of IP disputes which affect public at large can be addressed through legislation requiring that some or all of the proceeding be publicly disclosed. For example, USA laws explicitly allow arbitration of patent validity and infringement issues and arbitration of "any aspect" of patent interference disputes but a copy of any arbitral award must be given to the United States Patent and Trademark Office. The award is unenforceable until this notice is given. Similarly, Switzerland practices the registration of an arbitral award with the authority which issues and maintains patents. Also, awards rendered in connection with the validity of intellectual property rights are recognized as the basis for entries in the register, provided these awards are accompanied by a certificate of enforceability issued by the Swiss court at the seat of the arbitral tribunal in accordance with Article 193 of the Swiss Private International Law Act.

Arbitration is a consensual means of dispute resolution, requiring all parties involved to submit the matter to arbitration, failing which this method of dispute resolution would fail to operationalize. The agreement to arbitrate, which

embodies the consent of the parties, obtains a binding force as a result of national and international support extended to it through domestic and international law. Most jurisdictions have modified their domestic laws to reflect the Model Laws prepared by UNCITRAL and recommended for adoption by the United Nations General Assembly. Internationally, instruments such as the New York Convention on the Recognition and Enforcement of Foreign Arbitral Awards 1958, adhered to by 156 States, provided for expedited enforcement of a valid arbitration agreement and award rendered in a contracting state in the territory of another contracting.

Arbitrability refers to the question of whether a particular dispute can be submitted to arbitration or it befits solely to the jurisdiction of the courts. Both the New York Convention, 1958 and the Model Law on International Commercial Arbitration, 1985 provide for settlement of international disputes by way of Arbitration. It also involves the recognition and enforcement of foreign awards by the courts of different jurisdictions. Whether a particular dispute falls within the ambit of arbitrability under a given law, is fundamentally a matter of Public Policy. Public policy varies from state to state and constantly evolves with changes in the society.

As already discussed, patent rights are the property rights conferred by the State upon an inventor. These are statutory monopoly rights which are granted to the patentee to manufacture and market their inventions for commercial gains for a specified period of time. These rights could be exigent to the overall development of the society.

Intermittently it is contended that since these are territorial rights created by a sovereign entity, only the courts of this sovereign entity should have the authority to adjudge matters relating to such rights. It has been held that a patent right is available against the whole world at large. On the other hand, Arbitration, as a dispute settlement resolution, is the outcome of a concerted agreement between two parties who are bound by certain rights and obligations towards each other. Consequently, concerns were raised with respect to subject matter of arbitrability of patent disputes throughout the international community. In the beginning, disputes pertaining to the rights and entitlements to intellectual property could not, for a long time, be referred for arbitration. However, with the passage of time, disputes arising

from commercial arrangements such as transfer or assignment of rights, license agreements or multi-jurisdictional disputes, were considered to be *prima facie* arbitrable. It is justifiable to conclude that since the nature of the relationship between the parties is purely contractual in the above cases, arbitration agreements maybe entered into, and the awards thereto shall be considered as final and binding.

The municipal laws of various countries have different stands over subject matter arbitrability of patent disputes. United Kingdom and Singapore allow arbitration in Intellectual Property rights, but to a limited extent and with the prior sanction of the court. USA and Switzerland, on the contrary, follow a liberal approach. As a matter of fact, the United States Code expressly provides for arbitration in case of any kind of patent disputes.

It is also noteworthy, that the issue of subject matter arbitrability of patent disputes has been laid down as a condition precedent for the recognition and enforcement of foreign award under the New York Convention, 1958. Article V of the said convention provides that if a contracting state does not consider a subject matter capable of arbitration, an agreement to arbitrate on such subject matter be considered as invalid and shall be refused enforcement.

Hence, voluntary arbitration is more or less dependent upon the municipal laws of a country in so far as they are in compliance with the International Conventions.

CONCLUSION

Though there are various benefits of using arbitration as a method for resolving IP disputes there are also many criticisms against it. One of the biggest criticisms against arbitration in IP is that it is binding only between the parties and does not set a public precedent as regards its use as a deterrent to infringement and establishing a culture of integrity. Parties also do not actually resort to arbitration primarily on account of finding suitable arbitrators or because of jurisdictional issues in case of international contracts. One also needs to ponder on the effect of the counterclaim or defence of revocation in cases of infringement. As these remedies or reliefs are in rem, henceforth, the parties would have to turn to the relevant forum for resolution of that claim. So, whether such action would render the entire dispute non-arbitrable or the tribunal may

stay its proceedings until the appropriate forum decides on the validity of the copyright/ trademark/ patent? This is, however, far from ideal as it would delay the arbitration and substantially increase costs.

The conclusion which can be drawn in relation to the arbitrability of IP disputes in India is that it is a budding scheme which needs legislative support and a proper mechanism for better implementation. Though court rulings are quite unclear in the present scenario still it can be inferred that IP disputes are arbitrable, but still there is a long way ahead.

The one possible solution for addressing this issue in regard to enhancing arbitration in India is to provide for the arbitrability of IP disputes in the Arbitration and Conciliation Act, as well as the Indian Copyrights Act and Patents Act. In providing so, it not only eliminates the confusion regarding the arbitrability of Copyright and Patent disputes but also prevents further litigation in the light of public policy. An amendment to the Arbitration and Conciliation Act including the arbitrability of IP disputes, and also amendments to the Copyrights Act and Patent Rights authorizing the parties to subject the dispute to arbitration would clear the complications involved in such arbitrations.

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6

Intellectual Property Rights-Based Debt Financing to Startups: Need for A Changing Role of Indian Banks

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ABSTRACT

Knowledge-based capital is increasingly becoming an important source of economic growth worldwide. As startups and innovation-driven enterprises are scaling up in the domestic economy, their requirement of access to capital and market to monetize their intellectual property (IP) for business growth and expansion has been growing. Given the unique position of the Indian economy as the third-largest startup hub globally (NASSCOM, 2020), and increased recognition of IP assets as growth engines, it is time for India to utilize its potential to accelerate inclusive growth.

Globally startups are considered nation-builders due to their contribution to the economy through multiple channels—employment, foreign capital, advanced technology, competitive products, technological innovations, wealth creation and equitable distribution. The contribution of intangible assets to a nation's economic prosperity is presented in the OECD (2013)

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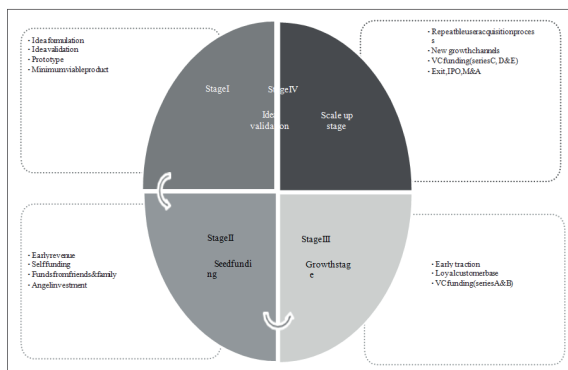
study, which argues that young firms with a large number of intangible assets have generated nearly 47% of all new jobs in OECD economies during 2001–2011.

Keywords: Intellectual Property Rights, Debt Finance Bank Loans, Government Policy Innovation.

INTRODUCTION

Today, India has a key position in knowledge capital development. Its knowledge economy continues to witness steady growth in recent years, aided by growing IPR awareness at the grassroots level and with innovations getting encouraged at schools, colleges, and universities. Being the third-largest startup hub and with increasing IP capital recognitions, India needs to utilize this unique position to be considered a knowledge and innovation-driven economy. The present study tries to identify the growth potential of the Indian economy based on these relatively unexplored growth agents, that is, IPR-dominated startups. The structure of the study is as follows. The next section presents the emergence of startups and problems associated with their funding cycle. Subsequent sections cover the development of knowledge capital in India and reviews selective literature on IPR-based debt financing. The section that follows presents the institutional setup in India for IPR-based debt financing and suggests certain debt financing options that can possibly be explored by Indian banks. The last section outlines the constraints (including market imperfections) of IPR-based debt financing to startups in India, followed by a conclusion (INC42 PLUS, 2021), in the first half of 2021, Indian startups raised ₹792.18 billion (USD 10.8 billion) in 614 funding rounds. With 56 Unicorns (startups valued over ₹73 billion (USD 1 billion)), India is home to the 3rd largest unicorn community in the world. In H1 2021, 16 Indian startups acquired the unicorn status. India has nearly 300 incubators and accelerators managed by academic institutes, corporate, commercial banks, and government entities.

INTELLECTUAL PROPERTY AND ITS DEVELOPMENT IN INDIA



Source: Created by the authors from data sourced from # startup India.

United Nation's World Intellectual Property Organization (WIPO) defines IP as "Creations of the mind and covers inventions; literary and artistic works; and symbols, names and images used in commercial activities. IP is similar to any other property rights, where creators/owners of patents, trademarks or copyrighted works are benefitted from these works or investment in a creation" (UN, 2011).

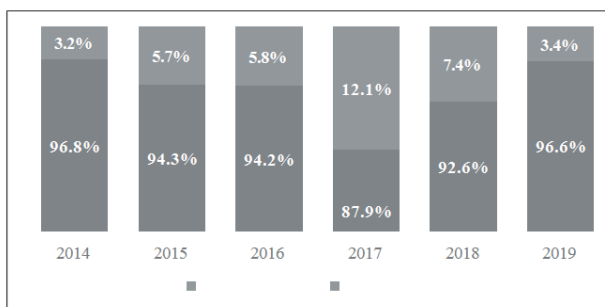
IP is divided into two major categories: industrial property and copyright. The industrial property includes patents (an exclusive right granted for a limited period for the invention of a product or process that provides a new way of doing something or offers a new technical solution to a problem), trademarks (a distinctive sign identifying certain goods or services produced or provided by an individual or a company), industrial designs (the aesthetic aspect of an article, where the owner is assured an exclusive right and protection against unauthorized imitation of the design by third parties), and geographical indications (a sign used on goods that have a specific geographical origin and possess qualities or a reputation due to the place of origin). Copyright is associated with literary works, films, music, artistic works and architectural design.

Development of Knowledge Capital in India

The role of IPR as an important factor for the success of the Indian startup ecosystem cannot be denied. A significant number of Indian startups own at least one IP asset (WIPO, 2020).

India currently occupies the 5th position in trademark registration, 6th in patent registration and 11th in industrial design registration. Total patent applications in India have grown from 3,024 in 1980 to 53,627 in 2019, a compound annual growth rate (CAGR) of 7.7%, aided by increased IPR awareness across sectors and robust government policies. Similarly, the number of 'industrial design' registration has grown from 1,033 in 1980 to 13,723 in 2019, a CAGR of 6.9%. At the same time, trademark registrations reached 367,764 in 2019 from 14,397 in 1980.

In a knowledge economy, intangible assets are the predominant form of assets. Monetization of IPR is based on the logic of transforming the innovative idea into a financial asset where the underlined IPR is used as collateral in raising capital (Nithyananda, 2012). Usage of IPR and other intangible assets as security for debt financing is an old concept though not popularized. For instance, in the 1880s, Thomas Edison first used his patent on the light bulb as security to borrow the money needed to launch the General Electric Company. Apart from equity financing, some major economies, including the USA, Japan, Sweden, the UK, and few European countries, are the prominent leaders in IPR-based debt financing. The success of USA as a market for IPR debt financing is mainly because of the development of IPs as independent assets. Hence, IP valuation remains relatively easy, and they serve as collateral for debt finance. On the other hand, regulatory constraints and lack of supportive infrastructure in Japan does not support debt financing of IPRs, rather equity financing remains the popular concept in the country. IPRs being 'embedded' in business make it almost impossible to assess their value separately (Shimizu, 2017).



Debt and Equity Funding in Indian Start-up Ecosystem.

Source: Data Labs

On the demand side, many innovative businesses are not fully aware of IPRs and their associated benefits (Bennett, 2006). The policy bottleneck and lack of security mechanism in the IPR filing process discourage IPR registration by startups, while expensive IPR registration processes hinder market penetration (Verma, 2006). The startup promotion mechanism of South Korea, Singapore and China have aided in scaling up IPR registrations in these countries. Some of the incentives offered by those governments include financial support for registration, acquisition and research and development expenditure of IPRs, upto 80% discount on official fees and attorney fees, rewards for patent and utility model utilization and direct subsidies for patent filing, prosecution, and maintenance, etc., among others.

CONSTRAINTS IN IPR-BASED DEBT FINANCING IN INDIA

Some of the constraints with the development of IP-based debt financing in India include: Infrastructure bottlenecks: IPR-based debt financing requires a number of essential infrastructures, including creation, maintenance, and proper valuation of IPs to raise money and use IPR as collateral. The practice of debt financing against IP assets is not prevalent in India. Most of the startups get equity finance primarily sponsored by VCs and private equity investors.

Negative experience: Several banks are already extending financial support to the startups based on tangible asset collateral. Financing innovation is never treated as a profitable business by Indian banks. Many lenders are financing innovation (equity financing) through VC and have no exposure to innovation debt financing. The negative experiences of the past, including debt to Kingfisher Airlines on its 'Kingfisher brand' as collateral, has earned bitter taste.

Under-developed valuation mechanism: Valuation of IPRs remains difficult, costly, and unreliable in India. Given the unreliability of the valuation, startups fail to borrow sufficient money at a competitive rate, ultimately hampering the market mechanism and discourages lenders and startups from debt financing using IPR as collateral. The absence of a central valuation agency works as a significant dent in the development of the market. The lenders are shying away mainly due to the risk of the overvaluation of IPRs. Without a proper valuation of IP assets, banks cannot use these IPR-based collaterals in their

regulatory capital calculations.

Institutional Mechanism for IPR - based Financing in India

Given the importance of startups to the domestic economy, the Government of India has initiated many schemes to promote them. India's first IPR policy in May 2016 (GoI, 2016) has proposed securitization of innovation rights, allowing them to be used as collateral to raise funds for their commercial development. The policy highlights the financial support for developing IP assets through banks, VC, angel funds and crowd funding mechanisms. The IPR policy aims at promoting a holistic and conducive ecosystem to catalyze the full potential of knowledge capital for India's economic growth and socio-cultural development.

The Indian IPR policy complies with World Trade Organization's agreement on TRIPS (Trade-Related Aspects of IPRs).

In India, the Federation of Indian Chambers of Commerce and Industry (FICCI) and the Federation of Micro, Small and Medium Enterprises (FISME) drive the commercial activity in IPR. FICCI, in association with the Ministry of Micro, Small and Medium Enterprises (MSME) has established the Intellectual Property Rights Facilitation Centre (IPFC), aiming at promoting awareness and adoption of IPRs amongst small entrepreneurs and startups. Recognizing the growing contribution of IPR to member organizations, FISME has initiated several programmes with assistance from the national manufacturing competitiveness programme under the Ministry of MSME. FISME has been focusing on IPR valuation and the creation of a mechanism to sell the IPR and realize the value. To promote debt financing of IPRs, the government needs to robust the IPR market infrastructure.

CONCLUSION

The potential of startups in driving India to a `370 trillion (USD 5 trillion) economy by FY 2024–2025 cannot be understated. The role of intangible assets has gained prominence, with knowledge-intensive innovation activities becoming the central drivers of competitive advantage in the modern world. Intangible assets currently account more towards a firm's market value than tangible assets. In advanced economies, IPR is treated as an asset and a substantial part of the company's portfolio. This practice is not extensively prevalent in emerging and developing economies, particularly in India, because of the relatively

insufficient IPR related infrastructure. Imperfections in the capital market restrain the pace of knowledge-driven growth in India by financially constraining young and innovative firms, which are the key drivers of economic growth.

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Enforcement of Intellectual Property Arbitration Awards: Challenges in India

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G. Milton*

ABSTRACT

Intellectual Property Disputes are principally commercial in nature and often have international dimensions because of people protecting their Intellectual Properties or licensing them in multiple jurisdictions. The question which this paper target is whether arbitration is possible in IP disputes? If yes, then in what kind of disputes is it possible? In the past, many legal systems did not allow the arbitration of IP disputes, simply because the rights had been granted by a sovereign power. It was argued that the nature of the rights was such that questions as to validity should only be decided by the authority which issued the right. However, it is now broadly accepted that disputes relating to IP rights are arbitrable, just like disputes relating to any other type of privately held rights like transfer of granted IP rights as in licensing or any other such commercial arrangements. The research work consists of Theoretical and Analytical Study, based on the collection of data from secondary sources. It is an

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attempt to understand the significance of Arbitration in respect to the disputes related to Intellectual Property Rights in India.

Keywords: Intellectual Property, Arbitration Awards.

INTRODUCTION

Intellectual Property Rights has seen a wide development across jurisdictions, especially in the area of commercial transactions which includes a wide range of products and services. There are various international treaties and legislations which have enabled the registration and recognition of copyrights, patents, and trademarks. One of the vital issue in the area is that of arbitration of Intellectual Property disputes. Arbitration in Intellectual Property disputes gives due advantage to the parties in the way of discretion in selecting a competent arbitrator, time and cost efficient, and most importantly, confidentiality in the concerned matter of dispute. In addition to this, arbitration in IP matters is promising as often where an international party is involved, the parties to the dispute might be subject to different jurisdictions individually and arbitration provides a flexible, speedy and a common base for adjudication. Because of these reasons, arbitration is widely favored among international or multinational companies.

The issue in consideration with regard to the intellectual property arbitration lies in the arbitrability of the intellectual property disputes where the right to the intellectual property is given by the sovereign authority and thus, the only competent authority to decide the validity, infringement or interference is the administrative authority. This results in the conclusion that entitlements with regard to intellectual property, and the legal issues which flowed from those rights, could not usefully be referred to or considered by an arbitration tribunal. Another important concern is whether such enforcement of an award would be contrary to the public policy of the country.

Article V of the Convention on the Recognition and Enforcement of Foreign Arbitral Awards specifies the grounds for refusing the enforcement of such award in the case where the subject matter of the dispute is not capable of arbitration under the particular law of the country or in case where enforcement of such an award would be contrary to public policy. Further, Article II(3) of the Convention also specifies that the Courts can refuse to refer the dispute to arbitration if it finds that the agreement to arbitration is incapable of being performed.

Article 36 of the UNCITRAL Model law also provides for grounds for refusing recognition or enforcement of an award, which is also the Article that the Section 48 of the Arbitration and Conciliation Act, 1996 is based upon. This Section 48 of the Act lays down the condition for enforcement of a foreign award and an award maybe refused in the cases where it meets the requirements of the Section.

The paper shall deal with whether Intellectual Property Rights is arbitral in India and analyses the extent of its arbitrability. The major considerations in this particular case would pertain to whether there is an arbitration agreement specifying the dispute to arbitration, whether all the parties to the suit are also parties to the arbitration agreement and finally, whether the relief sought can be adjudicated or granted in an arbitration. These issues are still in the light of uncertainty and are also of immediate concern, which if addressed, would result in growth in the international arbitration with respect to intellectual property disputes.

On one hand, in the process of international economic globalization, most countries are inclined to acknowledge the IPR as private property rights. On the other hand, courts are overburdened by a large amount of commercial disputes. This has resulted in increasing debates and researches, both academically and practically, on alternative dispute resolution methods, and many countries are inclined to adopt a policy favoring and allowing arbitration and further enlarge the scope of arbitrability. With the world more and more dependent upon technology of all types, the continued and growing importance of intellectual property cannot be understated. There has been, and will continue to be, an accompanying explosion in the number and complexity of transactions in which intellectual property is a critical, if not the critical, element. Many of these transactions cross national boundaries; as do the disputes which inevitably arise from them. But international intellectual property disputes present complexities not encountered in either intellectual property disputes which are confined to one country or other international commercial disputes.

POSITION IN INDIA

The Arbitration and Conciliation Act, 1996 was created on the lines of the Model Law on Arbitration of the UNCITRAL (United Nations Commission on International Trade Law). India adopted the Act by repealing the existing three separate arbitration laws

with respect to domestic arbitration, international commercial arbitration and the enforcement of foreign arbitral awards. Part I of the Act provides provisions for domestic arbitrations and some provisions such as Section 9 (interim measures by Court), Section 27 (Court assistance in taking evidence) and Section 37 (appealable orders) also apply to international arbitrations, while Part II of the Act deals with the Enforcement of Foreign Awards.

In Part II of the Act, Section 48 is analogous to Article 36 of the UNCITRAL Model Law. A foreign award can be enforced in a Court in India, unless such an award is not affected by the limitations provided in this Section. In the case of Intellectual Property Rights, the arbitrability of the dispute and whether the enforcement of the award would be in conflict with the public policy are the concerns to be addressed. Section 34(2)(b) of the Act also provides for recourse to a Court for setting aside an award if it finds that the subject matter of dispute is not capable of settlement by arbitration under the law for the time being in the country and of the arbitral award being contrary to public policy of India.

The stand of India towards arbitrability of IP disputes is a little complicated but logical. The policy debate arises because of the distinction between rights in rem and right in personem, also between judgment in rem and judgment in persona. The scope of remedies that should be available to parties in intellectual property arbitration is a source of controversy.

The judgment in personem is in form, as well as substance, between the parties claiming the right; and that it is so inter parties appears by the record itself. A judgment in rem is adjudication, pronounced upon the status of some particular subject-matter, by a tribunal having competent authority for that purpose. Disputes seeking judgment in rem are thus generally considered to be unsuitable for private arbitration, although this is not a rigid rule. The Apex Court in *Booz Allen Case* has stated that subject matter of arbitration that involves only rights in personem are arbitral in nature, but no matter involving right in rem, for example, with validity proceedings, where the effect of the award could potentially be to discontinue the existence or enforceability of the monopoly, can be put before any private arbitral tribunal for decisions.

However, the Supreme Court also recognized that this rule isn't

infallible and that subordinate rights in personem that arise from rights in rem might be subject to arbitration, for example, if the IP disputes arise from commercial arrangements for the use of Intellectual Property, they are arbitral disputes. While dealing with the similar issue the bench of the Hon'ble High Court of Bombay headed by Justice G.S. Patel in the case of *Eros International Media Limited v. Telemax Links India Pvt. Ltd. and Ors*, held that IP Dispute arising out of a commercial contract, like between two claimants to a copyright or a trademark in either an infringement or passing off action, that action and that remedy can only ever be an action in personem and hence such IP disputes are arbitral in nature.

A. Copyrights

The judicial doctrine that has evolved with regard to the limit of arbitrability is that all disputes relating to rights in personam are considered to be amenable to arbitration and all disputes relating to rights in rem are required to be adjudicated by courts and public tribunals.

In this regard, the Delhi High Court in the matter of *HDFC Bank v. Satpal Singh Bakshi*, observed that 'all disputes relating to "right in personam" are arbitral and choice is given to the parties to choose this alternate forum. On the other hand, those relating to "right in rem" having inherent public interest are not arbitral and the parties choice to choose forum of arbitration is ousted'.

In a recent landmark judgment of *Eros International*, an application was moved by the defendant (Telemax) under Section 8 of the Arbitration and Conciliation Act, 1996, and the question arose whether under law there is a specific bar to arbitration or the arbitrability of such Intellectual Property disputes and whether such disputes are only amendable to jurisdiction of courts. In brief, the background of the case was that Eros (plaintiff) had copyright in several feature films. It executed a term sheet contract with Telemax (defendant) for granting content marketing and distribution rights in respect of films. The said term sheet had an arbitration clause. Also, while the term sheet contemplated the execution of an agreement within a limited time, however, no such agreement was executed.

Disputes arose between the parties and Eros (plaintiff) filed a suit for infringement of copyright against Telemax and the subsequent licensees. Eros argued that Telemax was not entitled

to exploit and deal with such content before execution of the agreement. On the other hand, to counter the suit, Telexmax filed an application under Section 8 of the Arbitration Act stating that all disputes (including under the present suit) between Eros and Telexmax be referred to arbitration in view of the arbitration clause in the term sheet, which aspect came to be decided as part of the decision.

Eros contended that term sheet was not binding and that Telexmax had infringed its copyright and had also sub-licensed this copyright-protected material to the other defendants to the suit. Eros argued that the action against Telexmax was not for breach of a contract, but was a statutory action under the Copyright Act, which is inherently non-arbitral. Eros also contended that the other defendants were not a party to the term sheet. Telexmax argued that the dispute arising out of the term sheet was purely contractual and not simply an action for copyright infringement. Telexmax further argued that by the suit, Eros sought to enforce a right in personam as opposed to a right in rem. Further, the other defendants, who were not parties to the term sheet, were in the nature of persons claiming through or under Telexmax (under the amended Section 8) and had also filed affidavits agreeing to submit the entire dispute to arbitration. Telexmax also argued that there was no specific bar on the arbitrability of such disputes and relied on the decision of the Supreme Court of India in *Booz Allen & Hamilton Inc v. SBI Home Finance Limited & Ors.*

The Court while deciding in favor of the defendant, observed that provisions of the Copyright Act and the (Indian) Trade Marks Act, 1999 (Trademarks Act) do not oust the jurisdiction of an arbitral panel, they only seek to ensure that such actions are not to be brought before the Registrar or the board. Further, where there are matters of commercial disputes and parties have consciously decided to refer these disputes arising from that contract to a private forum, no question arises of those disputes being non-arbitrable. Such actions are always actions in personam, one party seeking a specific relief against a particular defined party, not against the world at large. Eros' action is in personam as it is seeking a particular relief against a particular defined party.

This decision makes it abundantly clear that although under trademark and copyright law, registration grants the registrant

a right against the world at large and it is possible that an opposition to such an application (before the Registrar) would be an action in rem, however, an infringement or passing off action binds only the parties to it.

B. Patents

In case of Patents in India, Arbitration is available as a means to resolve disputes but is not widely used. However, arbitration is not available to determine matters of invalidity, as the Patent Office does not recognize arbitral awards in this respect. Only the disputes arising out of contracts between parties, like patent licensing disputes, can be subject to arbitration.

The significance of arbitration in the area of Intellectual Property is the ensured confidentiality of subject matter of dispute among the parties. But in a country like India, the difficulty arises in balancing the interests of the parties in maintaining confidentiality, and the interests of the public, thereby, preventing the arbitration of disputes involving rights in rem or third-party interests. The confidentiality conflicts with the public interest especially, in having the outcome of revocation proceedings be published. The answer to this criticism is that any award which is against the public policy of India can be challenged before the appropriate court of law, arbitral awards relating to patent infringement or validity could be denied as being against public policy or patently in violation of statutory provisions.

Challenges with respect to confidentiality of IP disputes which affect public at large can be addressed through legislation requiring that some or all of the proceeding be publicly disclosed. For example, USA laws explicitly allow arbitration of patent validity and infringement issues and arbitration of "any aspect" of patent interference disputes but a copy of any arbitral award must be given to the United States Patent and Trademark Office. The award is unenforceable until this notice is given. Similarly, Switzerland practices the registration of an arbitral award with the authority which issues and maintains patents. Also, awards rendered in connection with the validity of intellectual property rights are recognized as the basis for entries in the register, provided these awards are accompanied by a certificate of enforceability issued by the Swiss court at the seat of the arbitral tribunal in accordance with Article 193 of the Swiss Private International Law Act.

Arbitration is a consensual means of dispute resolution, requiring all parties involved to submit the matter to arbitration, failing which this method of dispute resolution would fail to operationalize. The agreement to arbitrate, which embodies the consent of the parties, obtains a binding force as a result of national and international support extended to it through domestic and international law. Most jurisdictions have modified their domestic laws to reflect the Model Laws prepared by UNCITRAL and recommended for adoption by the United Nations General Assembly. Internationally, instruments such as the New York Convention on the Recognition and Enforcement of Foreign Arbitral Awards 1958, adhered to by 156 States, provided for expedited enforcement of a valid arbitration agreement and award rendered in a contracting state in the territory of another contracting.

Arbitrability refers to the question of whether a particular dispute can be submitted to arbitration or it befits solely to the jurisdiction of the courts. Both the New York Convention, 1958 and the Model Law on International Commercial Arbitration, 1985 provide for settlement of international disputes by way of Arbitration. It also involves the recognition and enforcement of foreign awards by the courts of different jurisdictions. Whether a particular dispute falls within the ambit of arbitrability under a given law, is fundamentally a matter of Public Policy. Public policy varies from state to state and constantly evolves with changes in the society.

As already discussed, patent rights are the property rights conferred by the State upon an inventor. These are statutory monopoly rights which are granted to the patentee to manufacture and market their inventions for commercial gains for a specified period of time. These rights could be exigent to the overall development of the society.

Intermittently it is contended that since these are territorial rights created by a sovereign entity, only the courts of this sovereign entity should have the authority to adjudge matters relating to such rights. It has been held that a patent right is available against the whole world at large. On the other hand, Arbitration, as a dispute settlement resolution, is the outcome of a concerted agreement between two parties who are bound by certain rights and obligations towards each other. Consequently, concerns were raised with respect to subject matter of arbitrability of

patent disputes throughout the international community. In the beginning, disputes pertaining to the rights and entitlements to intellectual property could not, for a long time, be referred for arbitration. However, with the passage of time, disputes arising from commercial arrangements such as transfer or assignment of rights, license agreements or multi-jurisdictional disputes, were considered to be *prima facie* arbitrable. It is justifiable to conclude that since the nature of the relationship between the parties is purely contractual in the above cases, arbitration agreements may be entered into, and the awards thereto shall be considered as final and binding.

The municipal laws of various countries have different stands over subject matter arbitrability of patent disputes. United Kingdom and Singapore allow arbitration in Intellectual Property rights, but to a limited extent and with the prior sanction of the court. USA and Switzerland, on the contrary, follow a liberal approach. As a matter of fact, the United States Code expressly provides for arbitration in case of any kind of patent disputes.

It is also noteworthy, that the issue of subject matter arbitrability of patent disputes has been laid down as a condition precedent for the recognition and enforcement of foreign award under the New York Convention, 1958. Article V of the said convention provides that if a contracting state does not consider a subject matter capable of arbitration, an agreement to arbitrate on such subject matter be considered as invalid and shall be refused enforcement.

Hence, voluntary arbitration is more or less dependent upon the municipal laws of a country in so far as they are in compliance with the International Conventions.

CONCLUSION

Though there are various benefits of using arbitration as a method for resolving IP disputes there are also many criticisms against it. One of the biggest criticisms against arbitration in IP is that it is binding only between the parties and does not set a public precedent as regards its use as a deterrent to infringement and establishing a culture of integrity. Parties also do not actually resort to arbitration primarily on account of finding suitable arbitrators or because of jurisdictional issues in case of international contracts. One also needs to ponder on the effect of the counterclaim or defense of revocation in

cases of infringement. As these remedies or reliefs are in rem, henceforth, the parties would have to turn to the relevant forum for resolution of that claim. So, whether such action would render the entire dispute non-arbitral or the tribunal may stay its proceedings until the appropriate forum decides on the validity of the copyright/ trademark/ patent? This is, however, far from ideal as it would delay the arbitration and substantially increase costs.

The conclusion which can be drawn in relation to the arbitrability of IP disputes in India is that it is a budding scheme which needs legislative support and a proper mechanism for better implementation. Though court rulings are quite unclear in the present scenario still it can be inferred that IP disputes are arbitrable, but still there is a long way ahead.

The one possible solution for addressing this issue in regard to enhancing arbitration in India is to provide for the arbitrability of IP disputes in the Arbitration and Conciliation Act, as well as the Indian Copyrights Act and Patents Act. In providing so, it not only eliminates the confusion regarding the arbitrability of Copyright and Patent disputes but also prevents further litigation in the light of public policy. An amendment to the Arbitration and Conciliation Act including the arbitrability of IP disputes, and also amendments to the Copyrights Act and Patent Rights authorizing the parties to subject the dispute to arbitration would clear the complications involved in such arbitrations.

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8

Intellectual Property Rights (IPR) in Digital Environment: An Overview in Indian Digital Environment

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ABSTRACT

In the present scenario, IPR awareness is the key to technological innovations and in the emerging knowledge-based economy; the importance of IPR is likely to go further. The awareness among the creators of information and knowledge about IPR has become essential in the digital environment because in the digital environment it is becoming difficult to prove rights violation whenever they occur. In the present paper we are discussing of Intellectual Property Rights (IPR) in the Digital environment. We are focusing an overview of IPR in Indian digital environment.

Keywords: Intellectual Property Rights (IPR), Digital Environment, Information and Communication Technology.

INTRODUCTION

IPR is a general term covering patents, copyright, trademark, industrial designs, geographical indications, protection of layout

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design of integrated circuits and protection of undisclosed information (trade secrets). IPRs refer to the legal ownership by a person or business of an invention/discovery attached to particular product or processes which protects the owner against unauthorized copying or imitation. || (Business Guide to Uruguay Round, WTO, 1995) [1]

What is Intellectual Property?

Intellectual property refers to the product of a person's imagination and creativity and the rights of these people to control the use of their products. Intellectual property can be bought, sold, exchanged and licensed to other people or organizations by the intellectual property holder. Intellectual property is insubstantial and is not linked to the tangible artistic, dramatic or musical work which may have resulted from it. For example: a book is actual property and can change hands without affecting the intellectual property (in this case copyright) of the artist. Intellectual property is protected by intellectual property law. There are six major types of intellectual property law: copyright, patents, designs, trademarks, circuit layouts and new plant varieties; however, confidential information, the duty of fidelity, trade secrets, confidentiality and moral rights are also included.

HISTORICAL BACKGROUND

Through the years history has documented remarkable men and women which have contributed much of their facts to improving society. Intellectual Property Rights plays a very important role in not just protection the individual to protect the use of their facts from misuse but it was meant to promote originality and creativity. Intellectual Property Rights has evolved with the appearance of new technologies its possibility has grown and several factors including globalization of economies as well as changes in the way businesses operate and politicization of IPR issues have been factors influencing its direction. If one were to assess the Philippine setting it would appear that our progress is slow compared to our other neighbors. Our earliest record of laws on intellectual property rights dated back in 1947. We joined the World Organization (WIPO) in 1980 only after 10 years after it was established and our Intellectual Property code has only taken into effect during 1987. Furthermore the country is viewed as one of the nations that are weak in enforcing laws governing Intellectual Property. Resulting in Millions

lost in revenue for corporations and the government in taxes. Consistent enforcement is critical because of the reality that there are people who do not respect the Intellectual property rights of others. The reason may vary from greed, lack of awareness, perceived necessity, criminal intent or even an innocent mistake. When illegal copies take market share or even kill a potential market the enforcement mechanisms become vital to not only protect the players and the entities but also the general public as well. Most of the industries that are affected include computer software, music, films, luxury goods and fashion, perfumes, books, watches, medicine among others. According to World Intellectual Property Organization (WIPO) the factors that influence the increase include a significant gap in the consumer purchasing power, inability to meet the market demand and emergence of new technologies making it easier to produce volumes of illegal copies at faster rate. Enforcement measures are in the form of actions involving administrative, criminal, civil and technological. But in order to succeed a concerted effort to enhance public awareness and a strong political will can make a difference in minimizing if not eradicating the problem.

Why Intellectual Property Rights:

The Intellectual Property rights were basically documented and accepted all over the world due to some very significant reasons. Some of reasons for accepting these rights are:

1. To provide incentive to the individual for new creation.
2. Providing the recognition to creators and inventors.
3. Ensuring material reward for intellectual property.
4. Ensuring the availability of genuine and original products.

NEED OF IPR

1. Monetary profit is the most important, in most cases, the only motive behind man's relentless toil, inventiveness and ingenuity.
2. With the advent of technology one of issue is legal characterization of the new invention.
3. It is created to protect the rights of individual to enjoy their creations and invention.
4. Created to insure protection against unfair trade practices.
5. To assure the world a flow of useful, informative and intellectual works.

6. To encourage the continuing innovativeness and creativity of owners of IPR.

LITERATURE REVIEW

Bomanwar considered intellectual property rights in the context of new information society, noted the thrust area of economic activity shifted to knowledge based industries and intellectual goods, and described impact of piracy of intellectual property act viz. viopiracy, geopiracy and IT products of new information society. He noted that developed countries demand protection against piracy while developing countries feel that such protection will prevent entry of new comers and felt that in the free flow of information IPR was hurdle to it [2].

Panda; K C and others examined copyright law in the electronic age and noted proliferation of electronic information creating interest in the minds of authors, publishers, users and intermediates regarding the copyright law. Discussed the role of IFLA in the protection of copy right in the global scenario and concluded that there is an urgent need to reconsider the existing copyright law to make it suitable in electronic age [3].

Lakshmana Moorthy, A and Karisiddappa, C.R. observed copyright and electronic information, observed the main objectives of copyright law as promoting the access and the use for information and protecting the work from infringement and for encouraging the authors for pursuit of knowledge. They discussed the Indian Copyright law 1957 and its amendments; mentioned major worldwide projects to protect copy right of electronic information and concluded that the library professional should negotiate few electro copying privileges for legitimate non-commercial usage of electronic information similar to the kind of fair use as in the case of printed materials [4].

Murthy, T.A.V. and Jain, S.P. they found the present copyright law which was framed after the invention of the printing press as by and large being forced on the existing electronic environment and felt that there is need to modify the IPR which confers exclusive right to the author to exploit the work created by him/her for monitory gains in compensation of labour, skill and capital investment in generating information. [6]

DIGITAL LIBRARIES

Digital Libraries (DL) are now emerging as a crucial component of global information infrastructure, adopting the latest information and communication technology. Digital Libraries are networked collections of digital texts, documents, images, sounds, data, software, and many more that are the core of today's Internet and tomorrow's universally accessible digital repositories of all human knowledge.

According to the Digital Library Federation (DLF, USA - <http://www.dlf.org>), "Digital libraries are organizations that provide the resources, including the specialized staff, to select, structure, offer intellectual access to, interpret, distribute, preserve the integrity of, and ensure the persistence over time of collections of digital works so that they are readily and economically available for use by a defined community or set of communities".

In India currently the concept 'Digital Library' is being practiced by and large loosely or even confused by many information systems. It is therefore imperative that the concept is properly understood so that there is no ambiguity while we progress with the work of designing or developing a digital library which is fully justified in the technical sense of the word. It is important that embarking on a digital library project is something which will take away substantial amount of time, energy, manpower and of course the hard earned money being pumped into it – be it for system development or towards development and maintenance of the collection, in a meaningful way. There is consensus all over that there exists a very large quantum of digital information, scholarly as well as trade, which are scattered and distributed throughout the Net and also being stored in numerous other databases and repositories spread across the world. Also there is an unprecedented technology support and availability of infrastructure for digital libraries. [7]

IPR IN INDIAN DIGITAL ENVIRONMENT

Deming Zhou while discussing Chinese copyright protection system has raised specific issues of IPR in digital context. These are also relevant in the Indian context. The advent of digital technology has greatly accelerated the dissemination and distribution of information with great speed and accuracy never seen before. It is much easier to disseminate literary, artistic and scientific work to a very large community of Internet users and

users of electronic media. At the same time poses some problems and issues for consideration. The major issues are,

Is digitization to be considered as similar to reproduction, for example using Xerox machine?

Is digitization a deductive activity such as translation from one language to another? Can transmission of digitized documents through Internet be considered as commercial distribution or public communication similar to broadcasting?

Is the principle of exhaustion of the distribution right still effective in the digital age? Can we consider a database as a special collected work that should be protected by the copyright law or it can be considered as a special work requiring specific legislation for its protection?

What can be considered as —Faire use in the Internet environment? What are the concerns of the library community?

In the digital context if access could be technologically restricted by the copyright owner, how could the public exercise fair use with regard to that work?

Whether libraries should be prevented from employing digital technology to preserve work by making three copies—an archival copy, a master copy and a use copy?

Whether Internet Service Providers (including libraries and educational institutions) should be liable for copyright infringement merely because they facilitated the transmission of digital data (Zeroes and Ones) that translated into another party's copyrighted work.

The issues mentioned above are specific to the library community. The libraries as a service have allowed their users to read a document, to browse through the whole collection; to search through the library catalogue; to supply Xerox copy for specific individual research and education purpose; to procure photocopies of articles from other libraries or clearing centers; to widely distribute the re-produced copies of documents requiring public awareness and to provide inter library loan service. Whether all these activities will continue in the digital age? If digitization is considered as reproduction, it is clear that in digitization the initial work is merely changed into the digital form and the process of changing is accomplished by a machine, without any creativity. At the same time if it is considered as a translation from one language to another, the

digitization is also a change from natural language of humans in to binary language of machine. In digitization however, there is no creativity involved and it could be considered as an activity similar to reprography. The copyright protects creative works. Simply transformation in to the digital form of an original document cannot be considered as creative. [8]

IPR DEVELOPMENTS IN INDIA

- **1947:** Patents & Designs Act, 1911
- **1995:** India joins WTO
- **1998:** India joins Paris Convention/PCT
- **1999:** Patent amendment provided EMR retrospectively from 1/1/95
- **2003:** 2nd amendment in Patents Act
- **Term of Patent** – 20 years after 18 months publication
- Patent Tribunal set up at Chennai
- **2005:** Patents (Amendment) Act 2005
- **1999 – 2005:** Plant Varieties and Farmers' Rights Act & Biodiversity Act. Designs, TM/Copyright Acts updated GI Registry set up at Chennai. IP Acts TRIPS Compliant

HOW TO SECURE IPR

The legislative framework for securing IPR is as follows:

1. Contract Act, 1872
2. The Trade Marks Act, & (Amendment) 1999, 2002
4. Copyright Act, 1957 & (Amendment) 1994, 1999, 2012
5. The Patents Act, 1970 & (Amendment) 2005, 2006
5. The Designs Act, 2000, 2008
6. Plant Breeder Right, 2001
7. Geographical Indications of Goods (Registration and Protection) Act, 1999, 2002

CONCLUSION

According to this paper we found the conclusion that, before the advent of Information and Communication Technology (ICT), IPR and copyright laws were seen as a dull and almost irrelevant area of law relating to information provision. But with the use of ICT the IPR now have become central point and one of the most dynamic and fast moving areas of law. In the present

scenario, IPR awareness is the key to technological innovations and in the emerging knowledge-based economy; the importance of IPR is likely to go further. The awareness among the creators of information and knowledge about IPR has become essential in the digital environment because in the digital environment it is becoming difficult to prove rights violation whenever they occur. In the context of digital information, because it is distributed to a larger community, it is difficult to judge, —fair use, access and control the infringement of copyright law. It is almost impossible for a copyright owner to know which person used his/her work. It is also impossible for copyright owner to give permission to use and receive remuneration. In this context it is necessary to modify the copyright law. The librarians in the digital environment have the same responsibility to collect information and help the readers by giving it even if the form is electronic information. The role of librarian is to be protected and enhanced. The copyright protection should be encouraging the use of information for creativity and not for creating hurdles in the use of information. The Librarians should continue to work as catalyst for the free flow of information between the owners of copyright and the users of the information.

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Exigency of Intellectual Property Right (IPR) in Research

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ABSTRACT

Intellectual property rights (IPRs) are the property rights provided to an inventor or creator of some new research work. IPR holder has monopoly on the usage of his or her work for a period of time. Since IPR is a part of the legal system there may be a misconception that it is only related to law practitioners but there is exigency of it for every individual to protect their property / work. Lack of knowledge about IPR or improper implementation of it may cause impairment to the society. The present paper deals with various types of IPRs (patents, copyrights, trademarks and trade secrets), National IPR Policy, Patents act in India, World Intellectual Property day and Importance of IPR. Further, world intellectual property day themes has been discussed.

Keywords: *Intellectual property right, research, patents, copyrights, trademarks.*

INTRODUCTION

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With increasing technology and decreasing world boundaries, the term ‘Intellectual Property Rights (IPRs)’ is coming to be used more often than earlier. From research laboratories of Universities, colleges and R&D laboratories everyone is vigil about protecting their Intellectual Property. Therefore, it becomes important to understand what Intellectual Property is and what are the rights that individual acquire as their Intellectual Property rights.

Every individual who creates a literary work or invents an industrial technology is vested with certain rights such as the exclusive right to such literature or invention, right to gain monetary benefits from such intellectual property. All such rights that accrue to a person from the creation of intellectual property are known as Intellectual Property Rights.

Intellectual Property Rights can be held by an individual or a company. Generally, rights pertaining to literary works are held by an individual and industrial inventions are held by companies.

VARIOUS TYPES OF IPRS

There are four main types of intellectual property rights, they are

1. Patents

Patent law protects inventions from use by others and gives exclusive rights to one or more inventors. Technology companies commonly use patents, as seen in the patent for the first **computer** to protect their investment in creating new and innovative products. The three types of patents consist of:

- **Design patents:** Protection for the aesthetics of a device or invention. Ornamental design patents include a product's shape, emojis, fonts, or any other distinct visual traits.
- **Plant patents:** Safeguards for new varieties of plants. An example of a plant patent is pest-free versions of fruit trees. But inventors may also want a design patent if the tree has unique visual properties.
- **Utility patents:** Protection for a product that serves a practical purpose and is useful. IP examples include vehicle safety systems, software, and pharmaceuticals. This was the first, and is still the largest, area of patent law.

2. Trademarks

Trademarks protect logos, sounds, words, colors, or symbols used by a company to distinguish its service or product. Trademark examples include the Twitter logo, McDonald's golden arches, and the font used by Dunkin'.

Although patents protect one product, trademarks may cover a group of products.

3. Copyrights

Copyright law protects the rights of the original creator of original works of intellectual property. Unlike patents, copyrights must be tangible. For instance, you can't copyright an idea. But you can write down an original speech, poem, or song and get a copyright.

Once someone creates an original work of authorship (OWA), the author automatically owns the copyright.

4. Trade Secrets

Trade secrets are a company's intellectual property that isn't public, has economic value, and carries information. They may be a formula, recipe, or process used to gain a competitive advantage.

NATIONAL IPR POLICY

Main objectives of national IPR policy are :

1. **IPR Awareness: Outreach and Promotion** - To create public awareness about the economic, social and cultural benefits of IPRs among all sections of society.
2. **Generation of IPRs** - To stimulate the generation of IPRs.
3. **Legal and Legislative Framework** - To have strong and effective IPR laws, which balance the interests of rights owners with larger public interest.
4. **Administration and Management** - To modernize and strengthen service oriented IPR administration.
5. **Commercialization of IPR** - Get value for IPRs through commercialization.
6. **Enforcement and Adjudication** - To strengthen the enforcement and adjudicatory mechanisms for combating IPR infringements.

- 7. Human Capital Development** - To strengthen and expand human resources, institutions and capacities for teaching, training, research and skill building in IPRs.

PATENTS ACT IN INDIA

In the Patents Act, 1970, 18 chapters are there, they are :

Chapter I	-----	Preliminary
Chapter II	-----	Inventions Not Patentable
Chapter III	-----	Applications for Patents
Chapter IV	-----	Publication and Examination of Applications
Chapter IV.A	-----	Exclusive Marketing Rights (Omitted)
Chapter V	-----	Opposition Proceedings to Grant of Patents
Chapter VI	-----	Anticipation
Chapter VII	-----	Provisions for Secrecy of Certain Inventions
Chapter VIII	-----	Grant of Patents and Rights conferred thereby
Chapter IX	-----	Patents of Addition
Chapter X	-----	Amendment of Applications and Specification
Chapter XI	-----	Restoration of Lapsed Patents
Chapter XII	-----	Surrender and Revocation of Patents
Chapter XIII	-----	Register of Patents
Chapter XIV	-----	Patent Office and Its Establishment
Chapter XV	-----	Powers of Controller Generally
Chapter XVI	-----	Working of Patents, Compulsory Licences and Revocation
Chapter XVII	-----	Use of Inventions For Purposes of Government and Acquisition of Inventions by Central Government
Chapter XVIII	-----	Suits Concerning Infringement of Patents

THE PATENTS ACT

Every April 26, we celebrate World Intellectual Property Day to learn about the role that Intellectual Property (IP) rights play

in encouraging innovation and creativity. World Intellectual Property 2022 recognizes the huge potential of young people to find new and better solutions that support the transition to a sustainable future. In view of this the theme of World Intellectual Property Day 2022 is **“IP and Youth: Innovating for a Better Future”** and celebrates youth-led innovation and creativity.

IMPORTANCE OF IPR

IPR protects the monetary as well as non-monetary interest of the inventor. Non monetary benefits include due credit to author while publication of your work in a scientific journal or for further studies.

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Various Steps of Patent Filing in India

Sridevi Motupalli & Rupavalli. T***

ABSTRACT

*Intellectual property rights (IPRs) are the property rights provided to an inventor or creator of some new research work. IPR holder has monopoly on the usage of his or her work for a period of time. Since IPR is a part of the legal system there may be a misconception that it is only related to law practitioners but there is exigency of it for every individual to protect their property / work. Lack of knowledge about IPR or improper implementation of it may cause impairment to the society. There are four main types of intellectual property rights, including patents, trademarks, copyrights, and trade secrets. With globalization and the advancement of technology, innovative inventions to simply human existence have increased exponentially. The patent application process is a critical component of protecting such inventions. It allows inventors to protect their inventions and profit from their commercialization, hence increasing innovation and economic progress. The **patent registration process in India** ensures that an invention satisfies **patentability requirements in India** such as novelty, non-obviousness, and industrial applicability. It encourages inventors to invest in Research & Investment, which can lead to technological advancements and overall economic prosperity. To*

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properly comply with the patent application process, inventors must understand it and seek the aid of experienced patent attorneys. The present paper deals with the various steps involved in patent filing in India, they are Conceiving your Invention, Patent Search and Drafting, Filing the Patent Application, Publication of the Application, Request for Examination, Respond to the Objections, Grant of Patent.

Keywords: Intellectual property right, research, patents, copyrights, trademarks.

INTRODUCTION

Intellectual Property Rights (IPRs)

Intellectual property rights (IPRs) are the property rights provided to an inventor or creator of some new research work. IPR holder has monopoly on the usage of his or her work for a period of time. There are four main types of intellectual property rights they are, patents, trademarks, copyrights, and trade secrets. The patent registration process in India ensures that an invention satisfies patentability requirements in India such as novelty, non-obviousness, and industrial applicability. It encourages inventors to invest in Research & Investment, which can lead to technological advancements and overall economic prosperity.

Various Steps of Patent Filing in India

There are 9 steps involved in patent filing in India, they are

1. Securing our Novel Idea and Invention (NDA)
2. Verify Whether Your Idea Satisfies the Patentability Criteria
3. Patent Draft
4. Filing the Patent
5. Publication of the Patent Application
6. Examination Request by Inventor
7. Responding to Examiner's Objections
8. Patent Grant
9. Renewal of Patent

Step1- Securing our Novel Idea and Invention (NDA)

One of the concrete reasons for getting the **patent** is our novel and unique idea. The **patent** regime is created to protect inventors' rights and encourage them to pursue as many inventions as possible.

So, it can be understood that a single fresh ‘idea’ capable of getting our **patent** holds greater importance than anything. So, our duty as an inventor is to protect our idea and invention at all costs. Secure our idea with as many details as possible by writing it down and saving it as a soft or hard copy. Another significant step is to make sure we made them sign the **Non-Disclosure Agreement (NDA)** before disclosing our idea to any agency or patent filing professional.

Step 2 – Verify Whether Your Idea Satisfies the Patentability Criteria

Although this is an optional step, this is going to save your time, cost, and efforts by many folds.

After conducting the novelty and patentability search, you can get an idea about whether your invention is worth getting a patent or not. With this method, you can clearly understand whether you should file a patent in the first place.

Step 3 – Patent Draft

Drafting the patent requires knowledge of legal drafting techniques and technical details. You can pick between a provisional patent application and a complete patent application based on your invention stage.

If the invention is at the testing stage, opt for a provisional patent application which gets you 12 months to improve your invention to the final stage. The patent draft must include all the important clauses, detailed descriptions, inventive steps, patent specifications, and more to survive till the end of **patent registration** and further commercialization. The clauses should be drafted so that no competitor or person can misuse your invention for their benefit. Be meticulous and give special attention to the patent draft.

Step 4- Filing the Patent

Following the patent draft, you can file your patent application at the government office, and they will provide you with the patent application number that comes with many benefits. The main advantage of filing a patent application is that you can use words like patent-pending/patent applied for your invention, which prevents any other person from misusing your idea. Application forms must be filed along with your patent application, such as Forms 1, 2, 3, 5, 26, 28, and other relevant applications.

Step 5 - Publication of the Patent Application

Once you file your patent application, the Indian Patent Office will safeguard it. Your patent will be published in the “official patent journal” after approximately 18 months. If you are an inventor who wishes to have your patent published before the 18-month timeframe, you can submit Form 9 with an early publication request. Your patent will be published within a month of the early request. However, it’s possible that your patent might not be published in some cases due to incomplete applications, withdrawal requests, and other reasons.

Step 6 - Examination Request by Inventor

Unlike the automatic 18-month period followed in the publication of a patent, the examination of the patent is not automatic and requires the applicant’s or inventor’s request for inspection.

The inventor shall file Form 18 (Form 18 (A) for expedited or faster review for certain applicants) and formally request the patent office to examine the patent. Following the formal request, the patent officer examines your patent application in a prescribed way .

Verify the following points during the examination:

1. The patent application is reviewed according to the Patent Act and relevant provisions thereof
2. The patentability criteria like novelty, non-obvious and inventive step, industrial application, patentable subject matter, etc., are searched and verified
3. Following the patent scrutinization, the examiner releases the first examination report (FER) along with grounds for any objections

The objections made by the examiner can further extend the application by 6-9 months

The inventor can request the time extension by submitting Form

Step 7 – Responding to Examiner’s Objections

After filing Form 4, the inventor and the patent attorney shall analyze and comprehend the examination report. The patent agent creates a written response to the objections raised, proving the invention is patentable and novel. The written response shall indicate that your design satisfies all the patentability criteria.

Step 8 – Patent Grant

Suppose the examiner is satisfied that your invention meets all the patentability criteria and finds no objections. In that case, the patent is granted to you and then published in the 'official patent gazette'.

Step 9 – Renewal of Patent

Once the patent is granted, it must be renewed at specific intervals. According to the TRIPS agreement, the maximum period of the patent grant is 20 years in India. So, the patent needs to be renewed for an entire 20-year period.

Important Documents Required For the Patent Registration

Form 1 – Application for Patent Grant

Form 2 – Patent Specification Form

Form 3 – Undertaking and Statement with Regards to Foreign Applications Under Sec.8

Form 5 – Invention Declaration to Be Filed with Complete Application

- Power of Attorney
- Priority Documents
- Invention Abstract
- Any Other Documents as May Be Prescribed

CONCLUSION

To properly comply with the patent application process, inventors must understand the above steps clearly and seek the aid of experienced patent attorneys. It allows inventors to protect their inventions and profit from their commercialization, hence increasing innovation and economic progress.

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Summary on Patent Rights

*K.V.R.B Varalakshmi**

An invention is a new product or process that offers a new way of doing something, or offers a new technical solution to a problem. Inventions can be patented.

We need to know some points about an invention, many people think invention is a flash of inspiration or genius is necessary to spark the creativity or inventions but it must be noted that most of the patented inventions are not major breakthroughs but incremental though non-obvious technical improvements over the relevant prior art.

A patent Is a government-granted right for an inventor to exclude others from making, using, offering to sell, or selling the invention for a limited period of time in exchange for the public disclosure of the invention.

Reasons for patenting an invention it gives competitive edge , market power and earning money.

A patent is a type of intellectual property protection (IP).So first we will know what a intellectual property in detail (IP), is defined as the property resulting from creations of human mind ,the intellect. In this regard, it is fair the person making efforts for an intellectual creation has some benefit as a result of this endeavor. Probably, the most important thing among

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intellectual properties is Patent. Others IP protection include copyrights, trademark and trade secrets.

To be patentable, an invention must meet the following criteria: It must be new. This means that it must not have been previously known or used by others. It must be useful. This means that it must have a practical application.

The process of patenting an invention can be complex and time-consuming. It is important to consult with an lawyer who specializes in patent law to ensure that invention is properly protected.

Once an invention has been patented, the inventor has the exclusive right to make, use, sell, and offer for sale the invention for a period of 20 years from the filing date of the patent application.

A patent provides its owner a right to exclude others and not a right or freedom to use or to make or offering to sale or importing a product or process.

The process of obtaining a patent can be long and expensive. It typically takes several years and costs thousands of dollars.

Patents may be bought, sold or licensed. Patents may also serve as a collateral for bank loans.

Most venture capitalists, investment bankers, financial analyst And other investors favorable recognize the value of patent.

Products use Patents to signal higher technological capabilities, superior performance in your advertisements and marketing.

Preparing a patent application requires

Detailed technical information about the features of the claimed invention, how the invention can be made or carries out and it's application in industry or commerce.

It should contain title, bibliography and an abstract also.

The owner of the patent must be careful of patent infringement, if careful and perfect patent is not done.

So technically speaking, patent infringement means others have entered a prohibited space defined by one of the claims in your patent.

You may face competitors And they may stalemate you during their negotiations and competition, so you need strategic partnership, Mergers and Acquisitions, IPO, and Higher sale

price this allows you to make ,sell, use or distribute your new or improved product without your express approval this can eliminate your competition, so here we need to stay alert and checkout for the competition otherwise , he or she may take legal action and may stake you in infringement.

Convoys sales are present in patents when a customer is attracted by a patented improvement of a product, increased sales of non -patented articles this follows when a patented product is a component of a more complex product or sold in association with the other products. Such type of sales are called as convoys sales.

Patents can be done by free online and non-patent database and other paper -based sources of prior art, or if you can afford it you may use the services of a fee based value added patent search provider.

Another important thing about patent is the territorial principle where a patent is a territorial right , this limited to the geographical boundary of the relevant country or region for which it has been granted.

In some countries, utility models is another option that you may able to consider before applying for a patent.

Formality examination, first a patent office examines the application to check if it has complied with all administrative requirements or formalities. If not, then you are notified that efficiencies which must be addressed adequately in the time indicated by the Patent Office.

Next you may undergo A substantive examination with Patent examiner checks to see if the national or regional patent law does not exclude from its purview the subject matter of application or considers the patent, if granted the contrary to the public order or morality.

Some officers do not do any further examination but most of the patent offices of regional and national especially the big also do a fairly complete substantive examination to check if the nation meets all three basic conditions of a patentability namely nobility in inventive step or non obviousness, and industrial applicability.

When a patent application is accepted for grant then depending on the applicable patent law it published in the Official Journal of the Patent Office for inventing objections from the public

which is called as pre grant opposition .Objections to grant of the patent must be filed by any aggrieved party during this period of time.Or it may be published as a granted or without any pre grant opposition depending upon the applicable patent law and then allow the post opposition by agreed third parties.

If the opposition succeeds partially then the patent may still be granted if it fails then you would be granted a patent and a certificate of grant would be issued and the granted patent published in the Official Journal of the of the Patent Office.

Some characteristics of utility models are:

The conditions for granting utility models are less stringent, as the inventive step requirement may be lower or absent altogether.

Procedures for granting utility models are generally faster and simpler than for patents.

Acquisition and maintenance fees are generally lower than those applicable to patents.

For obtaining patent protection in other countries or regions ,many patent applications may have to be filled at the relevant national or regional patent office in the legally prescribed time limit.

To keep an invention secret or confidential, take all the practical measures that are considerably reasonable under the circumstances to ensure the invention is given only to those employees who may need to deal with it and who are under a duty to keep it confidential.

Keeping secrecy is crucial as once a trade secret is lost it cannot be retrieved in most countries.

Here are some of the benefits of patenting an invention:

Patents can help to protect in research and development.

Patents give you a competitive advantage in the marketplace.

Patents can help you to generate revenue from your invention.

Granting a patent also has opposition it is of two types Pre- grand opposition and post grand opposition. This type of opposition depends on the country.

Patents can help you to attract investors and partners.

Patents can help you to build your reputation as an innovator.

If you have an invention that you believe is patentable, it is

important to consult with an attorney who specializes in patent law to discuss your options.

The exclusive rights granted to inventors and assignees for a limited period of time in exchange for the public disclosure of their invention have been instrumental in encouraging new inventions, promoting innovation, and driving economic growth. In this essay, we will explore the concept of patent rights, the history of patents, their importance, and some of the controversies and challenges associated with them.

First, they provide inventors with exclusive rights to their inventions, which can encourage innovation by allowing inventors to recoup their investment in developing new products or processes.

patents promote disclosure and dissemination of new inventions, which can benefit society as a whole by allowing others to build on existing knowledge and develop new products and processes. This can lead to further innovation and economic growth.

CONCLUSION

In conclusion, patent rights are an essential aspect of modern innovation and technology. They provide inventors with exclusive rights to their inventions, promote innovation and economic growth, and encourage the dissemination of new knowledge. As such, it is important to continue to evaluate and improve the patent system to ensure that it continues to promote innovation and benefit society as a whole.

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An Introduction to Intellectual Property Rights and their Importance in Indian Context: Issues and Challenges

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ABSTRACT

Intellectual Property Disputes are principally commercial in nature and often have international dimensions because of people protecting their Intellectual Properties or licensing them in multiple jurisdictions. The question which this paper target is whether arbitration is possible in IP disputes? If yes, then in what kind of disputes is it possible? In the past, many legal systems did not allow the arbitration of IP disputes, simply because the rights had been granted by a sovereign power. It was argued that the nature of the rights was such that questions as to validity should only be decided by the authority which issued the right. However, it is now broadly accepted that disputes relating to IP rights are arbitrable, just like disputes relating to any other type of privately held rights like transfer of granted IP rights as in licensing or any other such commercial arrangements. The research work consists of Theoretical and Analytical Study, based on the collection of data from secondary sources. It is an attempt to understand the significance of Arbitration in respect to the disputes related to Intellectual Property Rights in India.

Keywords: Intellectual Property, Arbitration Awards.

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INTRODUCTION

Intellectual Property Rights has seen a wide development across jurisdictions, especially in the area of commercial transactions which includes a wide range of products and services. There are various international treaties and legislations which have enabled the registration and recognition of copyrights, patents, and trademarks. One of the vital issue in the area is that of arbitration of Intellectual Property disputes. Arbitration in Intellectual Property disputes gives due advantage to the parties in the way of discretion in selecting a competent arbitrator, time and cost efficient, and most importantly, confidentiality in the concerned matter of dispute. In addition to this, arbitration in IP matters is promising as often where an international party is involved, the parties to the dispute might be subject to different jurisdictions individually and arbitration provides a flexible, speedy and a common base for adjudication. Because of these reasons, arbitration is widely favored among international or multinational companies.

The issue in consideration with regard to the intellectual property arbitration lies in the arbitrability of the intellectual property disputes where the right to the intellectual property is given by the sovereign authority and thus, the only competent authority to decide the validity, infringement or interference is the administrative authority. This results in the conclusion that entitlements with regard to intellectual property, and the legal issues which flowed from those rights, could not usefully be referred to or considered by an arbitration tribunal. Another important concern is whether such enforcement of an award would be contrary to the public policy of the country.

Article V of the Convention on the Recognition and Enforcement of Foreign Arbitral Awards specifies the grounds for refusing the enforcement of such award in the case where the subject matter of the dispute is not capable of arbitration under the particular law of the country or in case where enforcement of such an award would be contrary to public policy. Further, Article II(3) of the Convention also specifies that the Courts can refuse to refer the dispute to arbitration if it finds that the agreement to arbitration is incapable of being performed.

Article 36 of the UNCITRAL Model law also provides for grounds for refusing recognition or enforcement of an award, which is also the Article that the Section 48 of the Arbitration

and Conciliation Act, 1996 is based upon. This Section 48 of the Act lays down the condition for enforcement of a foreign award and an award maybe refused in the cases where it meets the requirements of the Section.

The paper shall deal with whether Intellectual Property Rights is arbitral in India and analyses the extent of its arbitrability. The major considerations in this particular case would pertain to whether there is an arbitration agreement specifying the dispute to arbitration, whether all the parties to the suit are also parties to the arbitration agreement and finally, whether the relief sought can be adjudicated or granted in an arbitration. These issues are still in the light of uncertainty and are also of immediate concern, which if addressed, would result in growth in the international arbitration with respect to intellectual property disputes.

On one hand, in the process of international economic globalization, most countries are inclined to acknowledge the IPR as private property rights. On the other hand, courts are overburdened by a large amount of commercial disputes. This has resulted in increasing debates and researches, both academically and practically, on alternative dispute resolution methods, and many countries are inclined to adopt a policy favoring and allowing arbitration and further enlarge the scope of arbitrability. With the world more and more dependent upon technology of all types, the continued and growing importance of intellectual property cannot be understated. There has been, and will continue to be, an accompanying explosion in the number and complexity of transactions in which intellectual property is a critical, if not the critical, element. Many of these transactions cross national boundaries; as do the disputes which inevitably arise from them. But international intellectual property disputes present complexities not encountered in either intellectual property disputes which are confined to one country or other international commercial disputes.

POSITION IN INDIA

The Arbitration and Conciliation Act, 1996 was created on the lines of the Model Law on Arbitration of the UNCITRAL (United Nations Commission on International Trade Law). India adopted the Act by repealing the existing three separate arbitration laws with respect to domestic arbitration, international commercial arbitration and the enforcement of foreign arbitral awards. Part I of the Act provides provisions for domestic arbitrations and

some provisions such as Section 9 (interim measures by Court), Section 27 (Court assistance in taking evidence) and Section 37 (appealable orders) also apply to international arbitrations, while Part II of the Act deals with the Enforcement of Foreign Awards.

In Part II of the Act, Section 48 is analogous to Article 36 of the UNCITRAL Model Law. A foreign award can be enforced in a Court in India, unless such an award is not affected by the limitations provided in this Section. In the case of Intellectual Property Rights, the arbitrability of the dispute and whether the enforcement of the award would be in conflict with the public policy are the concerns to be addressed. Section 34(2)(b) of the Act also provides for recourse to a Court for setting aside an award if it finds that the subject matter of dispute is not capable of settlement by arbitration under the law for the time being in the country and of the arbitral award being contrary to public policy of India.

The stand of India towards arbitrability of IP disputes is a little complicated but logical. The policy debate arises because of the distinction between rights in rem and right in personem, also between judgment in rem and judgment in persona. The scope of remedies that should be available to parties in intellectual property arbitration is a source of controversy.

The judgment in personem is in form, as well as substance, between the parties claiming the right; and that it is so inter parties appears by the record itself. A judgment in rem is adjudication, pronounced upon the status of some particular subject-matter, by a tribunal having competent authority for that purpose. Disputes seeking judgment in rem are thus generally considered to be unsuitable for private arbitration, although this is not a rigid rule. The Apex Court in *Booz Allen Case* has stated that subject matter of arbitration that involves only rights in personem are arbitral in nature, but no matter involving right in rem, for example, with validity proceedings, where the effect of the award could potentially be to discontinue the existence or enforceability of the monopoly, can be put before any private arbitral tribunal for decisions.

However, the Supreme Court also recognized that this rule isn't infallible and that subordinate rights in personem that arise from rights in rem might be subject to arbitration, for example, if the IP disputes arise from commercial arrangements for the

use of Intellectual Property, they are arbitral disputes. While dealing with the similar issue the bench of the Hon'ble High Court of Bombay headed by Justice G.S. Patel in the case of *Eros International Media Limited v. Telex Links India Pvt. Ltd. and Ors.*, held that IP Dispute arising out of a commercial contract, like between two claimants to a copyright or a trademark in either an infringement or passing off action, that action and that remedy can only ever be an action in personam and hence such IP disputes are arbitral in nature.

A. Copyrights

The judicial doctrine that has evolved with regard to the limit of arbitrability is that all disputes relating to rights in personam are considered to be amenable to arbitration and all disputes relating to rights in rem are required to be adjudicated by courts and public tribunals.

In this regard, the Delhi High Court in the matter of *HDFC Bank v. Satpal Singh Bakshi*, observed that 'all disputes relating to "right in personam" are arbitral and choice is given to the parties to choose this alternate forum. On the other hand, those relating to "right in rem" having inherent public interest are not arbitral and the parties choice to choose forum of arbitration is ousted'.

In a recent landmark judgment of *Eros International*, an application was moved by the defendant (Telex) under Section 8 of the Arbitration and Conciliation Act, 1996, and the question arose whether under law there is a specific bar to arbitration or the arbitrability of such Intellectual Property disputes and whether such disputes are only amenable to jurisdiction of courts. In brief, the background of the case was that Eros (plaintiff) had copyright in several feature films. It executed a term sheet contract with Telex (defendant) for granting content marketing and distribution rights in respect of films. The said term sheet had an arbitration clause. Also, while the term sheet contemplated the execution of an agreement within a limited time, however, no such agreement was executed.

Disputes arose between the parties and Eros (plaintiff) filed a suit for infringement of copyright against Telex and the subsequent licensees. Eros argued that Telex was not entitled to exploit and deal with such content before execution of the agreement. On the other hand, to counter the suit, Telex filed an application under Section 8 of the Arbitration Act stating that

all disputes (including under the present suit) between Eros and Telexmax be referred to arbitration in view of the arbitration clause in the term sheet, which aspect came to be decided as part of the decision.

Eros contended that term sheet was not binding and that Telexmax had infringed its copyright and had also sub-licensed this copyright-protected material to the other defendants to the suit. Eros argued that the action against Telexmax was not for breach of a contract, but was a statutory action under the Copyright Act, which is inherently non-arbitral. Eros also contended that the other defendants were not a party to the term sheet. Telexmax argued that the dispute arising out of the term sheet was purely contractual and not simply an action for copyright infringement. Telexmax further argued that by the suit, Eros sought to enforce a right in personam as opposed to a right in rem. Further, the other defendants, who were not parties to the term sheet, were in the nature of persons claiming through or under Telexmax (under the amended Section 8) and had also filed affidavits agreeing to submit the entire dispute to arbitration. Telexmax also argued that there was no specific bar on the arbitrability of such disputes and relied on the decision of the Supreme Court of India in *Booz Allen & Hamilton Inc v. SBI Home Finance Limited & Ors.*

The Court while deciding in favor of the defendant, observed that provisions of the Copyright Act and the (Indian) Trade Marks Act, 1999 (Trademarks Act) do not oust the jurisdiction of an arbitral panel, they only seek to ensure that such actions are not to be brought before the Registrar or the board. Further, where there are matters of commercial disputes and parties have consciously decided to refer these disputes arising from that contract to a private forum, no question arises of those disputes being non-arbitrable. Such actions are always actions in personam, one party seeking a specific relief against a particular defined party, not against the world at large. Eros' action is in personam as it is seeking a particular relief against a particular defined party.

This decision makes it abundantly clear that although under trademark and copyright law, registration grants the registrant a right against the world at large and it is possible that an opposition to such an application (before the Registrar) would be an action in rem, however, an infringement or passing off

action binds only the parties to it.

B. Patents

In case of Patents in India, Arbitration is available as a means to resolve disputes but is not widely used. However, arbitration is not available to determine matters of invalidity, as the Patent Office does not recognize arbitral awards in this respect. Only the disputes arising out of contracts between parties, like patent licensing disputes, can be subject to arbitration.

The significance of arbitration in the area of Intellectual Property is the ensured confidentiality of subject matter of dispute among the parties. But in a country like India, the difficulty arises in balancing the interests of the parties in maintaining confidentiality, and the interests of the public, thereby, preventing the arbitration of disputes involving rights in rem or third-party interests. The confidentiality conflicts with the public interest especially, in having the outcome of revocation proceedings be published. The answer to this criticism is that any award which is against the public policy of India can be challenged before the appropriate court of law, arbitral awards relating to patent infringement or validity could be denied as being against public policy or patently in violation of statutory provisions.

Challenges with respect to confidentiality of IP disputes which affect public at large can be addressed through legislation requiring that some or all of the proceeding be publicly disclosed. For example, USA laws explicitly allow arbitration of patent validity and infringement issues and arbitration of “any aspect” of patent interference disputes but a copy of any arbitral award must be given to the United States Patent and Trademark Office. The award is unenforceable until this notice is given. Similarly, Switzerland practices the registration of an arbitral award with the authority which issues and maintains patents. Also, awards rendered in connection with the validity of intellectual property rights are recognized as the basis for entries in the register, provided these awards are accompanied by a certificate of enforceability issued by the Swiss court at the seat of the arbitral tribunal in accordance with Article 193 of the Swiss Private International Law Act.

Arbitration is a consensual means of dispute resolution, requiring all parties involved to submit the matter to arbitration, failing which this method of dispute resolution would fail to

operationalize. The agreement to arbitrate, which embodies the consent of the parties, obtains a binding force as a result of national and international support extended to it through domestic and international law. Most jurisdictions have modified their domestic laws to reflect the Model Laws prepared by UNCITRAL and recommended for adoption by the United Nations General Assembly. Internationally, instruments such as the New York Convention on the Recognition and Enforcement of Foreign Arbitral Awards 1958, adhered to by

156 States, provided for expedited enforcement of a valid arbitration agreement and award rendered in a contracting state in the territory of another contracting.

Arbitrability refers to the question of whether a particular dispute can be submitted to arbitration or it befits solely to the jurisdiction of the courts. Both the New York Convention, 1958 and the Model Law on International Commercial Arbitration, 1985 provide for settlement of international disputes by way of Arbitration. It also involves the recognition and enforcement of foreign awards by the courts of different jurisdictions. Whether a particular dispute falls within the ambit of arbitrability under a given law, is fundamentally a matter of Public Policy. Public policy varies from state to state and constantly evolves with changes in the society.

As already discussed, patent rights are the property rights conferred by the State upon an inventor. These are statutory monopoly rights which are granted to the patentee to manufacture and market their inventions for commercial gains for a specified period of time. These rights could be exigent to the overall development of the society.

Intermittently it is contended that since these are territorial rights created by a sovereign entity, only the courts of this sovereign entity should have the authority to adjudge matters relating to such rights. It has been held that a patent right is available against the whole world at large. On the other hand, Arbitration, as a dispute settlement resolution, is the outcome of a concerted agreement between two parties who are bound by certain rights and obligations towards each other. Consequently, concerns were raised with respect to subject matter of arbitrability of patent disputes throughout the international community. In the beginning, disputes pertaining to the rights and entitlements to intellectual property could not, for a long time, be referred for

arbitration. However, with the passage of time, disputes arising from commercial arrangements such as transfer or assignment of rights, license agreements or multi-jurisdictional disputes, were considered to be *prima facie* arbitrable. It is justifiable to conclude that since the nature of the relationship between the parties is purely contractual in the above cases, arbitration agreements maybe entered into, and the awards thereto shall be considered as final and binding.

The municipal laws of various countries have different stands over subject matter arbitrability of patent disputes. United Kingdom and Singapore allow arbitration in Intellectual Property rights, but to a limited extent and with the prior sanction of the court. USA and Switzerland, on the contrary, follow a liberal approach. As a matter of fact, the United States Code expressly provides for arbitration in case of any kind of patent disputes.

It is also noteworthy, that the issue of subject matter arbitrability of patent disputes has been laid down as a condition precedent for the recognition and enforcement of foreign award under the New York Convention, 1958. Article V of the said convention provides that if a contracting state does not consider a subject matter capable of arbitration, an agreement to arbitrate on such subject matter be considered as invalid and shall be refused enforcement.

Hence, voluntary arbitration is more or less dependent upon the municipal laws of a country in so far as they are in compliance with the International Conventions.

CONCLUSION

Though there are various benefits of using arbitration as a method for resolving IP disputes there are also many criticisms against it. One of the biggest criticisms against arbitration in IP is that it is binding only between the parties and does not set a public precedent as regards its use as a deterrent to infringement and establishing a culture of integrity. Parties also do not actually resort to arbitration primarily on account of finding suitable arbitrators or because of jurisdictional issues in case of international contracts. One also needs to ponder on the effect of the counterclaim or defense of revocation in cases of infringement. As these remedies or reliefs are in rem, henceforth, the parties would have to turn to the relevant forum for resolution of that claim. So, whether such action would

render the entire dispute non-arbitral or the tribunal may stay its proceedings until the appropriate forum decides on the validity of the copyright/ trademark/ patent? This is, however, far from ideal as it would delay the arbitration and substantially increase costs.

The conclusion which can be drawn in relation to the arbitrability of IP disputes in India is that it is a budding scheme which needs legislative support and a proper mechanism for better implementation. Though court rulings are quite unclear in the present scenario still it can be inferred that IP disputes are arbitrable, but still there is a long way ahead.

The one possible solution for addressing this issue in regard to enhancing arbitration in India is to provide for the arbitrability of IP disputes in the Arbitration and Conciliation Act, as well as the Indian Copyrights Act and Patents Act. In providing so, it not only eliminates the confusion regarding the arbitrability of Copyright and Patent disputes but also prevents further litigation in the light of public policy. An amendment to the Arbitration and Conciliation Act including the arbitrability of IP disputes, and also amendments to the Copyrights Act and Patent Rights authorizing the parties to subject the dispute to arbitration would clear the complications involved in such arbitrations.

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IPR Day Speech

Ladies and gentlemen, distinguished guests, fellow scholars, dear students and friends.

Today, we gather to celebrate Intellectual Property Day, a day dedicated to raising awareness of the importance of intellectual property rights in our world. It is indeed my pleasure and privilege to be here with you today sharing my thoughts with you. As we mark this important day, I would like to discuss the significance of these rights, the challenges we face, and the path forward for a more robust and equitable intellectual property system within the Indian legal eco-system.

Intellectual property rights have long been the backbone of human innovation and creativity. They allow us to transform ideas into tangible products and services that improve lives and drive economic growth. Whether we are discussing the protection of a famous author's novel or the patent for a ground-breaking medical discovery, intellectual property rights provide the foundation that allows individuals and organizations to invest in their ideas and reap the benefits of their labour.

The world has come a long way since the establishment of the first intellectual property systems. Today, we live in a globalized and interconnected world where technology has not only made it easier to create and disseminate new ideas but also to infringe upon the rights of others. This has led to a complex landscape of legal and ethical challenges that we must confront in order to maintain a fair and just system of intellectual property protection.

A robust intellectual property regime plays a crucial role in fostering innovation, creativity, and economic growth in India. By providing legal protection for inventions, designs, trademarks, and other forms of intellectual property, the regime

incentivizes individuals and businesses to invest time, effort, and resources into research and development. A strong IP regime not only enhances India's global competitiveness but also helps attract foreign investment and facilitate technology transfer, contributing to the country's overall technological advancements. Furthermore, it safeguards the interests of creators and innovators while balancing the public interest, ensuring that the benefits of intellectual property are fairly distributed and promote social and cultural development.

Let us first understand the different types of intellectual property rights in a simple manner:

PATENTS

Patents protect inventions and grant the inventor an exclusive right to produce, sell, and use the invention for a limited period, usually 20 years. Patents encourage innovation by allowing inventors to profit from their creations. The patent regime in India is governed by the Patents Act of 1970 and the Patents Rules of 2003 r/w Patent (Amendment) Rules, 2021, which together establish the legal framework for the protection of inventions within the country. To simplify the patent process in India, the key features of the Indian patent regime are as follows:

1. **Eligibility:** In India, patents are granted for inventions that meet three main criteria: novelty, inventive step (non-obviousness), and industrial applicability. The invention must be new, not obvious to a person skilled in the relevant field, and capable of being used in an industry. India excludes certain subject matter from patent eligibility, such as mathematical methods, business methods, literary or artistic works, and traditional knowledge.
2. **Patent Application:** To secure patent protection, the inventor must file an application with the Indian Patent Office, which comprises four branches located in Delhi, Mumbai, Kolkata, and Chennai. The application must include a detailed description of the invention, claims that define the scope of protection, an abstract, and any drawings necessary to understand the invention.
3. **Publication and Examination:** After filing, the patent application is typically published within 18 months. This allows the public to access the information about the invention. After publication, the inventor can request

examination, during which a patent examiner evaluates the application to ensure it meets the requirements for patentability.

4. **Opposition:** Before and after the grant of a patent, interested parties have the opportunity to challenge the application or the granted patent through pre-grant and post-grant opposition proceedings, respectively. This allows third parties to present arguments and evidence against the grant or validity of the patent.
5. **Grant and Term:** If the patent examiner is satisfied that the invention meets the patentability criteria, a patent is granted. In India, the term of a patent is 20 years from the date of filing. During this period, the patent holder has the exclusive right to make, use, and sell the invention within India.
6. **Maintenance and Working:** To keep the patent in force, the patent holder must pay annual renewal fees. Additionally, patent holders are required to work their patents, meaning they must utilize the invention in India to avoid compulsory licensing, which may be granted by the government in cases where the patent is not being adequately worked or made available to the public at a reasonable price.
7. **Compulsory Licensing:** India's patent regime includes provisions for compulsory licensing, which allows the government to grant a license to a third party to produce, use, or sell a patented invention without the consent of the patent holder, under certain circumstances. This can occur in cases of national emergency, public health crises, or if the invention is not being worked within India after three years from the date of grant.

The Indian patent regime aims to strike a balance between encouraging innovation and protecting public interests. By understanding the patent process and requirements in India, inventors can better navigate the system to protect their inventions and contribute to the country's growth and development.

TRADEMARKS

Trademarks protect brand names, logos, and symbols that distinguish a company's products or services from those of others. They help consumers identify the source of goods and

services, ensuring that businesses can build brand recognition and goodwill. The Trademark Law in India refers to the legal framework governing the protection of trademarks, which are symbols, logos, brand names, or other distinctive marks that represent a business's products or services. The primary legislation governing trademarks in India is the Trade Marks Act, 1999, and the Trade Marks Rules, 2017. Some key aspects of the Trademark Law in India are as follows:

1. **Eligibility:** A trademark can be any distinctive sign capable of being represented graphically, including words, names, symbols, logos, slogans, or combinations thereof, as long as they distinguish the goods or services of one business from those of others. The mark must be unique and should not be descriptive or generic to be eligible for protection.
2. **Registration:** To secure protection, the owner must file an application with the Trade Marks Registry, which has offices in various locations across India. The application should include details about the mark, the goods or services it represents, and the class of goods or services according to the Nice Classification. Once filed, the application undergoes examination for compliance with formal requirements and eligibility criteria, followed by publication in the Trade Marks Journal, allowing for opposition by third parties.
3. **Duration of Protection:** A registered trademark in India is valid for an initial period of 10 years, and it can be renewed indefinitely for successive periods of 10 years upon payment of a renewal fee. However, the owner must use the mark consistently to avoid the risk of cancellation due to non-use.
4. **Rights Conferred:** The registered proprietor of a trademark has the exclusive right to use the mark in connection with the goods or services for which it is registered. They can also prevent unauthorized use of identical or similar marks that may cause confusion or dilution of their trademark.
5. **Remedies for Infringement:** The Trade Marks Act provides both civil and criminal remedies for trademark infringement. Civil remedies include injunctions, damages, and accounts of profits, while criminal remedies may include fines, imprisonment, or the seizure of infringing goods.
6. **Well-known Trademarks:** The Trademark Law in India also recognizes the concept of "well-known trademarks," which

are marks with high reputation and recognition even if they are not registered in India. These trademarks enjoy special protection against infringement and dilution.

The Trademark Law in India offers protection for distinctive marks that represent a business's products or services, providing a legal framework to safeguard brand identity and reputation. Understanding the key aspects of the Trademark Law can help business owners protect their trademarks and navigate the registration process in India.

COPYRIGHTS

Copyrights protect original works of authorship, such as books, music, films, and software. They grant the creator exclusive rights to reproduce, distribute, perform, and display the work, under Indian Law -usually, for the lifetime of the author plus 60 years.

The copyright law in India is governed by the Copyright Act of 1957 and the Copyright Rules of 2013 (last amended in 2016), which together establish the legal framework for the protection of creative works within the country. A brief overview of the key features of the Indian copyright law is as follows:

1. **Eligible works:** Copyright protection in India extends to original works of authorship, including literary, artistic, musical, and dramatic works, as well as cinematographic films and sound recordings. The work must be original and exhibit a minimum level of creativity to be eligible for copyright protection.
2. **Automatic protection:** In India, copyright protection is automatic and begins as soon as the work is created, without any requirement of registration. However, registering the work with the Copyright Office can provide certain benefits, such as establishing a public record of the copyright and serving as evidence in case of disputes.
3. **Authorship and Ownership:** Generally, the author of the work is considered the first owner of the copyright. However, there are exceptions, such as when a work is created by an employee during the course of their employment, in which case the employer becomes the owner of the copyright, unless there is a contract stating otherwise.
4. **Rights Granted:** Copyright holders in India enjoy several exclusive rights, including the right to reproduce, distribute,

perform, adapt, and translate the work. These rights allow the copyright holder to control the use of their work and to benefit economically from it.

5. **Fair Use and Exceptions:** Indian copyright law includes certain exceptions and limitations that allow the use of copyrighted works without permission from the copyright holder, under specific conditions. These exceptions, known as “fair use” or “fair dealing,” include uses for purposes such as research, education, criticism, news reporting, and parody.
6. **Moral Rights:** In addition to economic rights, Indian copyright law also recognizes moral rights, which protect the reputation and integrity of the author. These rights include the right of paternity (the right to claim authorship of the work) and the right of integrity (the right to prevent distortion or mutilation of the work that could harm the author’s reputation).
7. **Remedies for Infringement:** If a copyrighted work is used without the permission of the copyright holder, it may constitute infringement. The remedies for copyright infringement in India include civil remedies (such as injunctions, damages, and the seizure of infringing copies) and criminal remedies (such as imprisonment and fines).

The Indian copyright law provides a framework for protecting and promoting the rights of creators while balancing the public interest in accessing and using creative works. Understanding these key aspects can help creators protect their works and users navigate the permissible uses of copyrighted materials.

Other Intellectual Property Rights that are gaining prominence over the Indian commercial and legal ecosystem are:

GEOGRAPHICAL INDICATIONS

Geographical Indications (GIs) in India are protected under the Geographical Indications of Goods (Registration and Protection) Act, 1999. GIs are distinctive signs that identify products originating from a specific region, possessing unique qualities, characteristics, or reputation attributable to that region. The registration of GIs in India promotes local industries, supports rural artisans, and preserves the cultural heritage associated

with these products. Some well-known Indian GIs include Darjeeling Tea, Basmati Rice, and Kanchipuram Silk etc.

DESIGNS

The Designs Act, 2000, and the Designs Rules, 2001, form the legal framework for protecting industrial designs in India. Eligible designs must be new, original, and visually appealing, with protection granted upon successful registration with the Controller of Designs. A registered design in India is protected for an initial period of 10 years, extendable to 15 years. The Designs Act confers exclusive rights to the registered proprietor and provides legal remedies in case of infringement.

PLANT VARIETIES AND FARMERS' RIGHTS

The Protection of Plant Varieties and Farmers' Rights Act, 2001, in India establishes a legal framework for safeguarding plant breeders' rights and promoting agricultural development. It enables the registration and protection of new and extant plant varieties, as well as farmers' varieties. The Act aims to encourage innovation in plant breeding, conserve biodiversity, and recognize farmers' contributions to plant genetic resources. It also provides a balance between plant breeders' and farmers' rights, fostering a sustainable agricultural ecosystem.

Trade secrets: Trade secrets protect valuable information that gives a business a competitive advantage, such as formulas, processes, or customer lists. To qualify as a trade secret, the information must not be generally known and must be subject to reasonable efforts to maintain its secrecy.

Then, there are

TRADE SECRETS

Trade secrets encompass confidential business information that provides a competitive advantage to a company, such as formulas, processes, or strategies. In India, there is no specific legislation for trade secrets, but protection is offered through common law principles, contractual agreements, and relevant provisions in the Indian Contract Act, 1872. Safeguarding trade secrets relies on implementing robust internal policies, non-disclosure agreements, and non-compete clauses. Misappropriation of trade secrets can lead to legal remedies, including injunctions and damages, under breach of contract or unfair competition claims.

Now, let us learn about **the challenges** we face in the field of intellectual property rights.

One of the most pressing challenges is the growing gap between developed and developing countries in terms of access to and participation in the intellectual property system. As we strive to create a more inclusive intellectual property system, we must work to increase access to knowledge and resources for developing countries through initiatives that provide education, training, and financial support to inventors and creators in these regions.

Another challenge is the rapid pace of technological change, which has given rise to new forms of intellectual property that existing laws may not adequately protect. To address these evolving issues, we must continuously re-evaluate and update our intellectual property laws and regulations to ensure that they remain relevant and effective in the face of new technologies.

Furthermore, we must also grapple with the delicate balance between protecting intellectual property rights and promoting the free flow of information and ideas. As we strive to maintain this balance, it is essential that we foster a culture of respect for intellectual property rights, while also promoting the values of collaboration, openness, and access to knowledge.

As we gather today to recognize the importance of intellectual property rights, let us also remember our collective responsibility to confront the challenges we face and work towards a more inclusive, equitable, and effective intellectual property system. This will require ongoing collaboration, adaptability, and a commitment to fostering innovation and creativity for the benefit of all.

About the Editor



Dr. M. Sridevi presently working as a Lecturer in chemistry (PG), Department of Chemistry HOD, IQAC Co-Ordinator in S.K.S.D. Mahila Kalasala, UG & PG(A), Tanuku. She Has More than 14 Years of teaching and research experience in chemistry. She obtained M.Sc, M.Phil, Ph.D from Andhra University, Visakhapatnam. She also qualified APSET in 2016. Her Specialization is Inorganic & Analytical Chemistry. She has published 13 Research Articles in various peer reviewed journals, having 5 Scopus indexed articles , published a text book of inorganic chemistry by Bharathi Publications, New Delhi, organized one national seminar with funding from ONGC, one International webinar with Guest speaker from Pennsylvania state University, U.S.A and also organized two national workshops and one state level quiz competition. She was carrying active research in multidisciplinary topics like Kinetics of oxidation of amino acids, micellar catalysis, water analysis, milk adulteration, Detection of nitrate poisoning in farms and soil analysis etc. She received a Patent and registered for one more patent. She was a member of board of studies, in Department of analytical chemistry of Adikavi Nannaya university, Rajamahendravaram. She also participated/presented in various national & International seminars. She received best teacher award from Lion's Club, Tanuku. She acted as a resource person for National Training Program on Eco Air: Developing Eco Educators at Malikipuram, East Godavari District, Organized by Department of Science & Technology, New Delhi & Science City of Andhrapradesh. In addition to these academic activities she also participated in various extension activities like oldage home visits with students every year on August 26th, Swachbharat through plantation etc.



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Dr. Hephzibah Rani Singh

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Dr. I. Niyas Ahamed

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Tirupattur -635601, Tirupattur District, Tamil Nadu.

In Collaboration with

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Tirupattur -635601, Tirupattur District, Tamil Nadu.
In Collaboration with
**Association of Global Academicians and Researchers (AGAR),
Tamil Nadu.****

MESSAGE FROM CHIEF EDITOR



It is indeed a pleasure and honour to be part and involvement to releasing the book entitled “**CONFERENCE PROCEEDINGS OF "INTERNATIONAL E-CONFERENCE ON INNOVATION IN LIFE SCIENCES" (IECILS-2023)**” by Association of Global Academician and Researchers (AGAR), Tamil Nadu. This remains as a history due to its tremendous response across the globe. I am indeed grateful to the members of the association for providing me an opportunity and for reposing faith in me. All this has been made possible with their guidance. My thanks to the faculty members, Research scholars and students who have contributed the articles to this dynamic publication. I am very thankful to Dr. I. Niyas Ahamed, President of AGAR for assisted me in times of need. I am very fortunate and blessed to be part of this prestigious conference proceeding.

With Regards,

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MESSAGE FROM ASSOCIATE EDITOR



Dear Friends,

It is wonderful to see the publishing the proceeding entitled on “**CONFERENCE PROCEEDINGS OF "INTERNATIONAL E-CONFERENCE ON INNOVATION IN LIFE SCIENCES" (IECILS-2023).**”

The topic “**Innovation in Life Sciences**” gives much room to search for the latest trends in dealing with important education role and emerging research strategies. This publication offers more strategic, holistic education and research approach to integrate aspects from the different field of research. It will enlighten the broaden minds of the young researchers to search for new solutions to real life strategies.

Congratulations and God Bless Your Effort.

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E-CONFERENCE ARTICLES

ARTICLE-1

INVIVO PHARMACOLOGICAL SCREENING OF CELOSIA ARGENTEA LEAVES

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Abstract

The study was designed to investigate the skeletal muscle relaxant effect of *celosia argentea* leaves in albino rats. Methanolic extract of *celosia argentea* at a dose of 200mg/kg was used for the study. In the present research the following in-vivo animal models were used. Rotarod apparatus for the assessment of skeletal muscle relaxant activity in rats. The rotarod apparatus consists of a metal rod (3 cm diameter) coated with rubber attached to a motor with the speed adjusted to 40 rotations per minute. The rod is 75 cm in length and is divided into 2 sections by metallic discs, allowing the simultaneous testing of Rats. The rod is in a height of about 50 cm above the table top in order to discourage the animals from jumping off the roller. Albino Rats underwent a pre-test on the apparatus. Albino Rats were divided into three groups consisting of three animals each. Group I served as control which received Distilled water, animals of group II received the methanolic extract of *Celosia Argentea* at a dose of 200mg/kg, p.o and animals of group III received alprazolam (0.3mg/kg). The animals were placed on the rotating rod and fall off time i.e, when the animal falls from the rotating rod, was recorded, which was taken as grip strength. *Celosia Argentea* leaves (200mg/kg) has significantly reduced the time spent by the animals on revolving rod by reducing the fall off time (3.89 seconds) when compared to Control group rats (fall off time 5.40 seconds). Hence the methanolic extract of *Celosia Argentea* leaves possesses significant skeletal muscle relaxant activity.

Keywords: skeletal muscle relaxant activity, *Celosia Argentea* leaves and Albino Rats

ARTICLE-2

SYNTHESIS AND CHARACTERIZATION OF CaZrO_3 CERAMICS

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Abstract

Calcium Zirconate Ceramics with the general formula CaZrO_3 was prepared by solid state reaction method. Reagent powders of Calcium carbonate (CaCO_3) (99.9%) and Zirconium dioxide (ZrO_2) (99.9%) were used as raw materials (precursors). The mixture CaCO_3 and ZrO_2 were stoichiometrically weighed, thoroughly grinded for 1 hour. Solid state reaction technique was carried out under the calcination and sintering condition of 500 °C and 1100 °C for 6 hours respectively. The prepared CaZrO_3 ceramics were systematically investigated using Fouriertransform infrared spectroscopy (FT-IR) and Ultraviolet visible spectroscopy (UV). The FTIR spectrum of the CaZrO_3 ceramics displayed main absorption bands. The UV-Vis absorption spectralanalysis showed an intense absorption at 620 nm, confirming the excellent optical behavior.

Keywords:

CaZrO_3 ceramics, Solid State reaction, XRD, Perovskite, FT-IR, and UV Spectroscopy.

ARTICLE-3

ISOLATION AND CHARACTERISATION OF PIGMENT PRODUCING ACTINOMYCETES AND *IN-VITRO* PHOTOPROTECTIVE EFFECT OF AN ACTINOMYCETES DERIVED PIGMENT AGAINST MELANOMA

By

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Abstract

Microbial pigment production is one of the promising fields of research. Actinobacteria showed considerable interest owing to their ability to produce pigments. Microbial pigment production by fermentation technology is more dynamic and economic. Actinomycetes have also capable of producing dark-brown coloured substances called melanin or melanoid pigments. Melanin compounds are irregular, dark brown polymers. In biological life, they have broad spectrum properties including antioxidant, antimicrobial activity, antitumor activity, antivenin activity, anti-virus, hepatoprotective activity and radio protective, etc. Effectively, it protects the living organisms from extreme temperature and ultraviolet radiation. Melanins are widely used in medicine, pharmacology and cosmetics preparations. Recent studies revealed that the function of melanin is associated with the protection against environmental stress. These properties make melanin an important bioactive material with various industrial applications. Melanin and its derivatives are used for the therapeutic agents to cure neurodegenerative diseases like Alzheimer's disease, retinitis pigmentosa, schizophrenia and dementia. Although many roles have been attributed to melanic pigments, the main role in nature seems to be photoprotection damage. Melanin possesses anti- UV radiation property by absorbing the electromagnetic spectrum and preventing optical damage in the living organisms. Melanoma is a malignant of melanocytes that controls the pigment melanin in the skin. The aim of the present study is to isolate the melanin producing actinomycetes from the agricultural soil and to assay the cytotoxicity using murine B16 melanoma cell line and normal mouse L929 fibroblast cell line. The results showed that the melanin obtained from the actinomycetes showed good anticancer

activity against murine B16 melanoma cell line and nontoxic against normal mouse L929 fibroblast cell line. Hence it can be used as a photoprotective agent.

Key words: Actinomycetes, Melanin, Melanoma, Photo protective agent, Anti-cancer agent.

ARTICLE-4

BIOACTIVE COMPOUNDS AND BIO-FUNCTIONAL PROPERTIES OF

Garcinia indica

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Abstract

Traditional medicines play an important role in the current scenario and more than 50% of the world's population depends on the constituents extracted from plants for short term and long term disorders and diseases. *Garcinia indica* , a plant from *Clusiaceae* family, is an underexplored fruit tree in the Western Ghats region. Kokum has been studied for its health benefits, associated with numerous bioactive compounds, including phenolic acids, flavonoids, citric acids, and others. Among all, garcinol, hydroxycitric acid, and anthocyanins (5yaniding-3-glucoside and 5yaniding-3-sambubioside) are major bioactive compounds. *G. indica* fruit and fruit rinds have been reported to possess numerous therapeutic applications in various health conditions such as cancer, inflammation, diabetes, obesity, cardiovascular disease, and neurologic disorders. In vitro and In vivo studies of bioactive components on various diseases have also been reported.

Keywords: *Garcinia indica* , Bioactive compounds, Garcinol

ARTICLE-5

EXPLORING THE ANTICANCER POTENTIAL OF HOMEOPATHY DRUGS- A COMPREHENSIVE REVIEW

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Abstract

Introduction

Globally cancer ranks as the second leading cause of death next to cardiovascular disorders. Conventional and advanced cancer treatments are notorious due to their adverse effects and high cost. As a result, the pursuit of alternative medicines is imperative. Homeopathy, a commonly used complementary and alternative medicine worldwide, is renowned for its negligible side effects.

Objective

This study aims to review, research studies reported on homeopathic remedies, shedding light on their potential molecular mechanisms in the fight against cancer and evaluating their effectiveness as adjunctive therapies in cancer treatment.

Methods

A comprehensive literature search was conducted to identify research studies focused on homeopathic remedies in the context of cancer treatment. Studies involving *in vitro*

experimentation using various cancer cell lines and animal models, were included in this review.

Results

Our review results identified an increase in the number of validated homeopathic remedies for cancer treatment over the past two decades. These remedies have shown promising potential as adjunctive therapies, significantly contributing to the ongoing battle against cancer. While the extreme dilution of homeopathic medicines remains a subject of clinical controversy, their effectiveness as adjunct therapies in cancer treatment cannot be denied.

Discussion

This review contributes to the understanding of the possible molecular mechanisms behind homeopathic remedy's actions against cancer and their role in enhancing the effectiveness of cancer treatment. While the extreme dilution of homeopathic medicines sparks clinical controversy, they have demonstrated significant promise as adjunct therapies in cancer treatment.

Conclusion

Further research is needed to uncover the full potential of homeopathic therapies in the field of oncology.

ARTICLE-6

EFFECT OF BIOSYNTHESISED ZINC OXIDE NANOPARTICLES ON GROWTH AND PHOTOSYNTHETIC PARAMETERS IN MUNGBEAN CULTIVARS UNDER ARSENIC STRESS

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Abstract

At present, various environmental stresses affect mungbean cultivation which leads to loss of yield every year. Among this arsenic (As) contamination is one of the major abiotic stresses which interfere with various metabolic processes in plants, decreasing plant productivity. To alleviate As toxicity, zinc oxide nanoparticles (ZnONPs) have attained a great attention. The present study analyzed the influence of ZnONPs (24-28 nm) over a concentration range (0, 10, 20 and 50 mg/L) by foliar spray on growth and photosynthetic parameters in As-stressed (0, 15 and 30 μ M) mungbean cultivars (IPM 02-14 and RMG 975). Our results show that As stress reduces growth, photosynthetic efficiency but the application of ZnONPs alleviates the adverse effects of As and it leads to increase in growth and maximum apparent electron transport rate, effective quantum yield in both mungbean cultivars. The present study suggested that the optimal concentration of ZnONPs for mungbean cultivars was 20 mg/L as it significantly alleviates the As toxicity and enhances mungbean performance. Higher concentration of ZnONPs (50 mg/L) showed negative effects in both cultivars of mungbean under As stress. In conclusion, ZnONPs could be considered as an effective approach to increase productivity of mungbean plants in dose dependent manner under As stress.

Keywords: Zinc oxide nanoparticles, Mungbean, Arsenic stress, Photosynthetic parameters

ARTICLE-7

ANEMIA DUE TO LOW-IRON AFFECTS COGNITIVE CAPACITY OF ADOLESCENT GIRLS SCHOOLING IN SECONDARY SCHOOLS IN SOKOTO, NIGERIA

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Abstract:

Anaemia is a problem occurring due to poor iron intake or hereditary sickle cells threatening public health in many adolescents and adults. Anaemia is able to affect cognitive ability of people especially adolescents (youngsters). This study evaluates the effect of iron-deficiency anaemia and sickle cell anaemia on cognition of some adolescents schooling girls from Sokoto, Nigeria. The study consisted of recruitment of 80 girls (40 normal, and 40 anemic) subjected to Montreal Cognitive Assessment. 10 girls diagnosed with sickle cell anemia and 25 normal girls were assessed with Montreal cognitive assessment. The mean marks of the respondents were noted; therewith, chi-square test revealed significant difference at ($p < 0.05$). The anemic girls earned fewer mean marks (400.0 ± 13.0) compared to the normal girls (960.0 ± 25.0). The healthy participants in the study scored higher marks (945.0 ± 10.0) than the sickle cell anemia patients (90.0 ± 3). Therefore, anemia is of the potential to affect cognitive capacity of schooling girls in Sokoto. Nutritional and related interventions are important, because poor cognition may affect education and overall potential of girls to be keys in growth and development of societies.

Keywords: Cognition, cognitive capacity, iron-deficiency anemia, education, sickle cell anemia

INTRODUCTION

Education determines the growth or development of any society and any nation. It serves as a pillar for emancipation, empowerment, and guidance of people in all societies (Abubakar et al., 2022). Education is important for humans at all phases of life. Irrespective of sex or any other societal difference education is key to success and guidance, as well as healthy behaviors incorporation (Abubakar & Kwashabawa, 2021). Parable, education influences girls to be healthy, socially-oriented, economically empowered and liberated, and achieve greater heights (Ibrahim et al., 2021). Girls should be educated at least to a secondary school stage for the betterment of all. A girl child education is important for spiritual, economics, social, emotional, physical, and mental culturing (Abubakar & Kwashabawa, 2021).

However, a crucial life stage in girl's education is the adolescence period. At adolescence stage, girls are vulnerable, and can be exposed to uncertainties due to the characterized growth and overall changes that on many occasions trigger ill health. Of great concern in adolescent life in our nation is the issue of malnutrition or undernutrition. Malnutrition or undernutrition has been linked to anemia and is rampant in our country (Trivedi, 2012; Iqbal et al., 2014; Moghaddam et al., 2016). Many girls in the northern Nigeria are malnourished and underweight. Consequently, the effects manifest as infectious diseases, menstrual problems, later pregnancy problems, general ill health, and cognitive impairment (Trivedi, 2012; Abubakar et al., 2022).

Malnutrition is vividly a causer of anemia, and on many occasions is due to Fe deficiency (Elrazak et al., 2019). Fe is a trace element vital in the cells functions in biological systems and affect many enzymes vital for maintenance of constant internal environment (Gupta, 2014; Matondo et al., 2020; Umar et al., 2022). Fe partakes in brain biochemistry, neurotransmitters synthesis, and dopamine-opiate system functioning (Cumurcu et al., 2009). In oxidative stress cushioning, Fe helps in removing the superoxide anion and in turn protecting cells against damage (Cumurcu et al, 2009; Fretham et al. 2011; Umar et al, 2023). Fe deficiency generally is a commonly prevalent nutritional deficiency affecting over 2 billion individuals; therewith, 30% of the affected are women and offsprings. This deficiency molests the cognitive ability of processing, learning, memory (Fretham et al., 2011; Gupta, 2014; Yiannikourides, A. & Latunde-Dada, 2019).

Unfortunately, many children in Sokoto were reported to be challenged by inaccessibility to education and malnutrition as well (Sarkingobir et al., 2023; Shehu et al., 2023). Umar et al., (2019) in their work show that the female students in Sokoto experience poor performance in mathematics, a key science subject and basic for advance education (Umar et al, 2019). Another

work among secondary school girls in Sokoto decried that, inadequate iodine incites a decrease in academic performance in the affected subjects (Umar et al., 2018). Ehabor et al., (2013) reported a high prevalence of Fe-deficiency anemia in pregnant women at a hospital in Sokoto city, Nigeria and called for Fe supplementation among pregnant women in Sokoto. From the forgone, malnutrition is a factor affecting girls in the state. However, few information was related especially concerning Fe-deficiency anemia among adolescent girls. The objective to be fulfilled by this study is to evaluate the effect of Fe-deficiency anemia among schooling adolescent girls in Sokoto, Nigeria.

MATERIALS AND METHODS

This work was conducted in Gwadabawa, Sokoto state, Nigeria. Whereas, the study design recruited of 80 girls (40 normal, and 40 anemics, using the hospital register) on voluntary basis. The participants were evaluated with Montreal cognitive assessment. While, 10 sickle cell anemic girls, and 25 normal girls were assessed using Montreal Cognitive Assessment (Mahendra et al., 2015; Felek, 2023). The scores of earned by the respondents were calculated and subjected to Chi-square test and revealed significant difference at ($p < 0.05$).

RESULTS AND DISCUSSION

Table 1: Showing the effect of anemia on cognitive ability of some adult students in Sokoto, Nigeria

	N (individuals)	Mean marks scored	Standard deviation	X ²	Remark
Anemic patients	40	400.0	25.0	230.588	Significant
Healthy people	40	960.0	13.0		
Total	80				

Fe-deficiency anemia is linked to malnutrition bedeviling the parts of the world including the Northern region of Nigeria; and it is due to insufficient iron or lesion in iron intake. Fe is conferring the blood with capacity to act as carrier that deliver oxygen to tissues (Koduri, 2003; Abbaspour et al., 2014; Iqbal et al., 2014; Castro & Viana, 2018; Erdem et al., 2021). On the other hand, Fe is a parcel of many enzymes such as cytochromes (that act in preventing oxidative stress). Cytochrome p450 is important in detoxifying the body system from xenobiotics. Moreover, Fe containing enzymes partake in synthesis of steroid hormones,

transmission of neurotransmitters (like dopamine and serotonin) attached to the brain function in cognition and relations (Gupta, 2014; Soleimani & abbaszadeh, 2011; Tebbi et al., 2022; Umar et al., 2022; Sarkingobir et al., 2023). Thus, this work conducted to assess the effect of low-iron anemia on cognitive ability of adolescents schooling girls in Sokoto is significant. Table 1 shows the effects of Fe-deficiency anemia on schooling adolescents' girls' cognitive capacity in Gwadabawa, Sokoto State, Nigeria. The result therewith indicate that the patients scored a mean of 400.0 which is lower than the healthy girls that scored 960.0. This could point to the fact that Fe-deficiency anemia might have affected the cognitive capacity of the adolescents girls. Thus, the Fe-deficiency anemia could act to affect the academic achievement or attainment or performance of the affected girls. This observation invariably points to the significant importance of Fe in the brain functioning in the human biological system especially to the developing youngsters. This result (in Table 1) that revealed the effect of low iron on cognitive capacity was similarly reported elsewhere (Cumurcu et al., 2009). Fretham et al., (2011) reveals how alteration of hippocampal nature and plasticity affects learning and memory in mice experiment and reiterated that hypoxia in cells reduces cognition. Gutema et al., (2023) revealed in their work that, supplementation with Fe improves intelligence, concentration, attention, and memory of schooling children. In a conflicting information, Cumurcu et al., (2009) divulged a finding that shows excess Fe, Zn, and Cu in patients after surgery is linked to delirium.

Table 2: showing the effect of sickle anemia condition on cognitive ability of some adult students in Sokoto, Nigeria

	N (individuals)	Mean marks scored	Standard deviation	X ²	Remark
Anemia patients	10	90.0	3.0	685.953	Significant
Normal girls	25	924.0	10.0		
Total	35				

Table 2 shows the effects of anemia on schooling adolescents girls in Gwadabawa Sokoto, Nigeria. The results show that sickle cell patients score lower than the healthy girls. Thus, it is possible to link low cognitive capacity with sickle cell anemia and that could be associated with lesion in iron metabolism (Abaspour et al., 2014; Adewoyin, 2015; Castro & Viana, 2018; Alhazai et al., 2022; Siamisang et al., 2023). This finding (Table 2) was similarly found by **Association of Global Academicians and Researchers (AGAR)**

Youssry et al., (2023) therewith, sickle cell impaired cognitive and hearing functions. A Jamaican work indicates that cognitive ability in sickle cell children was deficient and in turns can militates academic performance as well (King et al., 2023). Cognitive ability was also revealed to be affected in sickle cell condition especially due to changes in brain nature as reported by Hamdule et al., (2023). In the same streak, another finding decried that cognitive impairment is notable in children affected by sickle cell and later life quality is affected (Hamdule & Kirkham, 2023).

CONCLUSION

Adolescent period is very important especially in girls. Therefore, they need better education and cognitive potential. However, malnutrition and other biochemically related issues such as anemia effects may affect schooling girls potentials. This work evaluated the ability of anemia (Fe-deficiency anemia and sickle cell anemia) to affect cognition in girls in Sokoto. Upon an evaluation with Montreal Cognitive Assessment, the results show that, the Fe-deficiency anemia and sickle cell anemia girls earned less marks compared to normal girls. Nutritional and related interventions are important, because poor cognition may affect education and overall potential of girls to be keys in growth and development of societies.

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ARTICLE-8

INNOVATIVE FOOD PACKING TECHNOLOGIES: CHITOSAN NANOPARTICLES FOR FRESHNESS

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Chitosan, a natural polysaccharide from shrimp and crab, has diverse food and medical uses due to its antibacterial, antioxidant, inhibitory properties, and biodegradability over 50 years. The current study aims to prepare sodium alginate loaded chitosan nanoparticles (SACs) and fabricate SACs embedded gelatine nanofibers for biocontrol of food borne pathogens. The optimal SACs were prepared by ionic crosslinking method. The nanoparticle exhibited desired particle size, and Zeta potential. The results of SEM and AFM confirmed its diameter. FTIR, XRD, TGA analysis revealed that co-polymer was incorporated into chitosan. Furthermore, the damage of SACs to the cell membranes of *S. aureus* and *E. coli* was confirmed by the change of bacterial cell morphology. For the application on grapes, SAC nanofibers possessed high antibacterial activity at 4°C and 25°C for 10 days, without any effect on the sensory quality of grapes. The results confirmed that grapes treated with SACs showed significantly reduced decay percentage, weight loss, and maintained titratable acidity at high levels compared with those of untreated fruit. Therefore, the results suggest that SACs nanofibers could be a promising active food packaging material for food preservation.

Keywords: Bio-preservation, biopolymer, seafood waste, sodium alginate.

ARTICLE-9

BIO COLORANTS- USES IN HEALTH AND FOOD INDUSTRY

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Abstract

Colour enhances the attraction and acceptance of food making it is the most important characteristics of any food item. Significant colour is lost during processing. so artificial or natural colours are added to make any food appealing to consumers. As colouring agents for food there are numerous of dyes on the market. However, due to consumer's knowledge, that synthetic colours can harm one's health, Bio colorants are currently becoming more and more popular and significant. The bulk of Bio- colorants are made from sources that can be recycled. The primary dietary Bio-colorants come from a variety of horticultural plants which are sources for carotenoids, flavonoids, anthocyanins, chlorophyll, betalain. Bio-colorants in addition to serving as food dyes also function as antimicrobials and antioxidant preventing a number of diseases and ailments

Keywords: Bio colorants, antimicrobials and antioxidant.

ARTICLE-10

ISOLATION AND CHARACTERIZATION OF FUNGI FROM BAKERY FOOD PRODUCTS

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Abstract:

Bakery food products, including bread, pastries, and cakes, are susceptible to fungal contamination. The presence of fungi in these products can affect their quality, shelf life, and safety. The isolation of fungi from bakery food products is a crucial step in ensuring the quality and safety of these goods. Various isolation methods, including direct plating, dilution series, filtration, and microscopic analysis, are used to identify and characterize fungal contaminants. Understanding the significance of fungal contamination in bakery products, including spoilage, mycotoxin production, allergenic reactions, and quality control, is essential for both the food industry and consumer safety. Effective monitoring and prevention strategies are necessary to mitigate the impact of fungal contamination and maintain the integrity of bakery products in the market. Advances in detection methods and technology continue to enhance our ability to isolate and manage fungal contamination in the bakery industry.

The aim of this work is to provide a comprehensive overview of the methods used to isolate fungi from bakery food products, with a focus on both the isolation techniques and the significance of fungal contamination in the bakery industry.

1. Introduction:

Bakery food products encompass a delectable array of items that are crafted through the art and science of baking. They hold a special place in culinary traditions worldwide, offering a wide range of tastes, textures, and aromas that can delight our senses. From crusty artisan bread to sweet pastries, bakery products play a significant role in the culinary world and are beloved by people of all ages and cultures. Bakery products typically consist of a few basic ingredients: flour, water, yeast or leavening agents, sugar, and salt. However, the variations in these components, along with the incorporation of fats, eggs, flavorings, and fillings, give rise

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to a multitude of products with distinct tastes and textures. Baking, the central process in creating bakery products, involves the transformation of dough or batter through exposure to dry heat. The precise techniques, temperatures, and timings employed by bakers are fundamental to the quality and characteristics of the final products. Bakery food products are an integral part of our culinary heritage, offering a vast assortment of tastes, textures, and traditions.

Bakery food products, while beloved for their deliciousness and versatility, are not immune to the risk of contamination. Contamination can occur at various stages of production, storage, and distribution, and it can have serious consequences for both the quality and safety of these products.

Common sources and types of contamination associated with bakery food products:

- Microbiological Contamination:

Bacteria: Harmful bacteria, such as *Salmonella*, *Escherichia coli* (*E. coli*), and *Listeria*, can find their way into bakery products through contaminated raw ingredients, poor hygiene practices, or unsanitary processing environments.

Molds and Yeasts: Mold spores and yeast cells can affect the shelf life and quality of bakery items, particularly those with higher moisture content, like bread and cakes.

- Chemical Contamination:

Food Additives and Preservatives: The misuse or overuse of food additives and preservatives can lead to chemical contamination. For example, excessive use of certain food colorings can be harmful.

Pesticide Residues: If grains or other ingredients are contaminated with pesticide residues, this can transfer to bakery products and pose health risks.

- Allergenic Contamination: Cross-contamination with allergenic ingredients, such as nuts, dairy, or gluten, can occur during processing, and this can be a significant concern for individuals with food allergies. Physical contamination can result from foreign objects like glass, metal fragments, or plastic inadvertently entering the bakery products during processing or packaging.

- Environmental Contamination: Poor environmental hygiene in bakeries can lead to contamination by pests like rodents and insects, which carry diseases and contaminate food surfaces with their waste and pathogens.

- Storage and Transportation: Inadequate storage conditions or improper transportation can expose bakery products to temperature fluctuations, moisture, or contamination from unclean storage areas, further compromising their quality and safety.
- Mycotoxins: Fungi that produce mycotoxins can contaminate grains and other raw ingredients used in bakery products. The mycotoxins, such as aflatoxins and ochratoxins, can be carcinogenic and harmful to human health.
- Bacterial Toxins: Some bacteria, like *Staphylococcus aureus*, can produce toxins that remain in the bakery products, causing foodborne illness when consumed.

To prevent contamination of bakery food products, various measures should be in place:

- Good Manufacturing Practices (GMP): Ensure that the bakery follows strict hygiene and sanitation protocols, including regular cleaning and sanitizing of equipment and work surfaces.
- HACCP (Hazard Analysis and Critical Control Points) System: Implement a systematic approach to identifying and controlling potential hazards throughout the production process.
- Ingredient and Supplier Control: Regularly assess the quality and safety of raw ingredients and establish supplier standards.
- Allergen Management: Clearly label allergenic ingredients, segregate allergenic and non-allergenic production areas, and educate staff on allergen-handling procedures.
- Temperature and Moisture Control: Maintain appropriate storage and transportation conditions to prevent spoilage, and ensure the proper use of preservatives to extend shelf life.
- Employee Training: Train staff on hygiene, food safety, and proper handling procedures to minimize the risk of contamination.
- Regular Testing: Conduct routine testing for pathogens, contaminants, and spoilage microorganisms in both raw materials and finished bakery products.

Contamination of bakery food products is a significant concern, and it is essential for the bakery industry to implement rigorous food safety practices to ensure that the products reaching consumers are not only delicious but also safe for consumption.

2. Materials and Methods:

2.1. Samples collection:

Fifty-three (53) bakery food samples, including bread, buns, cakes, chips, pizza bases, cookies, chocolates, toasts, peda, etc., were randomly taken from various stores in rural areas and in the vicinity of Davangere city (**Fig.2.1**). These samples were specifically brought together from the local market where they were displayed in open stalls as decorated samples.

The obtained samples were transported to the lab for further processing in sterile polythene bags, where they were kept sterile throughout processing (Patil and Kukade, 2020; Daou *et al.*, 2021).

2.2. Isolation of fungi:

By using the spread plate method, serial dilution method, and direct plate method, fungi were recovered from bakery product samples. On Potato dextrose agar (PDA), Rose Bengal agar (RBA), Czapek(dox) agar medium (CZA), and Sabouraud dextrose agar medium (SDA) plates, samples were inoculated, and the plates were then incubated at 37⁰C for 3 to 7 days. Following incubation, many fungi were seen and identified using microscopic analysis and morphological traits (Al-kahtani, 2014). All of the samples followed the same process.

a. Direct plate technique for isolation of mycotoxin-producing fungi

This technique performs well for finding, counting, and isolating fungi in bakery products. This approach involved directly placing or sparingly sprinkling 1 g of bakery samples on solidified agar media (PDA+RBA+CZA+SDA) and incubating it for 3–7 days at 30-37⁰C. Following incubation, many fungi were seen and identified using microscopic analysis and morphological traits (Al-kahtani, 2014). All of the samples underwent the same process.

b. Spread plate technique for isolation of mycotoxin producing fungi

In this entire process, 1 g of sample was combined with 9 ml of distilled water. PDA, RBA, CZA, and SDA homogenate was then added to the medium surface and dispersed uniformly using a sterile L-shaped spreader. The plates were then incubated for 3–7 days at 30-37⁰C. Following incubation, many fungi were seen and named using microscopic examination and morphological traits (Patil and Kukade, 2020; Mohamed Hashem, 2011). All of the samples underwent the same process.

c. Serial dilution technique for isolation of mycotoxin producing fungi

In this method, 1 g of material was combined with 9 ml of sterile water and well blended to produce a 10⁻¹ dilution, which was then serially diluted up to a 10⁻⁷ dilution. The spread plate technique was used to inoculate 0.1 ml of sample from each dilution onto the solidified agar media (PDA+RBA+CZA+SDA). The plates were then incubated for 3–7 days at 30-37⁰C. Following incubation, many fungi were spotted and identified using microscopic examination and morphological traits (Khan *et al.*, 2020; Pundir and Jain, 2011). All of the samples underwent the exact same process (Fig. 2.2).

2.3. Characterization of isolated microorganisms:

Fungi were identified based on morphological and microscopic observation, after staining with lactophenol cotton blue stain followed by Domsch *et al*, 1980; Subramanian, 1983; Ellis and Ellis, 1997; Gilman, 2001 and Nagamani *et al*, 2006 (**Table.2.2**).

3. Results and Discussion:

Total 21 fungi were isolated from 53 samples by three isolation methods (**Fig.2.3 and Table 2.1**). By direct plate method, 09 fungi were isolated and they were identified as *Trichoderma harzianum*, *A. niger*, *Rhizopus*, *A. flavus*, *Penicillium sp*, *Curvularia sp*, *A. parasiticus*, *Penicillium chrysogenum*, *Aspergillus sp*. By spread method, 05 fungi were isolated and they were identified as *Trichoderma sp*, *Penicillium sp*, *Aspergillus oryzae*, *Penicillium chrysogenum*, *Fusarium sp*. By serial method, 07 fungi were isolated and they were identified as *A. niger*, *A. flavus*, *Rhizopus*, *A. parasiticus*, *Aspergillus oryzae*, *Trichoderma sp*, *Penicillium sp*.



Figure.2.1. Different Bakery Products.

(Bread, Ladoo, Chikki, Barfi, Dry fruit burfi, soft burfi, Badusha, Biscuit, Rusk, Cake, Chips)



Figure.2.2. Isolation of Microorganisms by SPM, SDM, DPM.

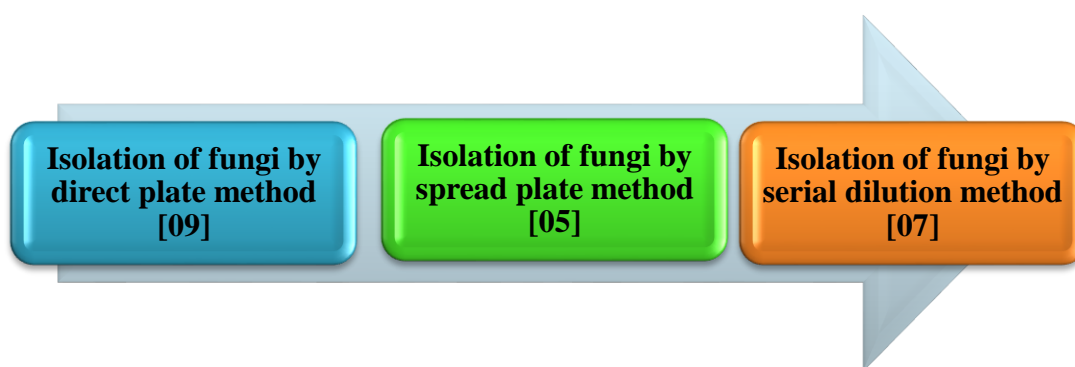
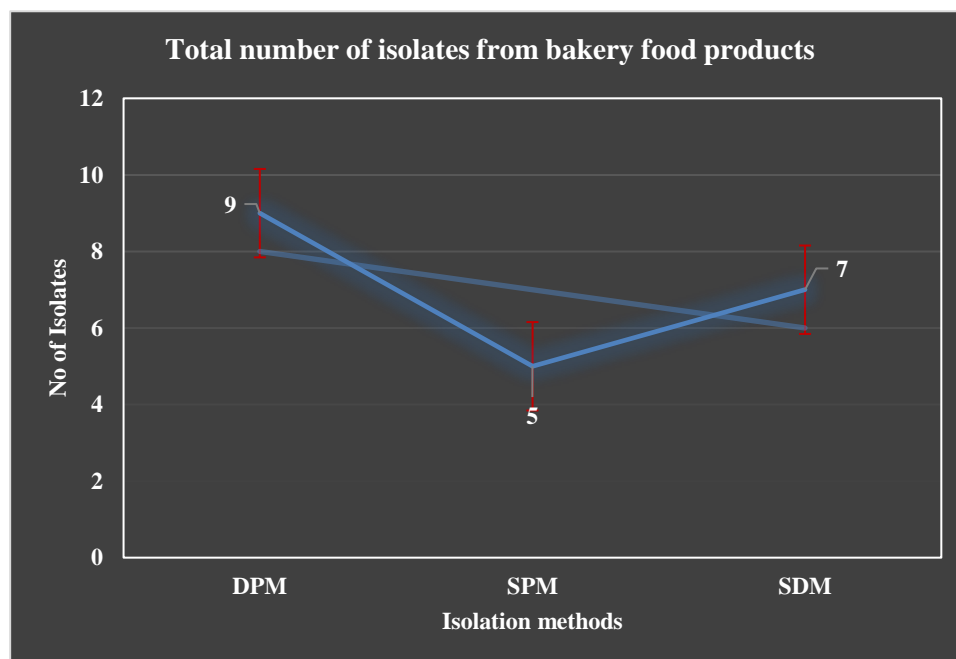






Figure.2.3. Total number of microorganisms isolated from bakery food products

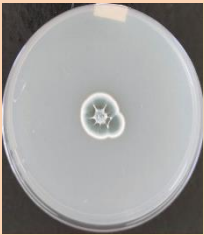
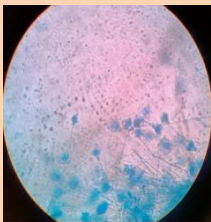
Table.2.1. Number of isolates from bakery food products



All the isolated microorganisms were identified by their macro and microscopic appearance after staining with lactophenol cotton blue stain. Among 21 isolated microorganisms, 2 were identified as *Trichoderma harzianum*, 3 were *A. niger*, 2 were *Bipolaris* sp, 3 were *A. oryzae*, 6 were *Rhizopus*, 2 were *A. flavus*, 2 were *Penicillium* sp, 1 were *Alternaria* sp,

Table 2.2. Macroscopic and Microscopic features of isolated microorganisms

Isolate s	Macroscopic features	Colony morphology on PDA	Microscopic on features	Microscopic observation (40X)
GS 2	Colonies on PDA & RBA initially white, quickly becoming black with conidial production.		Filamentous hyphae, Conidial heads were radiated, walls were thick. Vesicles were globose. Conidia were brown.	
GS 3	Colonies on PDA and RBA are whitish, woolly to cottony growth, grey with fluffy growth.		The hyphae are septate and brown. Conidiophores are brown, simple or branched.	

GS 7	Colonies on PDA & RBA, are dark green color with whitish tint & initially white in colour and later becoming green colour.		Septate hyphae, Conidiophores are branched. Brush like clusters were observed at the end of the conidiophores. Conidia looks like round to ovoid.	
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The results of isolation of some species of microorganisms from 53 bakery food samples collected randomly from different shops in rural sides and around Davangere city, a total of 21 fungi were isolated. Fungi are remarkable organisms that readily produce a wide range of secondary metabolites. Some are beneficial and some are deleterious., for example mycotoxins to human kind. Diba *et al.*, observed the macroscopic and microscopic features of *Aspergillus* species in medical and environmental samples and concluded that the use of PDA, DRBC, AFPA, and other growth media may stimulate the growth and sporulation process of *Aspergillus* species. Morphological characterization approaches have also been used on *Aspergillus* species in Iran's Fars and Kerman provinces (Mohammadi *et al.*, 2009). The use of Potato Dextrose Agar medium (PDA), Rose Bengal Agar medium (RBA), Czapek (dox) agar medium (CZA), and Sabouraud's dextrose agar medium (SDA) allowed for adequate growth and sporulation, allowing for a satisfactory examination of the macroscopic and microscopic features of *fungi*. After morphological Characterization on SZA, many *A.flavus* isolates isolated from corn in North-Eastern China were identified (Gao *et al.*, 2007). Fungi that exhibit filamentous growth and have a relatively complex morphology produce several secondary metabolites. The collected samples were grown on PDA, SDA, RBA and CZA medium plates. After 3-7 days incubation, the results were recorded. In this study, a total of 21 fungi were isolated by using three isolation methods. These isolates were identified through the observation of morphological characteristics and microscopic observations.

4. Conclusion:

The main conclusion of this study includes, the isolation and characterization of contaminants of bakery food products, distribution of mycoflora in bakery food products and moisture content determination of bakery food products, these may cause severe problems to the peoples who consume bakery food products. So, it is important that to avoid the contamination of bakery food products during the processing, handling and transformation.

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Author contributions:

Conducted all the experiments in the Bioprocess and Fermentation Technology, Department of Studies in Microbiology, Davangere University, Davangere under the guidance of Dr. Ramalingappa. B. Professor & Dean of studies in Science & Technology who critically reviewed the study and summarised the manuscript.

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ARTICLE-11

The Aromatic Symphony of *Salvia officinalis*: An In-depth Study of its Antioxidant, Antimicrobial, and Mosquitocidal Prowess

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Abstract

In the current study, the effectiveness of *Salvia officinalis* essential oils was evaluated in our laboratory against their antioxidant, antibacterial, and mosquitocidal properties. In this work, the antioxidant activity of DPPH, which provides the maximum inhibition, was examined. The well diffusion method was used to assess the essential oil's antibacterial properties after being extracted from the aerial portions of *Salvia officinalis* species. Different antibacterial activities were displayed by the essential oils of the *Salvia* species against the tested microorganisms. *K. pneumoniae* was highly prone to the antibacterial activity, followed by *S. aureus*, *E. coli* and *E. faecalis*. Similar to other antifungal agents, *Salvia officinalis* essential oil significantly inhibited the growth of *Candida albicans*. The maximum larval mortality of *A. aegypti* was recorded at 97.87% after a 72-hour exposure to *S. officinalis*. Similarly, the pupal mortality and the highest mortality (95.2%) in 72 hours of exposure periods were also determined. The qualities of the components of essential oils, as well as their antibacterial, antioxidant, and mosquitocidal effects, were discovered in this study of *Salvia* species utilized in food, medicine, and cosmetics.

Keywords: *Salvia officinalis* essential oil, antioxidant, antimicrobial and Mosquitocidal activities

1.0 Introduction

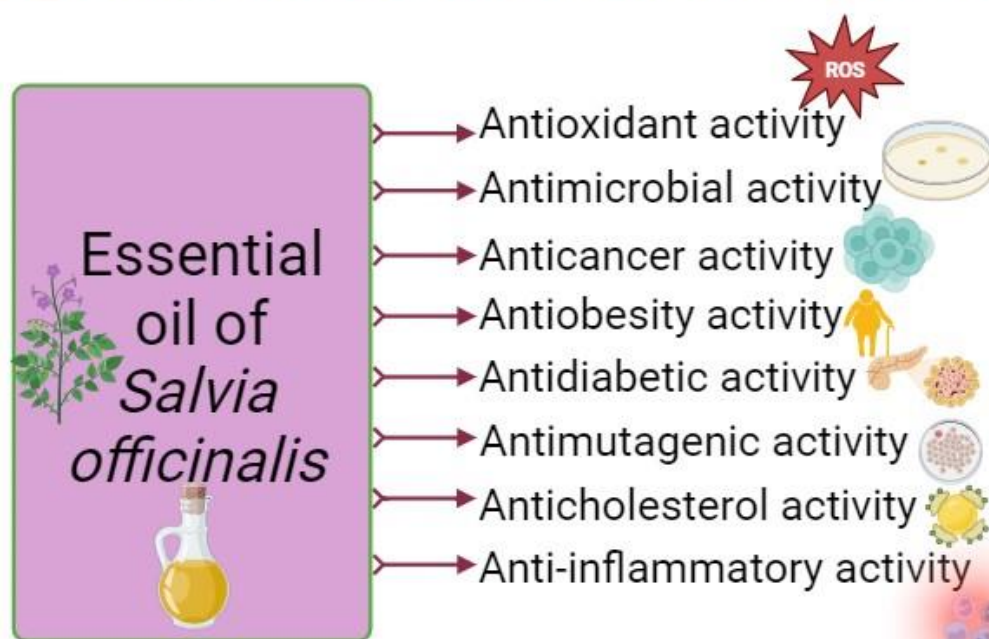
Salvia plants are found all over the world, including the Mediterranean region, Central Asia, the Pacific Islands, tropical Africa, and the Americas. *Salvia* is the most significant genus in the Lamiaceae family, with over 900 species. Many *Salvia* species have significant economic value as spices and flavorings in cosmetics and fragrances (González-Gallegos *et al.*, 2020).

The essential oils of *salvia* exhibit significant actions such as antioxidant, antimicrobial, anticholinesterase, memory and feelings improvement, stress at work reduction, antimutagenic, cancer-preventing, anti-inflammatory properties, and choleric (Miliauskas *et al.*, 2004; Association of Global Academicians and Researchers (AGAR))

Longaray Delamare *et al.*, 2007; Mathew and Thoppil, 2012; Owokotomo *et al.*, 2015; Fu *et al.*, 2017; Kostić *et al.*, 2017; Demirpolat, 2023). However, a number of genetic and environmental factors have a significant impact on the essential oil chemical composition of medicinal and aromatic plants (Rajabi *et al.*, 2014).

Due to their low toxic effects, pharmacological properties, and economic profitability, plants' therapeutic and health-improving capabilities have garnered a lot of attention in scientific developments (Ben Hsouna *et al.*, 2023; Ben Hsouna *et al.*, 2022; Ben Akachaetal *et al.*, 2023). The majority of research has concentrated on the advantages of phytochemical substances originating from plants and their favorable impact on human health. Single compounds or groups of compounds (mixtures), like in the scenario of essential oil (Bansal, 2016; Ben Hsouna *et al.*, 2017; Bouteraa *et al.*, 2023), can be found in naturally derived additives from plants.

Biological activities of essential oil of *S.officinalis*



The purpose of this study was to investigate the essential oil obtained from *Salvia officinalis* leaves and to assess its biological effects as an antioxidant, antimicrobial against gram-positive *Staphylococcus aureus* and *Enterococcus faecalis* gram-negative *Klebsiella pneumoniae* and *Escherichia coli*, and antifungal such as *Candida albicans* and mosquitocidal activity.

2.0 Materials and methods

The essential oils from leaves of *Salvia officinalis* L. in Kerala and obtained by hydro distillation process.

2.1 Antioxidant activity

Antioxidant activity tests were previously used to identify biological cells under oxidative stress. The antioxidant activity of *S. officinalis* essential oil was identified. Ben Hsouna *et al.*'s methodology for DPPH tests was created in 2022.

$$\text{Percentage of inhibition} = \frac{\text{Control OD} - \text{Test OD}}{\text{Control OD}} \times 100$$

2.2 Anti-microbial activity

The antibacterial and antifungal properties of *S. officinalis* essential oil were evaluated using the Muller Minton agar well diffusion method, as illustrated in the plate 0.00, according to Devillers *et al.*, (1985).

2.3 Rearing of *A.aegypti*

A. aegypti is being replenished in a number of places, including drains, wastebaskets, and a construction site. Both the larvae and pupa were separated, washed with water, and kept in our lab. Under laboratory circumstances, both larvae and pupae were placed in separate glass containers and fed biscuit powder.

2.4 Larvicidal activity against *A.aegypti*

The larvicidal activity of essential oil of *S.officinalis* was estimated according to World Health Organization guidelines for laboratory and analysis of a mosquito larva (WHO, 2012). The percentage of corrected mortality was calculated by using the Abbott formula (Abbott's, 1925).

$$\text{Percentage mortality} = \frac{\text{Mortality in treatment} - \text{Mortality in Control}}{100 - \text{Mortality in control}} \times 100$$

2.5 Pupical activity against *A. aegypti*

In pupical activity, was assessed by using standard WHO Protocols (WHO 2012) bioassays, essential oil of *S.officinalis* were tested at 100, 200. 300, 400 and 500ppm concentrations. The control mortalities were corrected by using Abbott's formula (Abbott's, 1925).

$$\text{Percentage of pupae mortality} = \frac{\text{Number of dead larvae/ pupae}}{\text{Number of larvae /pupae introduced}} \times 100$$

2.6 Stastical analysis

Using SPSS software, a probit analysis was performed on the mean mortality data to compute the chi-square, slope, LC₅₀, LC₉₅, as well as additional statistics with a 95% confidence interval for both the upper and lower confidence limits. Results were deemed statistically significant when they had a $p \leq 0.05$.

3.0 Result

Table 3.1: Antioxidant activity of DPPH against essential oil of *S.officinalis*

Concentrations($\mu\text{g/ml}$)	Absorbance	% of inhibition	IC ₅₀
100	0.953	17.13043	59.55461
200	0.876	23.82609	
300	0.638	44.52174	
400	0.436	62.08696	
500	0.294	74.43478	

The essential oil of *S. officinalis* was examined for its antioxidant and DPPH radical-scavenging abilities at doses ranging from 100, 200, 300, 400 and 500 g/ml, as indicated in table 3.1. The essential oil of *S. officinalis* had a maximal DPPH radical scavenging activity of 17.13, 23.82%, 44.52%, 62.03%, and 74.43%, with an IC₅₀ of 59.55.461. It is compared to the ascorbic acid as a standard as shown in Table3.1 and Figure3.1.

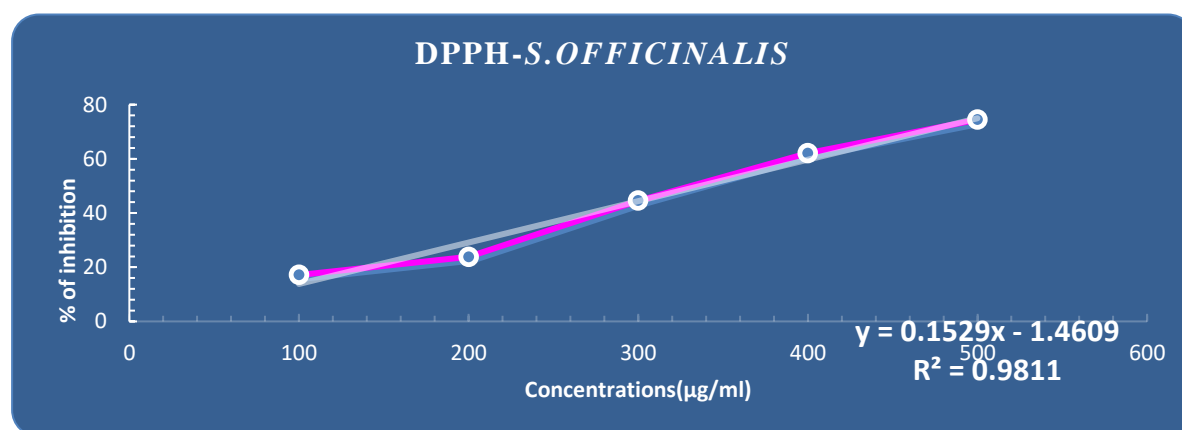


Figure 3.1: Antioxidant activity of DPPH against essential oil of *S.officinalis*

Table 3.2: Antimicrobial activity of essential oil of *S.officinalis* against bacteria and fungi

Pathogens	Zone of inhibition(mm in diameter)			
	Bacteria			
	25µg/ml	50µg/ml	100µg/ml	Control Tetracycline
<i>Staphylococcus aureus</i> - MTCC- 96	1.5	1.9	2.5	2.8
<i>Enterococcus faecalis</i> - MTCC-439	1.3	1.5	1.7	2.3
<i>Klebsiella pneumonia</i> - MTCC-39	1.5	1.8	2.7	2.5
<i>Escherichia coli</i> - MTCC-443	1.2	1.7	1.8	2.0
Pathogens	Fungi			Control Ketoconazole
<i>Candida albicans</i> - MTCC183	1.5	1.9	2.9	3.0

The antibacterial activity of essential oil of *S.officinalis* was tested 25, 50,100µg/ml concentrations against two species of gram positive and gram negative and one fungi respectively. It was observed that *C.albicans*, *K.pneumoniae* were significantly suppressed followed *S.aureus*, *E.coil* and *E.faecalis* as shown in Table3.2.

Table 3.3: Larvicidal activity of essential oil of *S.officinalis* against the third instar larvae of *A.egypti*- 48hrs

Concentrations	Mortality (%)	Lc ₅₀	Lc ₉₅	chi-square
100 µg/ml	19.81±1.99 ^a			0.156

200 µg/ml	26.73±2.78 ^b	285.472 (231.644-336.657)	593.379 (502.272-229.197)	
300 µg/ml	50.04±2.49 ^c			
400 µg/ml	79.37±3.99 ^d			
500 µg/ml	85.66±6.52 ^e			
Neem azal	100.00±0.0 ^e			

Findings represent the mean S.D. of five replications. At p0.05%; DMRT, a different alphabet in the column is statistically significant.

The larvicidal activity of essential oil of *S.officinalis* was tested with 100, 200, 300, 400 and 500ppm concentrations against the third instar larvae of *A.aegypti* and the data are shown in table 3.3 The larval mortality of 19.81±1.99, 26.73±2.78, 50.04±2.49, 79.37±3.99, and 85.66±6.52% was noticed against 100, 200, 300, 400 and 500ppm concentrations of the essential oil, respectively. Further, the LC₅₀ value of 285.472 ppm was calculated with the LCL value of 231.644 ppm, and the UCL value was found to be 336.657ppm. Whereas the LC₉₅ value of 593.379 ppm was noted with the LCL and UCL of 502.272 ppm, the UCL value was 229.197ppm. The chi-square value was calculated as 0.156. Since the difference between the means was found significant as per DMRT post hoc analysis ($p<0.005\%$), the data showed heterogeneity between the treated groups (concentrations) as evidenced from table 3.3 respectively.

Table 3.4: Larvicidal activity of essential oil of *S.officinalis* against the third instar larvae of *A.aegypti*- 72hrs

Concentratio ns	Mortality (%)	Lc ₅₀	Lc ₉₅	chi-square
100 µg/ml	27.11±2.01 ^a	225.332 (165.938-271.738)	509.161 (432,078-663.738)	0.159
200 µg/ml	43.93±3.22 ^b			
300 µg/ml	60.00±6.22 ^c			
400 µg/ml	83.15±4.87 ^d			
500 µg/ml	97.87±5.33 ^e			
Neem azal	100.00±0.0e			

Findings represent the mean S.D. of five replications. At p0.05%; DMRT, a different alphabet in the column is statistically significant.

The larvicidal activity of essential oil of *S.officinalis* was tested with 100, 200, 300, 400 and 500ppm concentrations against the third instar larvae of *A.aegypti* and the data are shown in table 3.4 and figure 0. The larval mortality of 27.11 ± 2.01 , 43.93 ± 3.22 , 60.00 ± 6.22 , 83.15 ± 4.87 , and $97.87 \pm 5.33\%$ was noticed against 100, 200, 300, 400 and 500ppm concentrations of the essential oil, respectively. Further, the LC_{50} value of 225.332 ppm was calculated with the LCL value of 165.938 ppm, and the UCL value was found to be 271.738 ppm. Whereas the LC_{95} value of 509.161 ppm was noted with the LCL and UCL of 432.078 ppm, the UCL value was 663.738ppm. The chi-square value was calculated as 0.159. Since the difference between the means was found significant as per DMRT post hoc analysis ($p < 0.005\%$), the data showed heterogeneity between the treated groups (concentrations) as evidenced from table 3.4 and figure 3.2.

Figure 3.2: Pupical activity of essential oil of *S.officinalis* against the pupae of *A.aegypti*-48hrs

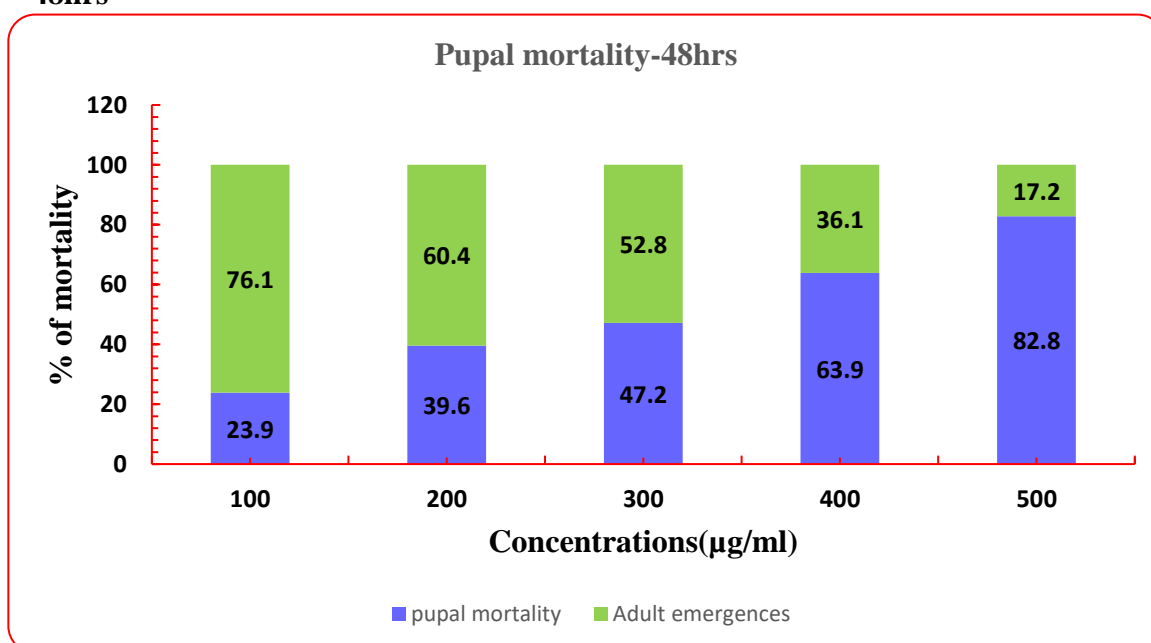


Figure 3.2 represents the pupicidal activity of essential oil of *S.officinalis* tested against the pupae of *A. aegypti* with exposure periods 48hrs. It was observed that 100ppm induced 23.9% pupal mortality with 76.1% adult emergence. In same manner, 39.6% pupal activity was noted with 60.4% adult emergence at 200ppm concentration of *S.officinalis*. Whereas 47.2% pupal mortality of adult emergence of 52.8% was noted at 300ppm concentration. Likewise, 63.9% pupal mortality with adult emergence of 36.1% was recorded at 400ppm concentration.

Similarly, the 500ppm concentration of the essential oil of *S.officinalis* induced 82.8% pupal mortality with 17.2% adult emergence.

Figure 3.3: Pupical activity of essential oil of *S.officinalis* against the pupae of *A.aegypti*-72hrs

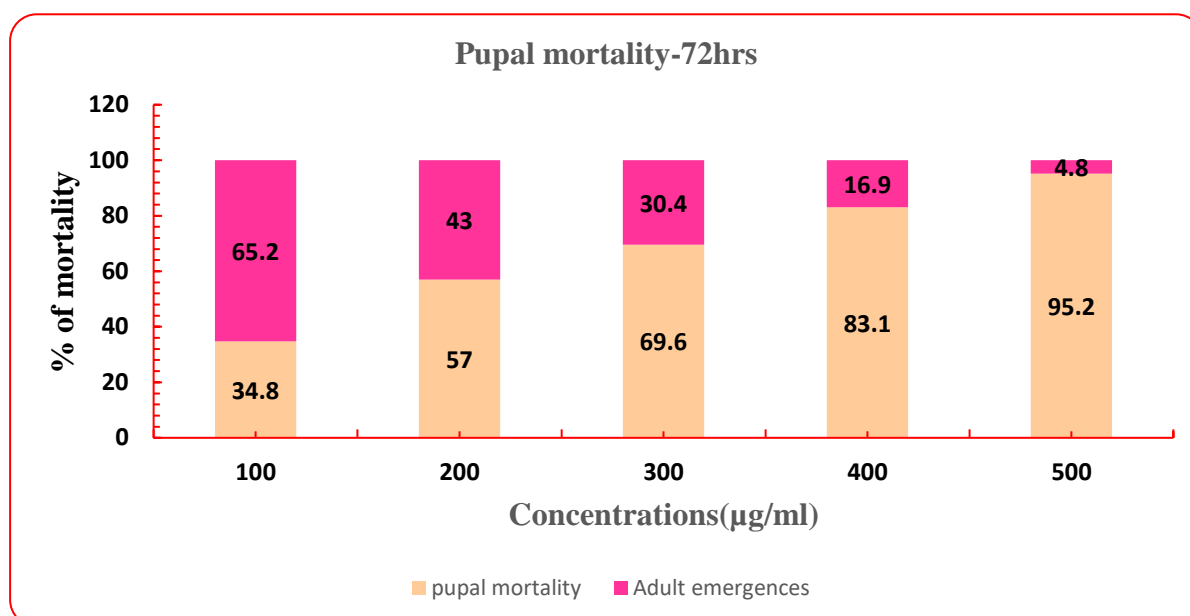


Figure 3.3 represents the pupicidal activity of essential oil of *S.officinalis* tested against the pupae of *A. aegypti* with exposure periods 72hrs. It was observed that 100ppm induced 34.8% pupal mortality with 65.2% adult emergence. Likewise, 57.0% pupal activity was noted with 43.0% adult emergence at 200ppm concentration of *S.officinalis*. Whereas 69.6% pupal mortality of adult emergence of 30.4% was noted at 300ppm concentration. In the same way, 83.1% pupal mortality with adult emergence of 16.9% was recorded at 400ppm concentration. Similarly, the 500ppm concentration of the essential oil of *S.officinalis* induced 95.2% pupal mortality with 4.8% adult emergence.

Plate1: shows the antioxidant activity of DPPH against essential oil of *S.officinalis*

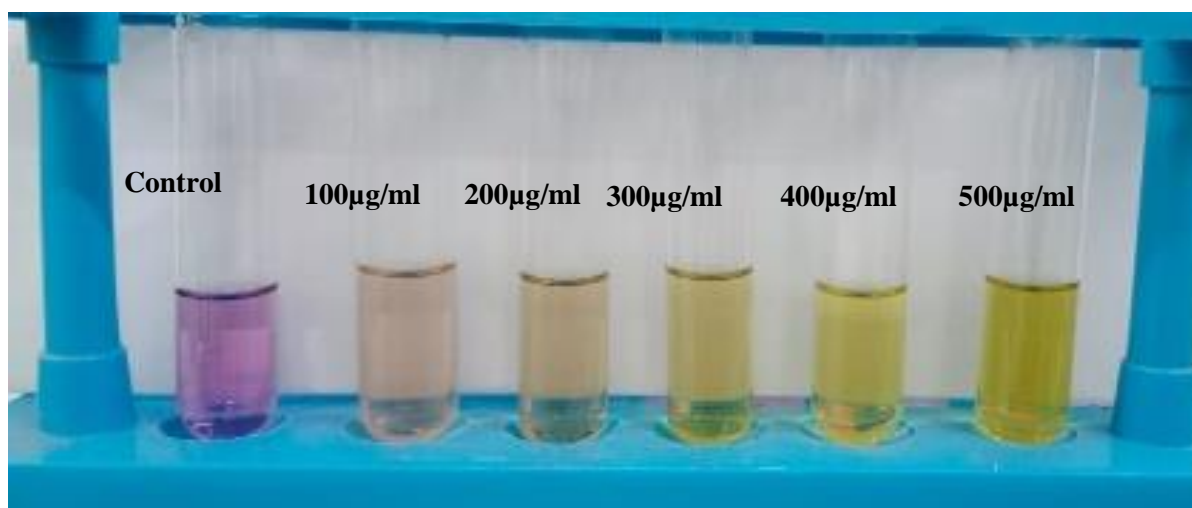
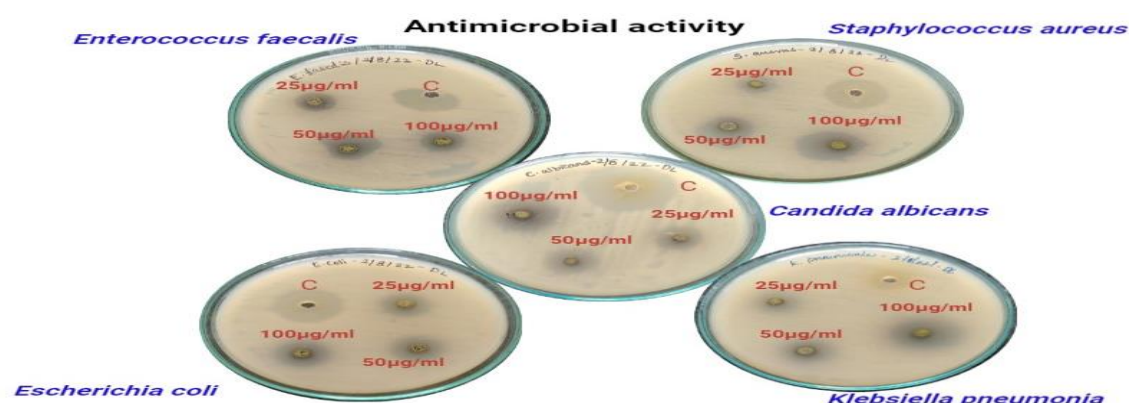


Plate2: represents the anti-microbial activity of essential oil of *S.officinalis*



4.0 Discussion

In the present investigation, essential oil of *S.officinalis* showed remarkable for antioxidant, antimicrobial and mosquitocidal activities. The findings of the current research plan are consistent with past authors' findings that essential oils have a remarkable ability to suppress vector mosquitoes at any stage of their life cycle. The large quantity of bioactive compounds found in plants makes them a potential replacement for chemical insecticides. A number of vectors have been attempted to be controlled in the past utilizing insect repellent natural chemicals derived from plants (Lee *et al.* 2002; Samyor *et al.* 2017).

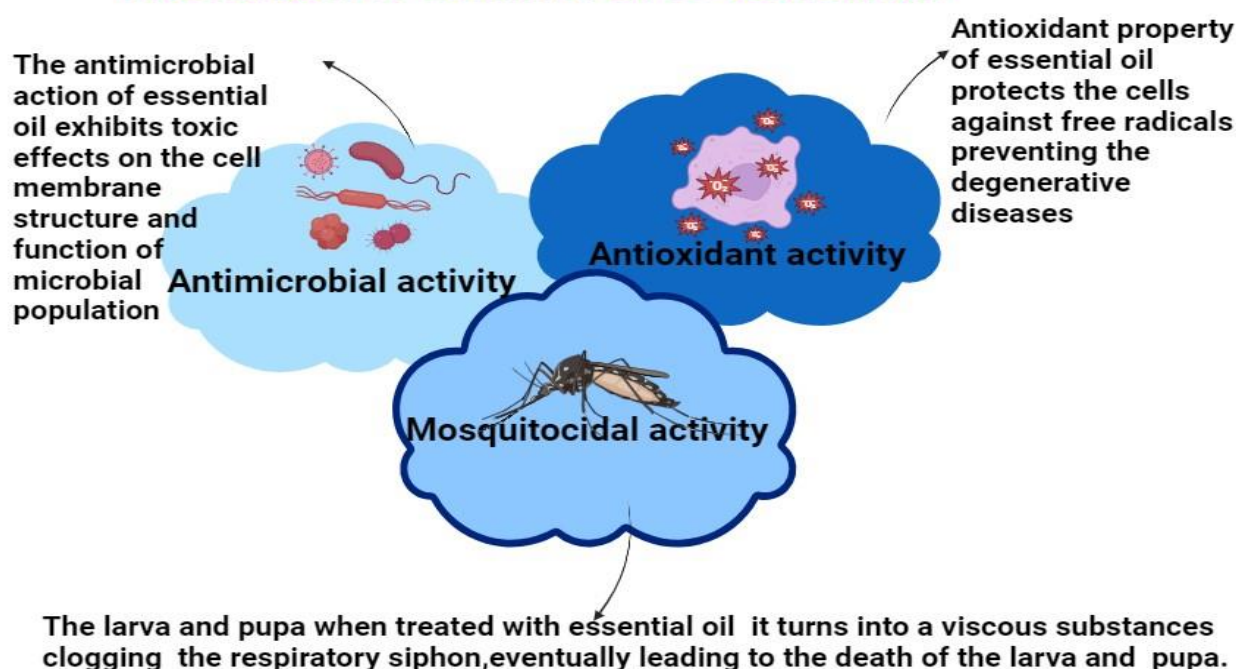
The mechanism of the larvae were very active, and before posing to aromatic oil, they were seen making a vigorous vertical movement in the experiment containers. This is because the essential oil turns into a viscous substance that plugs the larvae's respiratory siphon, preventing them from absorbing air oxygen. As a result, the larvae were eventually exposed to death by

having their breathing routes blocked. These results support prior research by Phukerd and Soonwera (2013), who found that the EOs of *Boesenbergia rotunda* and *Curcuma zedoaria* had an effect similar to that described above on *A. aegypti* larvae and prevented the microphytes of eggs (Mishra *et al.*, 2018).

The mechanisms of the antibacterial action of EOs are thought to be increased cell permeability due to the hydrophobicity of EO (Ding *et al.*, 2022; Yu, *et al.*, 2022), and their toxic effects on membrane structure and function (Li *et al.*, 2022). Additionally, it has been noted that EOs are more effective against Gram-positive organisms than Gram-negative organisms. This is because EOs have an outer membrane that prevents the components from diffusing out as freely (Ben Akacha *et al.*, 2022). On the other hand, the peptidoglycan cell wall in Gram-positive bacteria offers less resistance to hydrophobic compounds (Mishra *et al.*, 2020). Gram-positive bacteria were more sensitive to both EOs than Gram-negative bacteria, which were resistant to the concentrations tested (25.0 µg/mL and 50.0 µg/mL) with the exception of *S. enterica* (Demirpolat, 2023). The effectiveness of 1, 8-cineole's antibacterial action against various pathogens was examined in a study. The study's findings led to the conclusion that using 1, 8-cineole and chlorhexidine together may make it easier to get rid from certain resistant bacteria by boosting antibacterial activity (Şimşek and Duman 2017).

Figure 3.4 represents the mechanism of essential oil of *S. officinalis*

Mechanism of essential oil of *S.officinalis*



Management of mosquito populations is essential to preventing diseases spread by mosquitoes, enhancing the environment, and promoting public health. Insecticide spraying is crucial in efforts to manage mosquito populations. However, due to problems with people, technology, operations, the environment, and the economy, this hasn't been established to be very effective. It is necessary due to a lack of novel insecticides, the high cost of synthetic insecticides, environmental issues, harmful effects on humans and other non-target species, and ecological concerns.

5.0 Conclusion

Salvia officinalis has historically been of interest to academics due to its various biological, antioxidant, and antibacterial qualities, which contribute to their potential use as food preservatives and health enhancers. Still, aim to promote their wider use in the pharmaceutical and food industries. The variability in the phytochemical profile since it depends on a variety of elements, including the origin of the plant species, the component from the plant used for extraction, the phenological stage, and the agronomic techniques used. All of these variables have the potential to change the composition of volatile chemicals, highlighting the

requirement for essential oil standardization prior to their usage as medicinal agents or food additives.

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ARTICLE-12

IMPACT OF ROCK PHOSPHATE AMENDED BIOGAS SLURRY AND PHOSPHATE SOLUBILIZING MICROORGANISMS ON CHILLY PLANT GROWTH

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Abstract

The chilly plants used in this experiment were treated with biologically digested manure from a biogas plant together with Phosphate Solubilizing Microorganisms (PSM) and Rock Phosphate (RP) in four treatments with a control (T0, T1, T2, T3, and T4). For the purpose of identifying phenotypic traits such root length, shoot length, total height, wet weight, dry weight, chlorophyll content, and yield, samples were taken during the seedling, pre-flowering, blooming, and terminal stages of the plant. In comparison to the non-enriched slurry, the slurry enriched with rock phosphate (RP) and phosphate solubilizing microorganisms (PSMs) promoted the aforementioned phenotypic features and good yield. The combination of

PDS+PSM+RP (T4) produced the best results among the enriched manures (6.314 tons/hectare), followed by CDS+PSM+RP (T2) (5.280 tons/hectare), PSM+RP (5.010 tons/hectare) (T3), inorganic manure (3.454 t/hectare) (T1), and control (1.821 tons/hectare) (T0). The NPK consumption is more in final stage when compare to other stages. The fields that had biologically digested fertilizer had more microbial development than they did before application, according to a study of the microbiome.

Keywords: Biodigester slurry, PSM, RP

ARTICLE-13

NANOTECHNOLOGY IN AGRICULTURE

SATHYA.M

ABSTRACT:

Agriculture has always been the backbone of most of the developing countries. In recent decades the agricultural scenario has witnessed several challenges like burgeoning population, shrinking farm land, depletion of natural resources, resurgence of new pests and diseases and global warming. With increasing population there is further pressure on this sector to meet the growing food demand. To address all these challenges, there is a need for an alternate technology such as nanotechnology that promotes productivity while ensuring environmental safety. Nanotechnology can increase agricultural production, and its applications. Nano formulations of agrochemicals for applying pesticides and fertilizers for crop improvement.

ARTICLE-14

STUDY OF BIOINSPIRED SYNTHESIS OF NIO SYNTHESIS FROM SARGASSUM SPP AND ITS BIOLOGICAL CHARACTERIZATION

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Abstract:

Sargassum illicifolium is one of the dominant brown algae found west coast of Maharashtra India. Nanoparticles made by plants are more stable and synthesize at a faster rate than those made by other organisms. In this investigation put forth Green synthesis of Nickel-oxide Nanoparticles (NiO-NPs) by using of the extract of *Sargassum illicifolium* at room temperature. Nickel-oxide Nanoparticles (NiO-NPs) characterization can be done in the various experimental methodology such as the X-ray diffraction (XRD), Field Emission scanning electron microscope (FE-SEM), High-Resolution Transmission electron microscopy (HR-TEM), UV–VIS spectrophotometer and Fourier Transform Infrared (FT-IR) spectroscopy. In this study we analysed Biological potential of Nickel-oxide Nanoparticles (NiO-NPs) by Antioxidant activity (ABTS and DPPH Assay) and Anticancer activity by using MCF7 Cell line By MTT assay

Keywords : Nickel-oxide Nanoparticles (NiO-NPs), Biological Study, Characterization Sargassum

ARTICLE-15

AGRICULTURAL WASTE AS BIOMASS FEEDSTOCK FOR PRODUCTION OF BIOETHANOL USING *Saccharomyces* sp.

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Abstract:

Yeast strains are commonly associated with sugar rich environments. Various samples such as orange, tomato, bread, grape juice, mango juice, sugarcane juice, yogurt, buttermilk, idly batter and marine water were selected as source for isolating yeast cells. In this study, a total of fifteen yeast strains were selected based on colony morphology, microscopic observation, carbon and nitrogen assimilation tests and fermentative capacity tests. The selected strains were identified at Genus level by colony morphology, biochemical characteristics and cell morphological characters. Ethanol tolerance of each strain was studied by allowing the yeast to grow in liquid YEPD (Yeast Extract Peptone Dextrose) medium having different concentrations of ethanol. The isolate Y6 had the maximum ethanol tolerant level (10% v/v respectively), and was subjected to 18srRNA sequencing for species level identification. In molecular identification the yeast was identified as *Saccharomyces pastorianus*.

Keywords: Yeast, YEPD, Ethanol tolerant and *Saccharomyces pastorianus*.

ARTICLE-16

ISOLATION OF FUNGAL RHIZOSPHERIC AND ENDOPHYTES FROM *PASSIFLORA EDULIS* AND ITS ANTIBACTERIAL EFFECT.

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Abstract

Fungal Endophytes are ubiquitous in the plant kingdom, with an estimate of at least few million species. Plants may serve as a repository of innumerable number of micro organisms known as endophytes (Bacon and White, 2000; Strobel, 2002). According to Dreg Fuss and Chapela (1994) there are may be one million species of endophytic fungi in various medicinal plants. The existence of endophytes has been known for over one hundred years. The present study was done in *Passiflora edulis* which is known as passion fruit, a vine species of passion flower, belonging to the family Passifloraceae. It is cultivated in tropical and sub-tropical areas and native to Southern Brazil. It is rich in anti-oxidants, good source of fibre, controls diabetes and boosts the immune system.

The fungal isolates include a total five fungi *Trichoderma viridae*, *Cladorrhinium* sp., *Gliocladium fimbriatum*, *Fusarium solani*, and *Alternaria alternata* were isolated from rhizosphere while three fungi *Cladorrhinium* sp., *Gliocladium fimbriatum*, *Mycelia sterilia* were isolated as endophytes from the plant *Passiflora edulis*.

Three types of rhizosphere fungi *Trichoderma viridae*, *Fusarium solani*. *Alternaria alternata* were isolated which were found to be 50% of the population of total fungi isolated while one isolate of endophyte *Mycelia sterilia* was isolated which was 16.6 %.. The fungi common both as rhizospheric and endophytic include two isolates *Gliocladium fimbriatum* and *Cladorrhinium* sp. accounting to 33.3 % of the total population of the isolates.

In the present study, the isolated fungal endophytes from *Passiflora edulis* including *Gliocladium fimbriatum*, *Cunninghamella* sp. and *Cladorrhinium* sp. and *Mycelia sterilia*, were cultured in broth medium and the antibacterial study was conducted by turbidity method and Agar Diffusion technique.

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Gliocladium fimbriatum, the predominant fungi showed antibacterial property only against *S.aureus*, while *Cunninghamella* sp. and *Cladorrhinium* sp. showed inhibition of only against *S.aureus*. The endophyte *Mycelia sterilia* showed antibacterial activity only for *S.aureus*. Hence the fungal endophytes of *Passiflora edulis* with medicinal importance shows inhibition of the pathogenic bacteria.

Keywords: *Passiflora edulis*, rhizospheric fungi, endophytic fungi, anti-bacterial effect,

ARTICLE-17

PLASTIC EATING BACTERIA

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Abstract

Plastics are everywhere .once they get into the environment as trash,they stay there for years, decades, chemically inert.plastic pollution is increasing day by day and at some point plastic recycle is not possible . So that biodegradation of plastic is important. A new species *Ideonella sakaiensis* is a bacterium from the genus *Ideonella* and family Comamonadaceae capable of breaking down and consuming the plastic polyethylene terephthalate (PET) using it as both a carbon and energy source.The bacterium *Ideonella sakaiensis* 201-F6 ,secretes two enzymes that breakdown common plastic polymer PET. The two enzymes are PETase and MHETase. Plastic bottles take 450 years to degrade and plastic bottles in ocean causes chemical pollution but the newly discovered bacteria could help to solve these pollution problems ,the rate of degradation is slow but it works.As terephthalic acid could be isolated and reused ,this could provide huge savings in the production of new polymers.The *Ideonella sakaiensis* helps to reduce much of the waste found around the planet.

ARTICLE-18

ISOLATION OF FUNGAL ENDOPHYTES FROM *SANTALUM ALBUM* AND ITS ANTIBACTERIAL EFFECT

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Abstract

Fungal Endophytes are ubiquitous in the plant kingdom, with an estimate of at least few million species. Plants may serve as a reposition of innumerable number of micro organisms known as endophytes (Bacon and White, 2000; Strobel, 2002). The existence of endophytes has been known for over one hundred years. *Santalum album* is a small tropical tree with traditional source of sandalwood oil, belonging to the family Santalaceae. It is the native of Southern India and Southeast Asia. It is used in the treatment of bronchitis, cystitis, dysuria and diseases of urinary tract which contains alpha-santalol. In the present study, fungal endophytes were isolated from *Santalum album* by agar plate method and the various fungal isolates include *Chalaropsis* sp., *Phoma glomerata*, *Collectotrichum* sp. and *Fusarium solani*. The fungal endophytes were cultured in broth medium and the antibacterial study was conducted by turbidity method and Agar Diffusion technique.

All the endophytic fungal isolates from the plant *Santalum album* was studied for antibacterial property on *Staphylococcus aureus*, *Escherichia coli* and *Klebsiella pneumoniae*. The isolated fungal endophytes, *Collectotrichum* sp. showed antibacterial property against all the three bacteria *S.aureus*, *E.coli* and *K.pneumoniae*, while endophytic fungi *Phoma glomerata*, *Fusarium solani* and *Fusarium* sp. also showed inhibition against all the three test bacteria *S.aureus*, *E.coli* and *K.pneumoniae*. The fungus *Phoma glomerata* showed the presence of aromatic compounds, amines, aldehydes, esters, and ketones while *Fusarium solani* produced similar compounds along with aliphatic compounds. The fungus *Fusarium oxysporum* showed the presence of aliphatic and aromatic compounds, amines and ketones.

Hence the fungal endophytes of *Santalum album* with medicinal importance shows inhibition of the pathogenic bacteria.

Keywords: *Santalum album*, endophytic fungi, anti-bacterial effect, aliphatic and aromatic compounds, amines and ketones

ARTICLE-19

SCREENING OF PRELIMINARY PHYTOCHEMICALS AND MINERAL ANALYSIS OF THREE FRESH LEAFY MATERIALS

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Abstract

Medicinal plants contain number of medicinal properties . Phytotherapy acts as a source of treating and improving certain diseases by using the beneficial effects of medicinal plants. *Musa paradisiaca* also known as plantain is a familiar tropical fruit and important source of Food in the world and is consumed as an energy yielding food and desert. *Annona muricata* L commonly known as graviola or soursop belongs to the family of Annonaceae and is the most tropical semi deciduous tree with the largest fruits of the *Annona* genus. *Emblica officinalis* enjoys a hallowed position in Ayurveda an indian indigenous system of medicine. The leafy extract of choosen plant materials viz, *Musa paradisiaca*, *Annona muricata* and *Emblica officinalis* were analysed for the presence of phytochemicals. The maximum number of phytochemicals ie Phenols, Tannins, Alkaloids and Flavonoides were absorbed in all the Plant extracts .where as minimum phytochemical like steroids, glycosides was seen in *Annona* sps., *Emblica* sps. The mineral analysis of the selected plant extracts .The minerals ie, Pottasium, phosphorous, Calcium, sulphur, Magnesium and nitrogen were assessed. Phytochemical analysis help in identifying new source of therapeutically and industrially valuable compounds in the present study .It can be inferred from the results that the consumption of the leaves will result is significant treatment of health issues, owing to the investicated phytochemical and elemental composition .These findings have filled the gap in knowledge regarding the concentration of the mineral elements constituents and groups of phytocompounds present in leafy materials and thus will be helpful in quantifying consumption levels, dosage preparation for medicinal use and above all , improve food security.

Keywords: Secondary metabolites, leaf extracts, mineral compound.

ARTICLE-20

MYCOSYNTHESIS OF SILVER NANOPARTICLES USING AN EDIBLE BASIDIOMYCETES MUSHROOM, *PLEUROTUS SAJOR- CAJU* AND THEIR BIOLOGICAL APPLICATIONS

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Abstract

Background: Advances in nanotechnology have improved the investigation of next-generation products for the diagnosis and treatment of human diseases as well as industrial and biomedical applications. Producing nanoparticles via biological processes has the potential to be more sustainable, cheaper, an alternative, and less energy-intensive than current technologies. It is becoming increasingly efficient to use macrofungi in the mycosynthesis of a wide range of nanoparticles. This study aims to synthesize silver nanoparticles (AgNPs) from the mushroom to characterise and assess their biological applications.

Methods and materials: Mushrooms were extracted using the Soxhlet extraction method. The AgNPs were synthesized and characterized by UV-Vis spectral analysis, FTIR, XRD, particle and zeta potential analysis, SEM and EDX. This AgNPs was assessed for DPPH radical, H₂O₂ scavenging activity, antibacterial activity using an agar-well diffusion assay against pathogenic bacteria.

Results: The AgNPs were confirmed by colour change; a strong absorbance peak was found at 440nm in UV-Vis spectroscopy. The four distinct diffraction peaks of the 2θ values were observed in XRD, and the presence of different functional groups was found in FTIR. From the particle size graph, the average size of AgNPs was 189.8 nm. The presence of extremely tiny, spherical nanoparticle particle aggregation was observed in SEM. The AgNPs showed significant results with an IC₅₀ value of 48.96 ± 0.84 µg/mL in the DPPH radical scavenging

experiment; a zone of inhibition was formed against pathogenic bacteria activity in a concentration-dependent manner.

Conclusion: The mycosynthesized AgNPs showed effective antioxidant and antibacterial. The outcome of the study suggests and concludes that *P. sajor-caju* has enhanced biological applications that used to produce nano-pharmaceutical agents.

Keywords: Mushroom, macrofungi. mycosynthesis, antibacterial, and nanoparticles.

ARTICLE-21

INVITRO CYTOTOXIC ACTIVITY AND APOPTOSIS INDUCTION OF *ANACARDIUM OCCIDENTALE* L. LEAF EXTRACT ON THE TRIPLE NEGATIVE BREAST CANCER MDA-MB-231 CELL LINE

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Abstract

The second leading cause of death in the world is cancer. Despite several research being done, the precise process by which cancer can be effectively treated is still unknown. *Anacardium occidentale* L. is a medicinal plant belonging to the family Anacardiaceae. Its bark, leaves and fruits have been traditionally used in treating various diseases. In this study, ethanol leaf extracts of *Anacardium occidentale* L. was investigated for induction of apoptosis.

The anti-cancer activity was evaluated by standard cytotoxicity assay like 3-(4,5 – dimethylthiazol -2- yl) – 2,5 – diphenyltetrazolium bromide (MTT) reduction assay. The IC₅₀ dose determined using MTT assay was 380.50 ± 35.06 mg/ml. Further, the selective toxicity of the drug was determined where the ethanol extract induces apoptosis in MDA-MB 231 cell lines and is stained using Acridine orange and Ethidium bromide. Therefore, the ethanol fraction of *Anacardium occidentale* L was effective in inhibiting the cancer cell line.

Key words: *Anacardium occidentale* L., Apoptosis, MTT Assay.

INTRODUCTION:

India has been known to be rich repository of medicinal plants which from ancient civilization are largely collected as raw materials for the manufacture of the drugs. Now-a-days, the traditional system of medicine continues to be widely practiced. Population rise, inadequate usage of drugs, prohibitive cost of drugs, effects of several synthetic drugs and development of resistance to currently used drugs for pathogenic and toxigenic infections have led to increased emphasis on the use of plant materials as a source for a wide variety of human ailments. Antibiotics save lives but any time antibiotics are used, they can cause side effects and lead to antibiotic resistance. Since the 1940s, antibiotics have greatly reduced illness and death from infectious diseases. However, as we use the drugs, germs develop defence strategies against them. This makes the drugs less effective. The synergistic effect of plant extracts against drug resistant pathogens leads to new choices for the treatment of drug resistant pathogens [1]. Indian flora in general, has an important reserve of aromatic, food and medicinal plants. It was demonstrated that medicinal plants play an important role in the Indian pharmacopoeia [2]. Medicinal plants like Basil, Amla, Nilgiri, Ashwagandha, Ardushi, Neem, Satavari, were frequently used as medicine. It was evaluated the antibacterial activity in vitro of stem peels extract of *A. occidentale* L. against species of Streptococcus (*S. mitis*, *S. mutans* and *S. sanguis*) present in the bacterial biofilm Supra gingiva [3].

Anacardium occidentale is a tropical plant that occurs principally in Tuticorin district, Tamilnadu. *Anacardium occidentale* L. (Family Anacardiaceae), is a multipurpose tree of the tropics which attains a height of about 10-15m. They grow on relatively dry soil in nature but in cultivation grow well in the tropical rain forest. The cashew tree produces many products and resources. The leave, bark, and the apple are explored medicinally to treat variety of diseases in pharmacopia. The tree is a native plant of Nigeria commonly called Kanjuu in Hausa [4]. The shoots of *Ancardium occidentale* plant inhibited copper induced LDL oxidation [5]. *A. occidentale* has been used in the treatment of various diseases including malaria and yellow

fever as well as diarrhea [6]. Pentagalloylglucose was isolated from leaf extract of *Anacardium occidentale* L. and it was found cytotoxic against HeLa cell lines and MRC5-SV2 (Human foetal lung cancer cell line) [7,8]. Breast Cancer Breast cancer is one of the most commonly identified cancers in women worldwide. Though breast cancer is assumed to be a disease of the developed world but a major breast cancer deaths takes place in developing countries (WHO Global Burden of Disease, 2004) and relative survival is miserable in developing and under developed countries [9]. Breast cancer can be classified into three sub-groups (i) ER/PR positive (ii) ER negative or HER-2 positive and triple negative (ER, PR and HER-2 negative) on the basis of receptor status [10,11,12]. Triple negative Breast Cancer (TNBC) is diagnosed in 15-20% of all breast cancer patients [13,14]. Patients with TNBC were significantly more likely to die within 10 years of diagnosis than with other subtypes. The cell line chosen for this study is MDA-MB-231 cell line which is an epithelial, human breast cancer cell line that was established from a pleural effusion of a 51-year-old caucasian female with a metastatic mammary adenocarcinoma. FDA approved several drugs are used for treatment of breast drug widely in breast cancer treatments but all this drug are shown to have numerous side effects. Due to the side effects, herbal medicines are required to treat cancer.

MATERIALS & METHODS

Cancer cell lines and culture:

Breast Cancer (MDA MB 231) cell lines were procured from the cell repository of National Centre for Cell Sciences (NCCS), Pune, India. Dulbecco's Modified Eagle Media (DMEM) was used for maintaining the cell line, which was supplemented with 10% Fetal Bovine Serum (FBS). Penicillin (100 U/ml), and streptomycin (100 µg/ml) were added to the medium to prevent bacterial contamination. The medium with cell lines was maintained in a humidified environment with 5% CO₂ at 37°C.

In vitro cytotoxicity study by MTT assay:

The cytotoxicity of the sample on MDA MB231 cells was determined by the method of Mosmann, (1983). The yellow 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazoliumbromide (MTT) is reduced by mitochondrial dehydrogenase of viable cells yielding a measurable purple formation product. Viable cells contain NAD(P) H-dependent reductase, which reduce the MTT reagent to formazon, with a deep purple colour. Formazon crystals are then dissolved using solubilizing solution and absorbance is measured at 500-600 nm by plate reader. To study the in vitro cytotoxicity study against MDA MB 231 (1×10^4 cells/ml) were treated with different concentrations of ethanol extract of *Anacardium occidentale* for 24 h. Control cells

did not receive the extract and was only maintained with a required amount of complete culture media. After the treatment schedule, the cells were collected separately from the culture plates and centrifuged at 1200 rpm for 5 min at 4°C. Using 0.1 M PBS (pH 7.4), MDA MB 231 cells were washed twice and used for MTT test. After In vitro cytotoxicity study, MDA MB 231 (1×10^4 cells/ml) were treated with ethanol extract of *Anacardium occidentale* at respective IC50 dose for another experiments.

MTT assay

Cell viability assay, MDA MB 231 viable cells were harvested and counted using hemocytometer diluted in DMEM medium to a density of 1×10^4 cells/ml was seeded in 96 well plates for each well and incubated for 24 h to allow attachment. Then the cells were treated with the sample of different concentrations (2.5 to 50 µl/ml) were applied to each well. All the treated cells were incubated at 37°C in a humidified 95% air and 5% CO₂ incubator for 24 h. After incubation, the drug-containing cells were washed with fresh culture medium and the MTT (5 mg/ml in PBS) dye was added to each well, followed by incubated for another 4 h at 37°C. The purple precipitated formazan formed was dissolved in 100 µl of concentrated DMSO and the cell viability was absorbance and measured 540 nm using a multi-well plate reader was measured by spectrophotometric reading in 540 nm on ELISA ANALYSER (Bio-Rad, Model 680). The results were expressed at the percentage of stable cells with respect to the control. The half maximal inhibitory concentration (IC₅₀) values were calculated.

Inhibitory of cell proliferation (%)

$$= \frac{\text{Mean absorbance of the control} - \text{Mean absorbance of the sample}}{\text{Mean absorbance of the control}} \times 100$$

The IC₅₀ values were determined from the sample dose responsive curve where inhibition of 50% cytotoxicity compared to vehicle control cells. All experiments were performed in triplicate.

Measurement of apoptotic induction using acridine orange/ethidium bromide (AO/EB) dual staining method

According to apoptosis-associated changes of cell membranes during the process of apoptosis, a clear distinction is made between normal cells, early and late apoptotic cells, and necrotic cells. The fluorescence microscopic analysis of apoptotic cell death was carried out [15].

MDA MB 231 cells were seeded at 5×10^4 cells/well in a 6 well plate and incubated for 24 hours. After treatment with Sample 1 (200, 300 & 400 µg/ml) for 24 h, the cells were detached, washed with cold PBS and then stained with a mixture of AO (100µg ml⁻¹)/ EB (100µg ml⁻¹)

ratio (1:1) at room temperature for 5 min. The stained cells were observed by a fluorescence microscope at 20x magnifications. At the end of treatment, the cells were collected and washed three times with PBS. The plates were stained with acridine orange/ethidium bromide (AO/EB 1:1 ratio; 100 µg/ml) for 5 minutes and examined immediately under fluorescent microscope 20x magnification. (Fig: 4)

The number of cells showing feature of apoptosis was counted as a function of the total number of cells present in the field. MDA MB 231 cells treated with Sample 1 (200 and 400 µg/ml) for 24 h, stained with dual dye AO/EB and then analyzed by fluorescence microscopy (Zoe Fluorescent Cell Imager, Biorad). Live cells shows green fluorescence with normal nuclear appeared. Early apoptotic cells with fragmented nuclear shows yellow fluorescence with condensed chromatin. Late apoptotic cells shows orange fluorescence with chromatin condensation or fragmentation (uniformly red/orange-stained cell nuclei).

TABLES AND FIGURES:

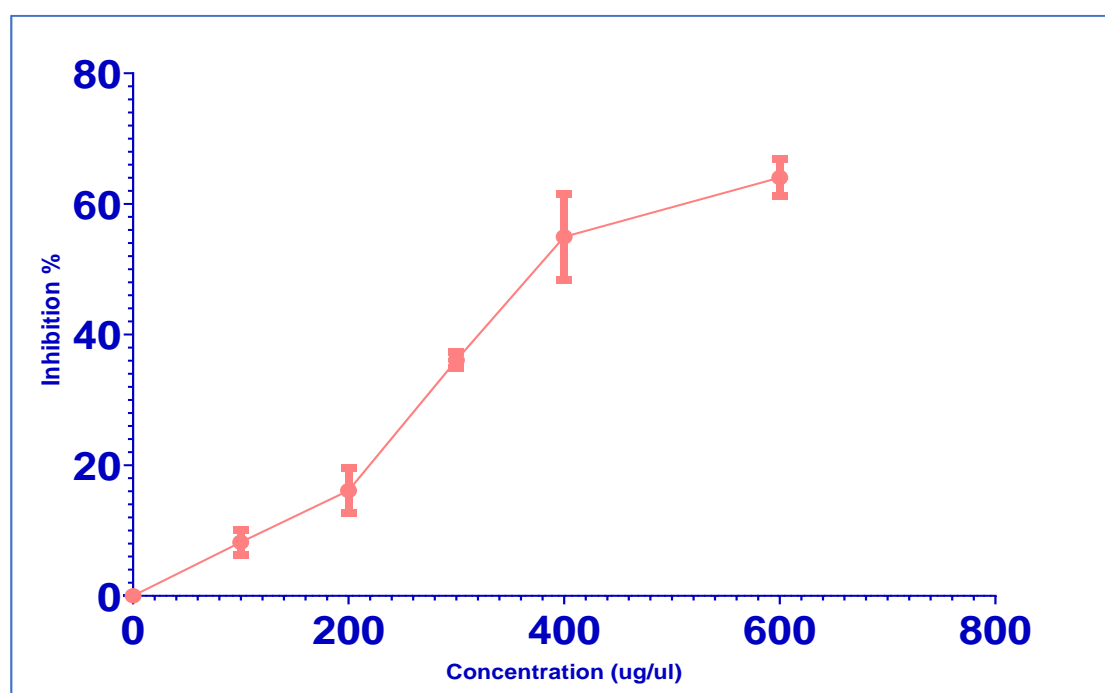


Fig: 1 Dose response curve of MDA MB 231 cells to *Anacardium occidentale* L extract during 24hrs treatment. Datas are shown as Mean \pm Standard

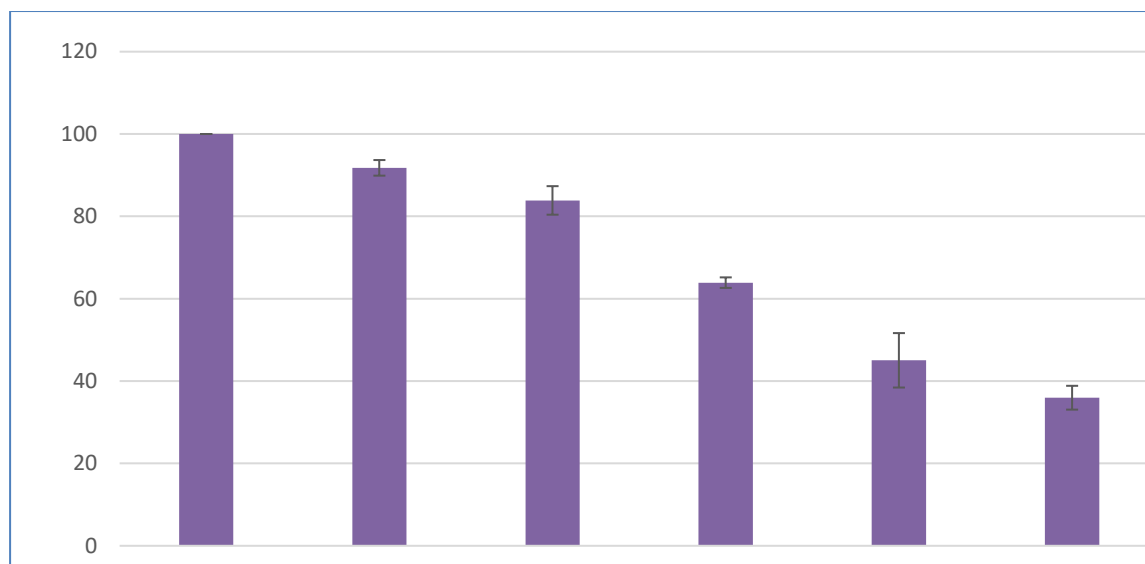


Fig: 2: Half maximal inhibitory concentrations (IC₅₀) of *Anacardium occidentale* L. extract in MDA MB 231 cells over 24 hrs of exposure using MTT Assay. Data was analysed using Analysis of Variance (ANOVA). Values are shown as Mean ± Standard; P<0.005.

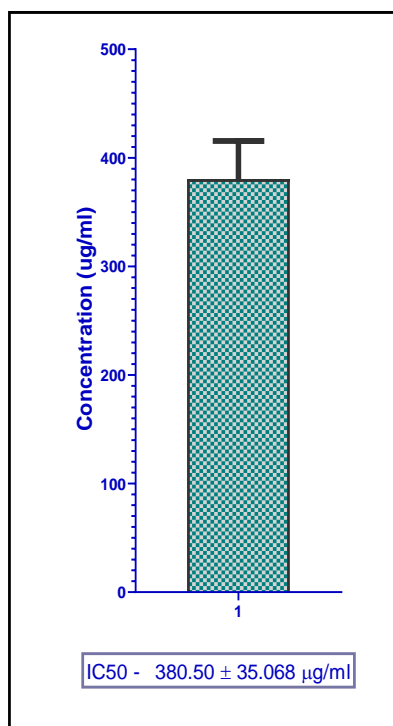


Fig 3: MDA MB 231 cells exposed to IC₅₀ concentration of extract of *Anacardium occidentale* L. Measurement of apoptotic induction was seen using acridine

orange/ethidium bromide (AO/EB) dual staining method. Values are shown as Mean \pm Standard; $P < 0.005$.

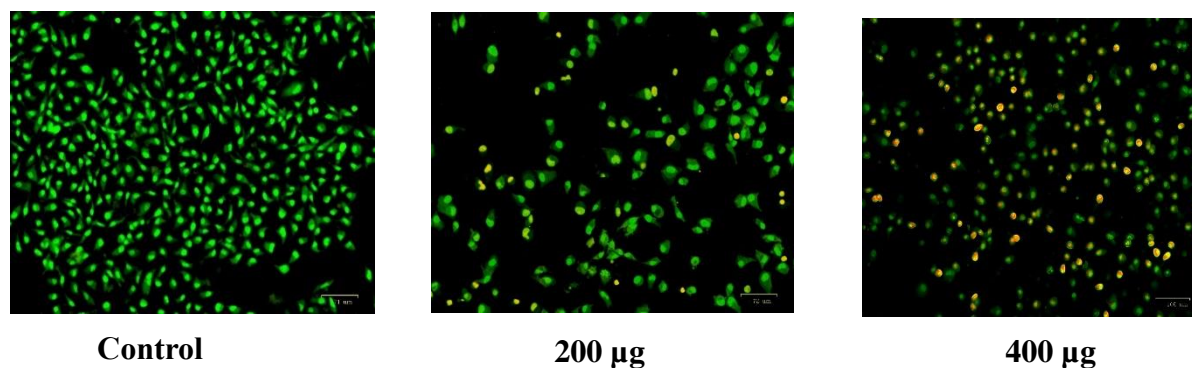


Fig: 4: Photomicrographs (20x) of *Anacardium occidentale* L. extract-treated MDA-MB 231 cells with different concentrations and control

RESULTS AND DISCUSSION

In this report, the ethanol leaf extract of *Anacardium occidentale* was demonstrated against cytotoxic potential against Breast cancer cell line (MDA MB 231) and induced apoptosis by breaking down double stranded DNA, leading LDH release and mitochondrial membrane depolarization. MTT Assay is one of the most versatile and popular assay for cytotoxicity dependent on the conversion of substrate to chromogenic product by live cells. The MTT Assay involves the conversion of water soluble yellow dye. MTT 3-[(4,5 – dimethylthiazol -2- yl) – 2,5 – diphenyltetrazolium bromide] to insoluble purple formazan by the action of mitochondrial reductase [16]. Activity of ethanol leaf extract of *Anacardium occidentale* L was assessed by MTT via application of different concentrations (i.e., 100µg/mL, 200 µg/mL, 300 µg/mL, 400 µg/mL, 600 µg/mL) where the plant extract showed better results at optimum concentration (IC₅₀) of 380.50 mg/ml. (Fig 2 & Fig 3). Therefore, it can be used for the isolation of pure component with antitumor potential for cancer treatment.

Several studies have characterized membrane blebbing as a feature to quantise apoptotic death in cells. Induction of Apoptosis and cell viability were assessed via AO/EB (Acridine Orange/ ethidium bromide) dual staining method of MDA-MB 231 cells treated with *Anacardium occidentale* L. this technique showed the differential uptake of the fluorescent DNA-binding AO and EB to determine viable and non-viable cells. These dyes were used to identify cells that have undergone apoptosis based on membrane integrity (Fig: 4).

The effect of *Anacardium occidentale* L. extract of MDA MB 231 cells regarding the fragmentation of DNA associated with caspase-3-mediated cleavage releasing caspase activated DNase (CAD) and resulting in degradation of DNA, (Fig: 5) thus demonstrating their potentials as anticancer chemotherapeutic agents. Further studies, however are needed to isolate their active compounds.

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ARTICLE-22

MICROBIAL DIVERSITY IN COASTAL ECOSYSTEMS: ISOLATION OF IDENTIFICATION OF MARINE FUNGI

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Abstract

Marine environment is a tremendous source of natural products. In recent years Marine derived fungi have been shown to produce a plethora of pharmacologically active compounds. The present study was confined to marine ecosystem in various parts of Tamil Nadu. Soil, water drift wood samples were collected from Marina beach, Kovalam, Tiruchendur, Tiruvottiyur and Rameswaram to isolate the marine fungal strains. All the collected samples were plated, incubated and the colonies were identified. A total 17 isolates were morphologically identified by plating techniques. Among them Ascomycota, Basidiomycota and Chytridiomycota were common. Phyla. *Periconia prolifica* was the only species common to all the four location.

Keywords: - Isolation, Marine fungi, *Periconia prolifica*.

ARTICLE-23

ENGLISH FOR MEDICINE

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Abstract

The English language plays a pivotal role in shaping our personalities because it is the most widely used language in every field around the world. The importance of English in the academic world is analogous to that of the language in the field of public health. Speaking English with coworkers, superiors, and patients in a clinic or other clinical holders may become essential in the field of public health care. It's important to cultivate a sense of family with our patients as we chat with them. By delving into their day and uncovering the truth about their habits, we can increase their joy. We should be able to communicate with them in a way that is both understandable and effective if we use English. Especially when dealing with elderly patients, we should be able to speak clearly and loudly enough for them to hear us. To better

communicate with your patients, try to slow down your speech. For more effective communication, mastery of English is essential. General medical services are booming and generally significant.

Keywords: Communication, Medical, Public Health, Patients, Specialists, Community, Professional, Global Language, Expression, Fluency, Treatment.

Introduction

The significance of English is fundamentally growing as global lines get more accessible for working experts, especially specialists in the medical services industry. English has become one of the standard international languages of correspondence in all rational fields, including clinical science and medical treatment. Knowledge of a common language for worldwide communication is essential in this age of accelerated information exchange, particularly when it comes to the exchange of nuanced information and the use of phrase in the medical professions. Therefore, developing reading comprehension skills and a reasonable grasp of English clinical writing are crucial for success in the medical profession. To transmit and trade thoughts, convictions, feelings and sentiments, English is liked as a typical language in the medical care area. Please let us see how English language data aids medical professionals. The medical care expert who communicates in English knows the latest things in the wellbeing field as they can go through the alien clinical diaries, most recent medical care and logical papers that are by and large distributed in English. If you're planning on studying medicine or paramedicine at a school you're not familiar with, brushing up on your English or other unfamiliar dialects will be a big help. Professional growth, including participation in international exploratory projects, is essential, and English is the language of most such interactions.

Quite a few locally run medical centres and practises collaborate with international health care organisations, invite international professionals to their teams, and hold meetings to discuss complex cases and come to a consensus on treatment plans. No matter what field of medicine you work in, being able to communicate in at least one language other than English will make you an invaluable asset to any medical facility that is providing assistance to patients who are not native English speakers. The following are a few areas where the English language is very useful in a healthcare setting: Many urgent care centres employ intermediaries to facilitate communication with patients. Though familiar with the local tongues, clinic personnel should also be fluent in English to better handle situations involving patients from other countries or states.

Patients and their loved ones may experience difficulty filling out paperwork regarding medical history, allergies, clinical difficulties, etc., before being admitted to an emergency clinic. A health care professional can visit and help the family stock the room. Most medical facilities in the country communicate with their patients in a hybrid of these two languages. Therefore, professionals in the medical field should have strong English language skills. In the medical care industry, even the misinterpretation could be possibly crushing. When people's lives are at stake, every word must be precise. Staff in healthcare facilities should be articulate and empathetic in order to give patients a complete picture of their health. It has been observed that medical professionals regularly scold patients for not adhering to clinical solutions and therapies when the problem may simply be that patients do not understand the clinical words. Although many settlers have a working knowledge of the English language, the specialised terminology used in the medical industry makes it difficult to avoid misunderstandings.

At first glance, it may appear that the specialist's or any Public Health Care taker's command of English is the deciding factor in their professional growth. If you're dedicated to lifelong learning, hoping to land a job at a prestigious institution, and would like to be of assistance to coworkers you've never met before, knowing English is a must. If you reside in a country where English is the primary language, knowing the language could be the difference between life and death in the medical field. It's impossible to know when a certain outcome will help someone with a mysterious illness. If your English is passable, you'll be able to tell when a patient is being tortured and identify the type of torture they're experiencing. What kids require at any given moment is something you'll learn to appreciate. So, if you want to better treat and care for your patients, learning English will help you do that. If it's not too much trouble, keep in mind that learning English could bolster your medical care career by helping you save lives and improve your patients' therapies. "Developing a strong set of language skills through English Language training courses can help medical and hospital employees provide better care and support for international patients and improved management of families." - (Pascale Chauvot: Language Competence in Healthcare).

Insurable Company:

Specialists and public healthcare providers who are fluent in English are more likely to be up-to-date on medical developments and to come up with novel approaches to treating their patients. Knowing English will allow you to read clinical diaries written in a foreign language with ease, as well as most modern medical publications written in English. You can maintain a high level of proficiency in English and learn the most recent diagnostic and treatment

methods by educating yourself on the language. In the event that you are merely going to be an expert, you may attend an unfamiliar institution and capacity in English is one of the essential states of affairs for the execution of your preparations. It's not necessary to go into debt to study at an unproven institution under these conditions. There are a variety of study abroad preparatory programmes for undergraduates, making it possible to study abroad on a budget, but learning a new language is an absolute necessity. First and foremost, we will be talking about the English language. If you're already a generalist but want to expand your knowledge, you can perform a rotation at a new hospital, take a few extra classes, and then go abroad to participate in international medical research projects.

However, you will also need a grasp of the English language skills for this. Specialists can take part in international clinical meetings if they have a firm grasp of the English language. A priority for many prestigious hospitals is sending their doctors to conferences focused on clinical and public health issues in other countries. So, if you work in a lab or a hospital, you might be able to take a business trip to another country. However, you'll need some level of English proficiency because most English is spoken at events like this. Learning English will allow you to collaborate with freshly trained experts. Local government agencies play an important role in assisting new medical and geriatric care facilities, training new professionals, resolving conflicts, making agreements, and deciding on treatment plans for patients. Additionally, experts who are fluent in English are encouraged to participate in worldwide clinical trials.

The ability to communicate in English opens the door to private consultations with patients the specialist has never met before. In a small office in a nondescript area, only your closest friends and family are likely to come to you for therapeutic advice. Even at a secluded DC law firm, such as those specialising in witness protection, you might gain new clients. Without knowledge of the English language, working or accepting a temporary post overseas is out of the question. Acknowledging English's value is highly regarded. Notwithstanding your vocation, whether or not you are a certified professional or another issue master, if you can impart in obscure dialects, you will be considered as a more substantial asset in any association supporting new accessories or not.

What your English proficiency test scores reveal about you is that you are a highly developed, sociable person who places a premium on self-awareness. A qualified professional or general health provider, as should be obvious, has several reasons to study English. The English proficiency should be strong. The aforementioned specialist should feel at ease

communicating in clinical language, be able to inspect and fully see even the most inconvenient clinical works, have excellent tuning in and communication skills with international partners, and be able to work with a wide range of clinical terminology. The specialist should speak English properly so that the other person can understand every word, even the technical terms that can be "jaw-breakers" in the medical field. It's obvious that all the professionals are fluent in Latin; the language is immune to chaos from a clinical perspective. What's more, you can't use Latin while consulting with new patients. After reviewing all the most-recently-cited institutions, we concluded that fluency in English is necessary for prescribing. This is the common language that facilitates the exchange of knowledge, skills, and information between nations.

Currently, all public health workers and medical professionals need to be fluent in Clinical English. The article "The Importance of English Language in the Public Healthcare" by Spanish research students echoes my own perspective by stating, "Nowadays, English is considered the global language for science communication." Over the course of the previous few decades, it has been taught in a variety of Cuban universities to satisfy the educational requirements of Cuban professionals and students. English for Specific Purposes (ESP) is a form of language instruction used by medical students and professionals. Since the majority of current medical literature, including books, articles, records, and newspapers, is written in English, this method of instruction has attained an undeniable status in the medical field. The aim of this research is to illustrate the significance for medical students and doctors to acquire English for medical purposes, in order to be able to develop in varied situations."

Conclusion

Professionals in the field of public health sciences have several reasons to study the English language. Because of the gravity of the stakes in the medical field, any misunderstanding is potentially deadly. Therefore, it is essential to focus on language in facilitating a trustworthy and possible relationship between clinical benefits staff and the two patients and family members. To avoid confusion and calm and facilitate the mind of the family, the choice of words used is of utmost importance. Considering the foregoing, it stands to reason that English is one of the major dialects used in the healthcare sector. In order to provide high-quality care to patients, it is essential that all involved professionals speak the same language.

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ARTICLE-24

IMMUNOLOGICAL TECHNIQUES

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Abstract

Traditionally, the diagnosis of infectious disorders has been achieved by the isolation of the infecting bacteria in pure culture. The study of bacterial, viral, and fungal infections has benefited greatly from traditional methods of microbial isolation and identification. There are disadvantages to cultivation systems when it comes to making a quick diagnosis of infectious diseases. For instance, the results from culture are sometimes not available at a time when the result can affect the course of therapy for many microorganisms, especially viruses and slow growing bacteria. In order to detect and identify a wide variety of infectious diseases of fish and prawns, more sensitive methods are required. Infectious illness diagnostics have lagged much behind other areas of medicine in terms of progress towards being fast, easy, sensitive, and specific. This is due in part to the difficulty in detecting tiny quantities of pathogenic organisms in samples, as well as the complexity and diversity of the organisms themselves. The diagnoses of diseases in fish and prawns are being quickly advanced by approaches based on immunology and molecular biology.

Immunological Techniques

It is easiest to study antigen-antibody responses in vitro using antigen and antibody preparations. Antigen-antibody reactions are extremely selective. Antibodies produced in response to a certain antigen can only react with that antigen or a very similar antigen. Reactions between antigens and antibodies are well suited for recognising one by employing the other due to their high specificity. However, cross-reactions between related antigens can occur, and they can restrict the use-fulness of the test. Clinical diagnostic microbiology relies heavily on serology, the study of antigen-antibody responses in vitro.

A disease-causing organisms antigen or antibody can be detected and identified using immunodiagnostic testing. The antigen-antibody response itself is quite specific. Thus, immunodiagnostic techniques benefit from the ability to detect the specific antibodies produced as a result of the host's immune response to the organism, and to identify the presence of a specific pathogen directly in the specimens, if the appropriate antibodies can be obtained. The antibody is the main part of the diagnostic procedure. The quality of the antibodies used in the reagents determines the specificity and, to a lesser extent, the sensitivity of the assay.

Immunoglobulin (Ig) molecules are displayed on the surface of a substantial population of B lymphocytes (B cells). Because each B cell expresses its own unique set of Ig, it can respond exclusively to a single antigen or a small group of closely related antigens. The B lymphocyte with the highest "fit" to an antigen, as measured by its Ig surface receptor, is the one that engages in the interaction. By binding to this receptor, antigens trigger B-cell proliferation and clonal expansion. Antibody-secreting plasma cells develop from these carefully culled B cells. Since each person may manufacture 10⁷-10⁸ different antibody molecules, there is an antigen-binding site on a B cell to fit practically any antigenic determinant.

Immunoglobulins known as antibodies react only to the antigen that prompted their formation. Antibodies that emerge in an animal in response to a single antigen are heterogeneous because they are generated by multiple separate clones of cells; i.e., they are polyclonal antibodies. Monoclonal antibodies are antibodies that originate from a single clone of cells, such as in a plasma cell tumour (myeloma). Myeloma cells and lymphocytes that produce antibodies can be fused to generate monoclonal antibodies. In vitro, these hybridomas can generate an almost infinite supply of monoclonal antibodies. Due to their lack of cross-reacting antibodies and great specificity, monoclonal antibodies are ideal for identifying antigens.

Agglutination, for particulate antigens, and precipitation, for soluble antigens, are the two most fundamental techniques for identifying new species using sera containing various recognised antibodies. In addition to ELISA and Western blotting, the fluorescent antibody technique (FAT) is another immunoassay approach.

Agglutination

The agglutination reaction is a simple immunological assay. For bacterial fish infections, their application in presumed identification has been proven and recorded for some time. Most bacterial fish infections can be positively identified with as few as a dozen antisera. Agglutination has provided useful information on the serological connection of bacterial fish pathogens, including species within genera and strains of the same species. In this response, the antigen is particulate (e.g., bacteria and red blood cells) or is an inert particle (latex beads) coated with an antigen. Clumping (agglutination) occurs as a result of the antibody cross-linking the antigenically multivalent particles and forming a latticework (Figure). The method is employed for both proving the existence of antibodies in serum and locating antigens on the surfaces of microorganisms.

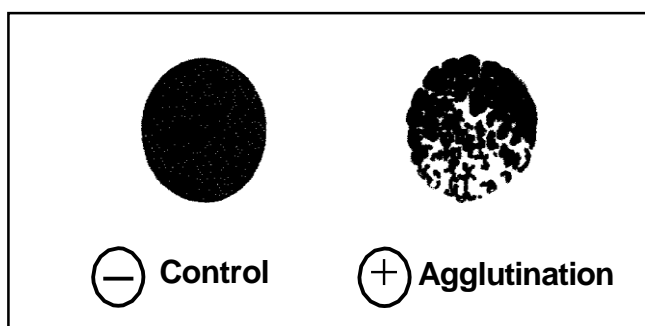


Figure 1. Slide agglutination. Negative (-) and positive (+) reactions

Bacteria cultured in broth or agar media can be resuspended well enough for use in agglutination assays. The ability of some bacteria to spontaneously clump together (known as "autoagglutinate") renders their use in agglutination assays impractical. Several adjustments can be made to prevent spontaneous agglutination with a bacterial suspension that will be employed as a test organism. In some cases, non-specific agglutination can be reduced by washing the bacteria in neutral buffered saline prior to formalinization if the preparation was formalinized before removal from the growth medium. To prevent further agglutination, non-fat dry milk or another 0.1% protein solution can be used to resuspend the organisms. Heating the bacterial solution by submerging it in a boiling water bath for 1 to 10 minutes may be

necessary if further autoagglutination is to be avoided. If autoagglutination persists despite these measures, the organism in question likely isn't susceptible to this technique.

Precipitation Here, the reaction takes place. Antibodies aggregate (precipitate) when they cross-link antigen molecules in varying ratios. The ideal ratio of antigen to antibody is found in the equivalence zone, where the most precipitates form and the supernatant has neither too much antibody nor too much antigen. Precipitation is suboptimal in the antibody excess region because there is an excessive amount of antibody present. While all antibodies will be joined in the zone of antigen excess, many antigen-antibody complexes will be too tiny to precipitate. Procedures employing soluble antigens have been utilized to explore the antigenic makeup of fish pathogens (bacterial, viral and parasitic) and to a lesser extent a diagnostic tool.

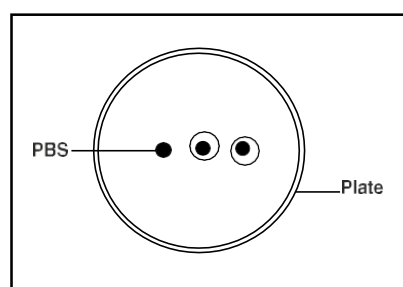


Figure 2. A representation of a single radial immunodiffusion measurement. Typical rings obtained with positive rabbit serum and no ring with phosphate buffered saline (PBS) as negative control

Immunoelectrophoresis

Electrophoresis and immunoprecipitation are combined in this common method used frequently in the field of fish immunology. Compared to gel diffusion, its resolution is significantly higher. In this system, the components of the antigen will first be separated using electrophoresis.

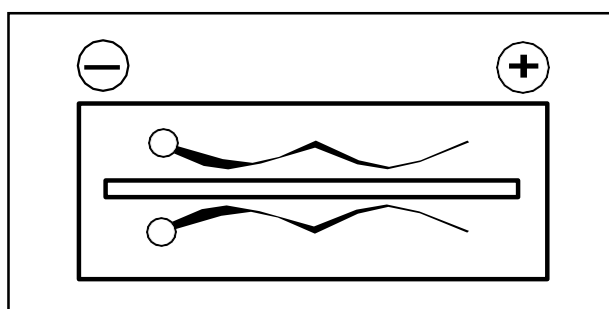


Figure 3. Immunoelectrophoretic pattern of *Vibrio harveyi* LPS. In the well above the trough, LPS in the supernatant after ultracentrifugation of the water layer while in the well below the trough, purified LPS. In the trough, anti-*V. harveyi* serum



Figure 4. Indirect fluorescent antibody technique (IFAT) staining of an impression smear prepared from *Vibriopenaeicida* cell suspension

Fluorescent Antibody Technique (FAT)

Both IPN virus in cell culture (Dea and Elazhary, 1983) and atypical strains of *Edwardsiella tarda* isolated from sea breams (Costa et al., 1998) were identified using this assay. Using FAT to define viral infections is more difficult than searching for bacteria in fish tissue. When using antisera against viral fish infections, it is common practise to cultivate the potentially infected fish tissues in fish cell lines in order to boost the viral load. The FAT takes advantage of the fact that some dyes fluoresce when exposed to ultraviolet (UV) light. These include fluorescein isothiocyanate, rhodamine isothiocyanate, and Texas red. These dyes can be utilised as tags, conjugated to specific antibody molecules, and "light" the complex when the antibody binds to its target antigen. The ability to see the antigen-antibody reaction on the pathogen is a huge help in making an accurate diagnosis. Antigens on a surface can be detected using this method. Bacteria are typically cultured on slide formats, where the organisms are affixed to the slides themselves. Antigen is then treated with a specific antibody after being fixed. Direct fluorescein antibody labelling (FAT) (Figure 10-5) allows antibody to be seen, while indirect FAT (Figures 10-6 and 10-7) uses a fluorescein-labeled antibody conjugate to detect attached antibody. After examining the slides with a UV microscope, the fluorescence intensity is measured against standard controls and assigned a score between minus (-) and plus (+) plus (+) plus (++++). Most assays only take a few of hours to complete.

Fish antigen or antibody detection, microbial species type, and identification are only few of the many applications of immunofluorescence. FAT has been used to detect antibodies to *Aeromonas liquifaciens* in fish (Lewis and Savage, 1972). For example, *Renibacterium salmoninarum* in salmonids (Bullock et al., 1980), *Vibrio penaeicida* in kuruma prawn (de la Pea et al., 1992), and Pseudotuberculosis in yellowtail (Kitao and Kimura, 1974) may all be detected quickly and easily with FAT diagnostics. Additionally, FAT has been created for the fast identification of IHNV (LaPatra et al., 1989) and iridovirus in red sea bream (Nakajima et al., 1995).

Enzyme-Linked Immunosorbent Assay (ELISA)

By chemically linking enzymes to antibody molecules, scientists have developed a powerful immunological instrument with unprecedented specificity and sensitivity. The method employs antibodies to which enzymes have been covalently linked, preserving both the catalytic capabilities of the enzyme and the specificity of the antibody. Peroxidase, alkaline phosphatase, and b-galactosidase are all examples of linked enzymes that catalyse reactions with coloured products that may be detected at low concentrations. The enzyme-linked immunosorbent assay (ELISA) is a highly effective immunochemical method. It employs a wide range of technologies to detect and quantitate antigens or antibodies and to examine the structure of antigens.

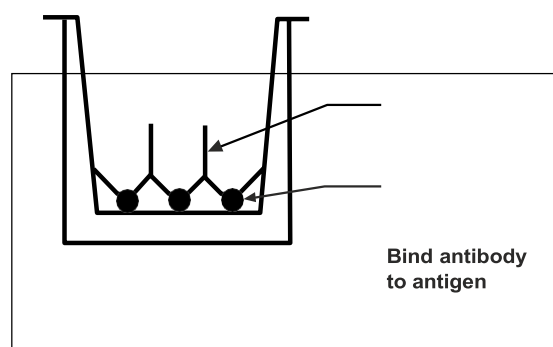


Figure 5

The immunoassays can be carried out in a wide variety of ways. Immunoassays are categorised in accordance with their approach, with similarities in principle and procedure between each subset. For instance, an assay can be modified to measure either antigen or antibody concentration by shifting a few critical parameters. While the procedures are comparable, the outcomes vary depending on the assay used.

ELISA testing can be broken down into three categories: 1) antibody capture assays,
2) Assays for the Capture of Antigen and
Sandwich experiments involving two antibodies

Antibody capture assay can be used to detect and quantitate antigens or anti- bodies and compare the epitopes recognised by different antibodies. Protocol often followed: unlabeled antigen is immobilised on a solid phase and antibody is allowed to bind to it. Labelling the antibody directly or employing a labelled secondary reagent, such as a goat anti-rabbit or anti-mouse IgG antibody conjugated with an enzyme that recognises the antibody, are both viable options for detection. An ELISA plate reader, essentially a modified spectrophotometer, measures the intensity of a colour reaction caused by the addition of an enzyme substrate to determine the concentration of antibody in relation to a specific antigen. How much of a given colour is produced depends on how much of an antibody is bound. The sensitivity of a labelled antibody assay is determined by three factors: (1) how much antigen is bound to the solid phase, (2) how avid the antibody is for the antigen, and (3) how many labelled moieties are utilised to label the antibody. Methods that fall under the umbrella of antibody capture assay include: (1) antigen excess assays for detecting and quantifying antibodies; (2) antibody competition assays for comparing antibody binding sites; (3) antibody excess assays for detecting and quantifying antigens; and (4) antigen competition assays for detecting and quantifying antigens.

Antigen capture assays are employed primarily to identify and quantitate antigens (Figure). Using labelled and unlabeled antigen in a competition, the concentration of antigen in the test solution can be calculated. Using either a direct interaction or an intermediary protein, like an anti-immunoglobulin antibody, unlabeled antibodies are attached to the solid phase. The antigen is isolated and given a specific name. To determine how much antigen is bound to an antibody, a sample of the labelled antigen is combined with the test solution, which contains an undetermined amount of antigen.

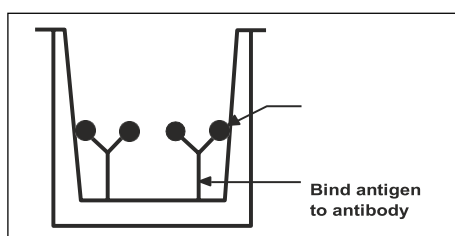


Figure 6: Antigen-capture assay

Molecular Biology Techniques Deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) are the nucleic acids at the centre of molecular biology. The primary structure of all proteins specific to an organism is encoded in nucleic acids. Cellular activity and physiological function are created when these lipids and the extracellular stroma come together. Thus, biological activities can be understood in part by investigating the interrelationships between these important components. Both RNA and DNA are built from four different types of molecules called nucleotides. There is a nucleic acid base (adenine, guanine, thymine, and cytosine), a deoxyribose sugar molecule, and a phosphoester in each of the four nucleotides that make up DNA. RNA contains the same nucleotides as DNA, with the exception of thymine (T), which is replaced by uridine (U), and deoxyribose (dRp), which is replaced by ribose. The sequence of a nucleic acid is the order in which its constituent nucleotides are linked together. DNA has two complementary strands, but RNA only has one. Pairs of strands can only align when they're facing in opposite or complimentary directions. To a large extent, DNA's two- and three-bond hydrogen bonds between the nucleotides A and T and C and G hold the two strands together. Hydrogen bonding between complementary base pairs (C and G in DNA) and A and T (or A and U in RNA) is the cornerstone of molecular biology. Despite the fact that every one AT or GC base pair match would easily dissociate, there is strength in numbers, and the more base pair matching, the more hydrogen bonds there are between the two cIn the hybridization of nucleic acid strands, when two DNA strands encounter, they orient each other in opposite or antiparallel directions to allow base pair matching to occur. If there is no matching at the base pairs, they split up. However, if there are enough complementary base pairs, the organisms will fuse or hybridise. Homology describes the exact degree of base pair matching that is responsible for keeping the strands together. For two strands to remain connected, what minimum amount of homology is required? Though "the more, the better," the proximity of the base pair matches is also a crucial factor. Matches between base pairs that are close together in a DNA sequence are more stable than those that are further apart. Unrelated DNA strands typically have base pair matches that are widely spaced, while related DNA molecules should have base pair matches that are tightly grouped. Clearly, if two DNA strands are completely homologous and have 100% base pair matching then the strands would tend to remain hybridised under most situations. In contrast, most environmental conditions favour the dissociation or denature of hybridised strands with poor homology (e.g., just 10% of base pairs matched). Intermediately homologous hybrid strands, where, say, 50% of the base pairs match, may or may not retain their hybrid status depending on the reaction conditions.

Considering that hydrogen bonds hold two hybridised strands together and that numerous chemicals and conditions can affect hydrogen bonding, a phrase is needed to characterise whether the hybridization reaction conditions relatively favour or disfavour hydrogen bonding; this term is called stringency. Hybridised strands with intermediate homology are more likely to retain their hybrid state under low stringency conditions, while hybridised strands with weak homology dissociate. When the requirements are particularly strict, only hybridised strands with particularly robust homology will tend to persist in their hybrid state.

The melting point, often known as T_m , is another important concept. Some of the DNA strands will stay hybridised while others will have separated after bringing together two strands of DNA that share homology and hybridising them. The amount of homology and other factors (such as formamide concentration and temperature) that can affect hydrogen bonding between matched base pairs will determine the hybridized/denatured DNA strand ratio in the reaction. The melting temperature is defined as that temperature under the specified reaction circumstances where one half of the hybridized strands are still hybridised and the other half are denatured. The gene probe and polymerase chain reaction (PCR) are two methods from the field of molecular biology that are addressed.

DNA probe analysis

Due to the ease with which nucleic acids can be measured and the uniqueness of each DNA molecule's nucleotide sequence, hybridization analyses can be utilised to provide accurate clinical diagnoses, DNA diagnostics have become increasingly powerful. Nucleic acid hybridization is one of the most potent analytical methods currently accessible. Hybridization detects the presence or absence of specific DNA sequences associated with a particular organism, as opposed to a full organism or its products. Nucleic acid probes are single strands of DNA that carry sequences specific to a given microorganism, and they are required for DNA-based microbial identification. The target is the unlabeled strand in the sample being analysed that is similar to the probe. A double-stranded molecule can develop if the DNA sequences in the probe and the organism's DNA are complementary. The probe is then labelled with a reporter molecule, such as a radioisotope, an enzyme, or a fluorescent chemical, whose concentration may be measured after hybridization to ascertain whether or not a reaction has taken place. As little as 0.25 mg of DNA per sample can be identified, depending on the reporter employed (radioisotopes are the most sensitive).

Several approaches have evolved based on the capacity of a labelled probe to bind to and so enabling the detection of the target nucleic acid sequence of interest. The sample's DNA (both target and non-target) can be isolated and hybridised with the labelled probe after being bound to a filter. The process is known as filter hybridization. Using a vacuum manifold with slot-like gaps for each sample, the DNA is typically put directly on the filter, leading to the terms slot blot and dot blot hybridization. Without the need for electrophoretic separation, dot blotting is a quick and easy approach for quantifying RNA or DNA target sequences. The immobilised nucleic acid patch deposited on the membrane is shaped slightly differently in this procedure. After a nitrocellulose filter has been dried, nucleic acid is put to it. The resulting "dots" are of varying sizes, which complicates attempts to determine the concentration of the target sequence. Southern blot hybridization is another option, in which the sample DNA is first electrophoretically separated according to size and configuration on a gel and then transferred to a filter. RNA molecules, like DNA fragments, can be size-separated via gel electrophoresis and immobilised on membranes using Northern blot hybridization. The conditions for Southern, Northern, and dot blot detection of target sequences are all but identical. There are essentially three steps: (1) prehybridization, wherein random DNA and polymers saturate nonspecific DNA binding sites on the membrane; (2) hybridization, wherein specific labelled probes anneal to target sequences; and (3) washing, wherein unhybridized and imprecisely hybridised probe are washed away. Because the tissue is destroyed in both methods, histological correlation is impossible.

Basic principle

Each cycle of polymerase chain reaction amplification consists of the following three stages. First, the double strand DNA must be melted or denatured (strand separation) for a few minutes at 94–96°C; second, the two primers must anneal to their respective DNA strands for a few minutes at 50–65°C; and third, the reaction must be allowed to continue at room temperature. Third, nucleotide additions mediated by polymerase are made to primers, creating two copies of the original sequence (in one to several minutes at 72°C).

The DNA double helix is first unwound and denatured by enzymes during cellular DNA replication. After the DNA is denatured, one additional process must occur before DNA synthesis may be catalysed by the DNA polymerase. It has to locate a spot where the DNA changes from being single- to double-stranded. Primers and target DNA hybridise effectively at temperatures near 55 degrees Celsius, leading to the creation of complementary strands

required for amplification. Primers are synthetic sequences of single-stranded DNA (20-30 nucleotides) used to speed up the PCR process by separating DNA molecules into individual strands at high temperature. Two distinct primer sequences are utilised to bracket the target region to be amplified. At the start of the target region, one primer recognises a sequence on one DNA strand; at the conclusion of the region, another primer recognises a sequence on the opposite DNA strand.

Components of a typical PCR	
Tris-HCl (pH 8.3)	20 mM
MgCl ₂	2.5 mM
KCl	25 mM
DNTPs	50 mM each
Primer 1	20 pmol
Primer 2	20 pmol
<i>Taq</i> polymerase	2.5 units
Template DNA	10-100 ng
Mineral oil	Optional

Summary

The identification of pathogens in fish and crustaceans has benefited from the refinement of existing immunoassay methods, the advancement of mono-clonal antibody technology, and the introduction of novel immunoassay methodologies. In the wake of the development of the polymerase chain reaction (PCR), it became clear that specific microorganisms, such as those causing a bacterial or viral infection, could be detected and identified with greater precision than ever before. It may be possible to rapidly amplify a characteristic DNA sequence from a single viral particle or cell of a certain organism to detectable levels. Traditional diagnostic procedures, such as the cultivation of microorganisms, can be time-consuming and laborious. PCR offers a quick, very sensitive, very specific and straightforward alternative. The detection and identification of infectious disease agents will be completely transformed by future breakthroughs in immunodiagnostics and developing technologies like DNA-based assays.

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ARTICLE-25

APPLICATIONS OF MATHEMATICAL MODELLING IN MEDICINE

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Abstract

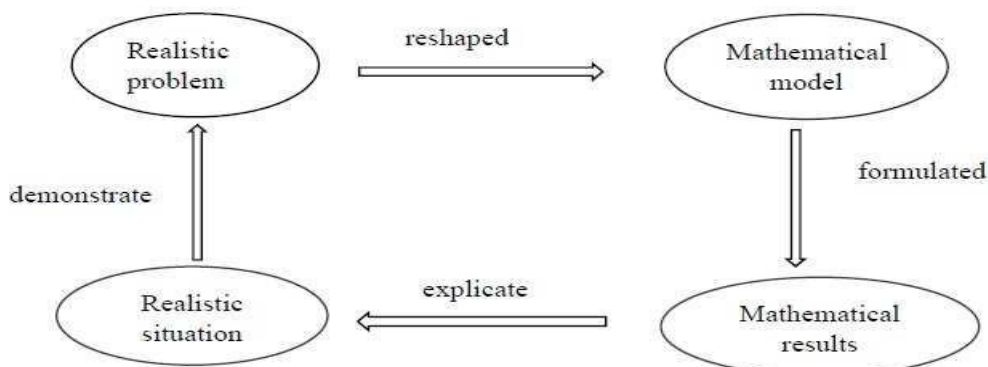
Mathematical modeling has been increasingly important in several fields in recent years. Mathematics has been a useful tool in many disciplines, including physics, computer science, economics, ecology, and biology. We shall identify several types of growth models, compartment models and their importance in the field of biology and medicine in this review essay.

Introduction

Mathematical modeling is a subfield of mathematics that aids in the translation of theoretical concepts into concrete issues, as well as the interpretation of theoretical results into the real world. Mathematical modelling is the process of creating a mathematical model. It's a way of seeing the system that makes use of a number of different ideas and libraries. The application of mathematics in biology dates back to at least the 12th century. Mathematical modeling in biology evolves into cross-disciplinary study that necessitates familiarity with both mathematics and biology. Recent studies have shown the need of combining findings from different fields. Medical, dynamical, population, ecological, ecological, biostatistical, molecular, and other biological fields have all benefited from the development of mathematical modeling. Mathematicians and scientists from other disciplines, such as botany, zoology, and chemistry, work together to create biological models. The complexity of modeling can be reduced to an easily digestible diagram.

MODELLING CYCLE

Modelling process can be easily emphasized by a cycle. The Kaiser (1995) and Blum



(1996) [13, 14] has formulated a modelling cycle which helps us to understand the model pictorially as shown in Figure 1.

Figure1. Modeling Cycle

From the above Figure 1 we can understand that the reality is converted into a mathematical model by using differential equations then solving the equations using various methods and techniques we get a solution and interpret into the real world solution. Models such as various growth models, compartment models are explained below. Population growth models are used to forecast the upcoming population.

Population Growth Models

In the later years of 18th century biologists began to develop many ideas and approaches in population modelling to emphasize dynamics of growing and shrinking ball populations of living organisms. Growth models are used in many areas of biology. The population growth means the increase in the number of individuals in a population. By using the growth models we can predict the future number of the population. The organism's growth depends on the available resources within the system. The population size grows at an increasing rate when the resources are plentiful and it is modelled as a simple model of exponential growth. This model has a fixed net fertility rate per person. On the other hand, as resources are decreased for expansion, the rate of population growth decreases as population growth rises and is modelled by the logistic growth model. There are two important models of population growth that are based on the propagative process [1, 8], as shown in the Figure 2.

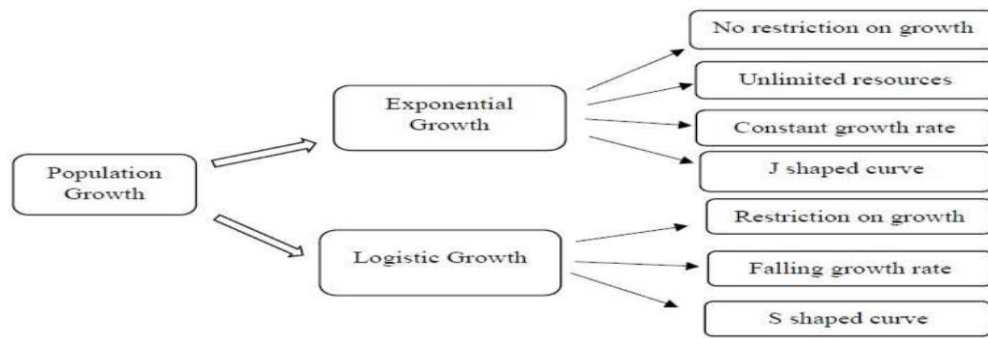


FIGURE 2. Growth Models

From the Figure 2 we can understand the features of the both exponential and logistic model. Now we are going to see some of the growth models.

3.1. Malthus (Exponential) Growth Model. In 1798 Thomas Malthus [7, 18, 24] formulated a mathematical model for population growth. The model assumes that the population grows at a rate proportional to the size of the population.

3.2. Verhulst (Logistic) Growth Model. In 1845 Verhulst [7, 18, 24] proposed a model which has a self-limiting process. This is applied when the population size is very high. The model is sometimes called a Verhulst model or logistic growth model.

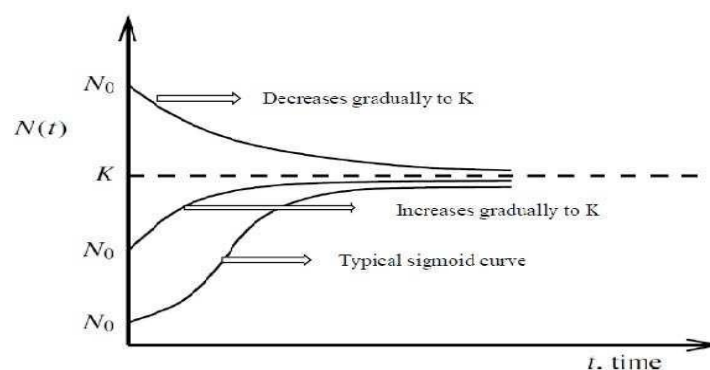


Figure 3. Logistic Growth

The performance of the exponential and logistic growth is represented in apictorial form.

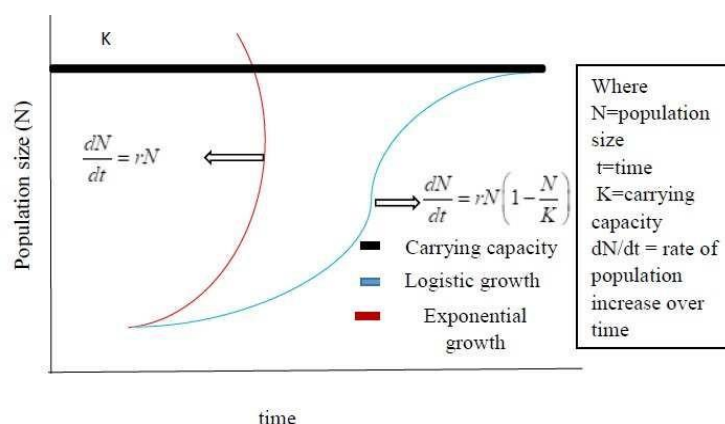


FIGURE 4. Exponential Vs Logistic

From the above Figure 5 we can identify the behavior of both models. The exponential model grows exponentially, there is no restriction and the resources are abundant whereas in the logistic model the resources are limited. The initial part of the logistic curve is exponential and in the middle the growth rate decreases and at the end, it attains asymptote K which is the carrying capacity. This model is used in various fields in medicine modelling the growth of tumors, in chemistry reaction models, in physics fermi distribution, in agriculture modelling crop.

The following various growth models are based on the logistic growth model.

We see how the models are formulated by the logistic growth equation.

Torner (Generic) Growth Model. Torner et al (1976) [7, 23] have proposed a model which is the modified form of the logistic growth model. The model is known as the generic growth model.

Blumberg Growth Model. Blumberg (1968) [3, 5, 7] proposed the concept of growth that is the modification of the logistic model. He found that its turning point is the key restriction in the logistic tangent. He regarded the natural growth rate function as a time-independent function so that this trend would eventually reach a growth rate of zero, thereby making this curve an ultra-logistic curve.

Gompertz Growth Model. Gompertz [3,7] proposed equation for the population dynamics and is given as follows:

D.Hathout (2013) [10] have proposed a new model known as the Hyperbolic growth model in which the accuracy of the real data in past gives good result. The author developed this model using the exponential growth model and says that whenever the model is developed it

should be tested with real data such that the models behaviour can be known. The author concludes that the growth models are used to predict the population growth in future.

Compartment Models

A compartment is a segment of the whole system. In Pharmacokinetics the compartment model is the mathematical description of the body where the body is represented as a series of compartments sorted either in series or in parallel. In Epidemiology [15] the behaviour of the infectious disease is mostly found on their compartment structure. It was initially formulated by Kermack and McKendrick.

M. A. Khanday (2016) [12, 16, 17] has formulated the compartment models for drug diffusion through oral and intravenous modes. The author says that depending upon the condition of patient and fact of a disease the drug can be specified in any mode.

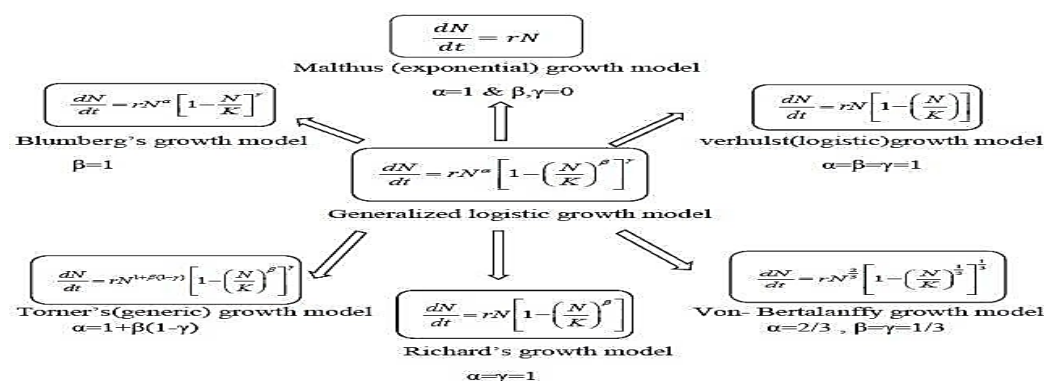


FIGURE 5. Generalized logistic growth model

These models were formulated on Ficks perfusion principle, first-order kinetics and balance law. Here they have used two-compartment model for drug diffusion for both oral and intravenous route.

V. H. Badshah et.al (2013) [4, 6, 11] have demonstrated the historical feature of deterministic modelling over the infectious disease in population dynamics. The author discussed many aspects of infectious diseases and explained various model with and without the latent period. The author concludes that this study correlates the mathematical modelling and dynamical behaviour of infectious diseases.

K. Ergen, A. Cilli, N. Yahnioglu (2014) [9] have used a SIR model to predict some of the epidemic disease such as TB (tuberculosis), HIV, CCHF (Crimean - congo hemorrhagic fever). The author says by knowing the previous year data and by calculating the infection rate we can

predict the number of infected ones. The author concludes that by using SIR model the results are obtained in short time.

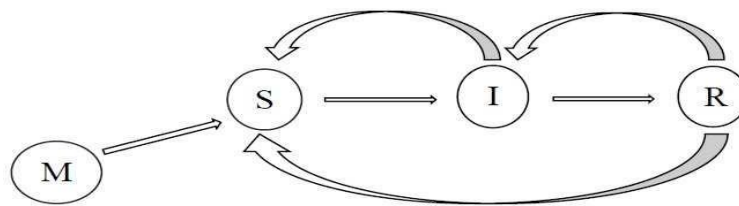


FIGURE 6. Models without latent period

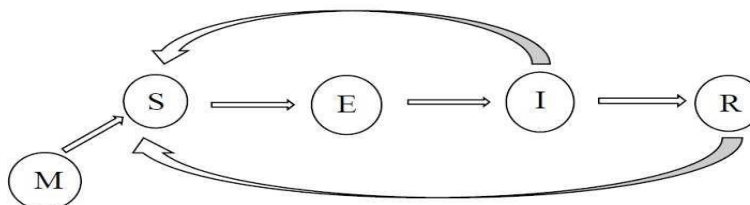


FIGURE 7. Models with latent period

Putani Pongsumpun (2018) [19, 20] has formulated the SIR model for the effect of vaccination for the dengue disease. The author says that the conditions for the stability of disease are free and endemic equilibrium states are analysed using basic reproductive rate. The author concludes that the consumption of vaccination can reduce the ailment of disease.

G. Shabbir, H. Khanand and M. A. Sadiq (2010) [2, 12, 15, 16, 21] have developed an exact solution to the models such as SIS, SIR. The author says thatfor some models with first-order differential equations are non-integrable but they have formulated the analytic solution using integrable tools. The author concludes that an exact solution predicts the behaviour of the models.

Conclusion

Mathematical modeling in many areas of research has now grown. Mathematical models are formulated and systematically solved based on the type of problem developed in the real-world. We have seen in this study the different types of growth models, compartment models and their application in the fields of medicine, ecology, population biology, molecular biology. Models of growth are used in the area of biology to assess the organism's survival.

In the field of medicine, the Compartment models are used to assess the medication for the various diseases.

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ARTICLE-26

**PREPARATION AND STRUCTURAL STUDIES OF PLATINUM
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Abstract

Among the many possible commercial uses for platinum nanoparticles (Pt NPs) are those of a heterogeneous catalyst, coating material for chemiresistors, nanomedicine, nanosensor, and electronic component. Physical, chemical as well as biological approaches are used for the creation of platinum NPs. For Pt NPs synthesis, physical approaches are dependant on physical phenomena. Chemical approaches utilize one or other chemical reactions to create Pt NPs. The use of biological approaches is highly recommended. Plant extracts are among the safest and cheapest biological sources that can be used in the manufacture of Pt NPs. Catalysis, electronics, nanodiagnostics, and nanomedicine are just few of the areas where Pt NPs can be useful. Future in vivo applications may benefit more from Pt NPs synthesized employing a wider variety of plant bioresources.

Keywords: platinum nanoparticles, green synthesis, biological synthesis, plant extract

1. Introduction

Nanoparticles (NPs) are described as particles with a size in the range of 1 to 100 nm, most precisely 1 to 100 nm. The range of possible uses for NPs is expanded by the variety in their size and shape. NPs' special characteristics stem from their size, shape, and the stability coating on their surface.[1] Due to nanorange size, the NPs feature huge surface area and improved penetration qualities that are necessary for environmental, and in vivo applications. The in vivo biological applications of NPs [2-6] include fluorescent labeling in biomedicine, medication administration, pathogen detection, and pharmacological investigations.[7-10] Because of their high corrosion resistance and considerable catalytic characteristics, Pt NPs stand out among the many types of nanomaterials.[11] Car exhaust polluting emissions can be reduced thanks to the increased catalytic activity of Pt NPs in comparison to their bulk counterparts. The production of hydrogen fuel is another important application of catalytic characteristics.[12, 13]

Over the past 20 years, scientists have diligently investigated new methods for synthesis and characterisation of NPs. Pt NPs are typically found in a fluid, typically water, as a suspension or colloid of Pt NPs. Similar to other metallic NPs, the size of Pt NPs can be adjusted by

changing the reaction conditions from 2-100 nm.[14, 15] Reactivity and agglomeration make synthesis of metallic NPs, such as Pt NPs, challenging. Pt NPs' primary requirement for use in a wide variety of contexts is that they remain stable throughout time.[16] When creating conductive thick film circuits or the internal electrodes of multilayer ceramic capacitors, Pt NPs are frequently employed.[17] o-Chloronitrobenzene and cinnamaldehyde hydrogenation are just two examples of the chemical reactions where the NPs are put to work.[18] The Pt compound cis-diammine-dichloro-Pt has found widespread application as a cancer treatment.[19] Cancer and cardiovascular disease are two of the many disorders that Pt NPs can be used to treat.[20, 21] There is rising worry about the danger of toxicity at different trophic levels through soil, air, and water, notwithstanding the broadening possibilities of nanomaterial applications.[22] In this overview, we focus on the numerous Pt NPs production methods, their advantages and disadvantages, and the various domains in which they have found use.

2. Synthesis and characterization of Pt NPs

The size, shape, surface covering and dispersion of Pt NPs are governed by their method of synthesis. These features can significantly be regulating the parameters and process of NPs synthesis. Following section describes the various identified and studied strategies of Pt NPs synthesis (Figure 1).

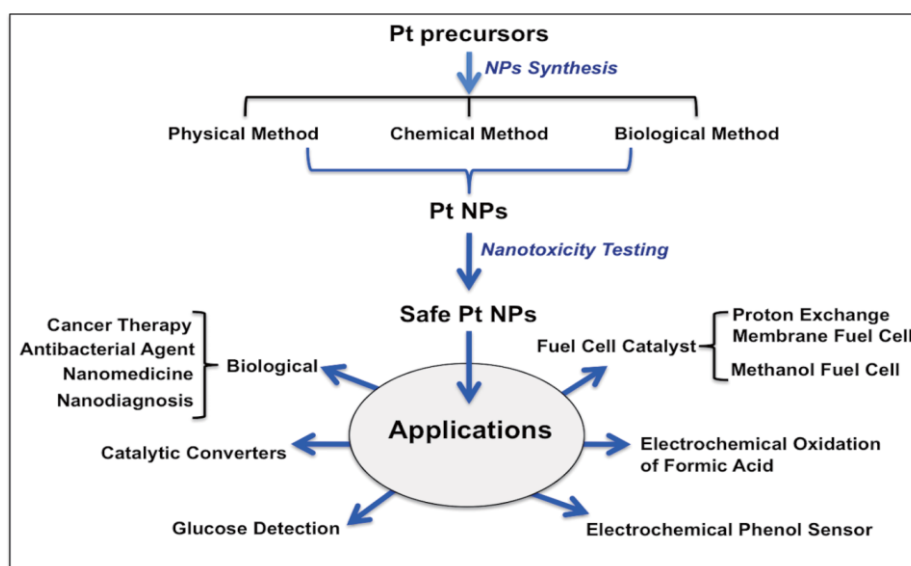


Figure 1. A schematic representation of steps for the production and utilization of Pt NPs containing various properties

2.1 Physical methods of Pt NPs synthesis

Various physical methods have already been reported for the preparation of metallic NPs. Some of the common physical methods of Pt NPs synthesis include laser ablation, ball milling, physical vapour deposition and ion sputtering. Following section describes use of these methods for the synthesis of Pt NPs of various morphologies.

In a simple method, heating chloroplatinic acid in a muffle furnace at 350 °C has been reported to form 2.5-3.3 nm Pt NPs over silicon carbide-alumina layer.^[23] Neodymium yttrium aluminium garnet (Nd:YAG) laser based ablation method has been used to produce 8-9 nm Pt NPs in deionized water from Pt plate.^[24, 25] Likewise, Nd: YAG laser was reported to synthesize Pt NPs in ethanol and aqueous trisodium citrate medium. Ethanol led to the production of 7-9 nm Pt NPs, while comparatively larger 9-10 nm NPs were produced in aqueous trisodium citrate solution.^[26]

Pt NPs of 5-20 nm were obtained by using PVD coater producing 700 °C for 90 minutes.^[27] Pt NPs have been synthesized from Pt wire by plasma sputtering in water. Plasma derived high energy electrons and radicals bombarded Pt surface releasing Pt atoms leading to the synthesis of highly dispersed 2 nm Pt NPs.^[28] Recently introduction of low pressure liquid as matrix with matrix sputtering was represented as a safer method for the synthesis and stabilization of Pt NPs. Use of polyethylene glycol as liquid matrix led to the synthesis of 0.9-1.4 nm sized NPs. The Pt NPs prepared through this method were stable in dispersion phase for a duration of 5 months (Figure 2).^[29]

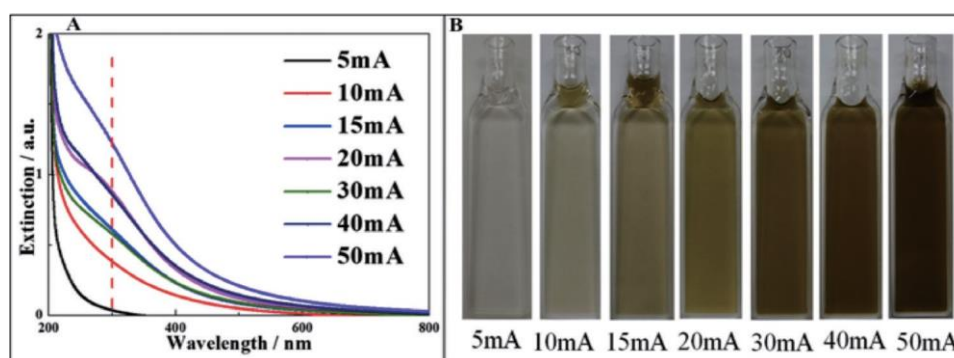


Figure 2. Pt NPs obtained by sputter deposition onto PEG. (A) UV-visible spectra of Pt NPs. Increase in peak intensity along the dotted red line indicates quantitative increase in Pt NPs synthesis with increase in sputtering current from 5 to 50 mA. (B) Photograph of Pt NPs dispersions of PEG under room light (right) with different sputtering currents. The change in color of reaction mixtures from colorless to yellow and to dark brown with increase in sputtering current from 5 to 50 mA indicates quantitative

increase in synthesis of Pt NPs. Color change acts as indicator of quantity of Pt NPs. “Reprinted with permission from (Deng et al., 2018) ^[29]. Copyright (2018) American Chemical Society.”

Ball milling approach has been used for the production FePt NPs in hexane. Iron and Pt powder were ground in presence of oleic acid and oleylamine to form 4 nm FePt NPs using hardened steel balls.^[30] Similarly, PtFe nanocomposites were obtained by grinding iron nitrate, chloroplatinic acid and PEO-PPO-PEO, P123 in a screw-capped zirconia reactor containing four zirconia ball bearings.^[31]

2.2 Chemical synthesis

Chemical methods has been used for the synthesis of Pt NPs in solutions phase as well as over the surface of a solid support. Support may be in the form of general supporting material like silica or even some nanomaterial like carbon nanotubes. Most of the chemical methods are easy and inexpensive. Pt NPs have been usually prepared by reduction of Pt metal precursor. Chloroplatinic acid, H_2PtCl_6 is one of the common precursors used for the chemical as well as biological synthesis of Pt NPs. The precursor is usually dissolved in an aqueous or organic liquid material. The conversion of dissolved precursor into solid NPs is done by introducing a reducing agent leading to a chemical conversion step. The most commonly used reducing agent for H_2PtCl_6 reduction is sodium borohydride (NaBH_4).^[32,33] Immediately after reduction of H_2PtCl_6 to Pt NPs, the NPs needs to be stabilized with surface stabilizing agents or surfactants. This step is critical to control the size and shape of metallic NPs including Pt NPs. Different methods have reported chemical preparation of Pt NPs with varying size, shape and surface covering. Pt NPs can also be synthesized by decomposition, displacement and electrochemical reactions.^[34,35]

Very small 2-3 nm Pt NPs were produced and deposited over hollow aluminium oxide (Al_2O_3) nanoplates prepared using NaBH_4 as reducing agent. The synthesized nanocomposite material was used for oxidative conversion of harmful formaldehyde to carbon dioxide and water.^[36,37,38] Likewise, supercritical fluid chemical deposition method has also been used for the synthesis of Pt NPs over the carbon nanotubes surface.^[39,40] Synthesis of Pt NPs of size range 2.9-60 nm has been documented using chloroplatinic acid as precursor, formic acid as reducing agent, and polyvinylpyrrolidone as surfactant. The control over size was obtained by using different concentrations of reducing agent and surfactant.^[41] Use of ethylene glycol as solvent and reducing agent and time bound addition

of polyvinyl pyrrolidone as surfactant has been reported to regulate the size of Pt NPs. Addition of precursor H_2PtCl_6 to preheated ethylene glycol followed by drop-by-drop addition of polyvinyl pyrrolidone was found to synthesize stable Pt NPs of size less than 10 nm within four hours of synthesis. The smaller amount of polyvinyl pyrrolidone addition assured Pt NPs size to be smaller, 7 nm. Further addition of polyvinyl pyrrolidone was found to inhibit the complete reduction of PtCl_6^{2-} perhaps due to formation of a stable complex.^[42] Sodium borohydrate mediated reduction of Pt precursor ions has been used in a microreactor system to synthesize Pt NPs over carbon fibers surface. The microreactor system can adjust the flow rate to obtain desired size of Pt NPs at variable deposition rates. Polyvinyl alcohol was used as a surfactant.^[43] Increasing reaction temperature is well known to decrease the time required for a chemical process. Likewise, chemical synthesis of Pt NPs in a microreactor could reduce time required for the synthesis from 40 min at 40 °C to few seconds at 105 °C. In this study, vitamin C was used as reducing agent and polyvinyl pyrrolidone was used as surfactant.^[44]

UV light mediated photoreduction of hexachloroplatinate (IV) (PtCl_6^{2-}) to Pt NPs by methanol has been reported.^[45] Likewise, photoreduction has been used to obtain monodisperse Pt NPs. In this method, poly(ethylenimine) (PEI) was used as surface stabilizing agent.^[46] Gamma radiation has also been explored for the reduction of Pt tetraammine to Pt NPs in the presence of stabilizer polyvinyl pyrrolidone. Radiation dose was used to control the size of NPs between 2.8 to 4.4 nm.^[47] Surfactant mediated synthesis of Pt NPs is useful for in vivo and environmental applications as it reduced the reactivity and hence toxicity of Pt NPs. Pt NPs synthesis has also been documented elsewhere in detail. Such Pt NPs are of specific interest for catalysis and electrochemical applications.^[48]

Pt nanocubes, 5-7 nm and nano-octahedra 8-12 nm were obtained by reacting H_2PtCl_6 with silver nitrate. Silver ions were mainly responsible for controlling the size and shape of Pt NPs.^[49] Pt NPs can also be prepared by decomposition, displacement and electrochemical reactions.^[34,35] Electrochemical method has also been employed for the synthesis of mesoporous Pt nanorods over the pores of mesoporous polycarbonate support.^[50]

For the shape controlled synthesis of Pt NPs, polymeric stabilizers have commonly been used as surfactant. The degree of polymerization and concentration of the used stabilized polymer influences the size of colloidal NPs and their growth. However, control of NPs size is difficult to achieve. The shape and size of Pt NPs can be regulated by changing the concentration ratio of the capping polymer material to the Pt cations used in the reductive

synthesis at room temperature. In such a study, Pt NPs of different shapes has been documented using different concentration ratio of capping agent, polyacrylate to precursor metal ion, Potassium tetrachloroplatinate(II). The capping agent: precursor ratio was varied between 1: 1 to 1: 5 to obtain tetrahedral, cubic, irregular-prismatic, icosahedral, and cubo-octahedral particle.^[51] So, Pt NPs of various shapes namely nanospheres, nanowires, truncated octahedral and nanocubes.

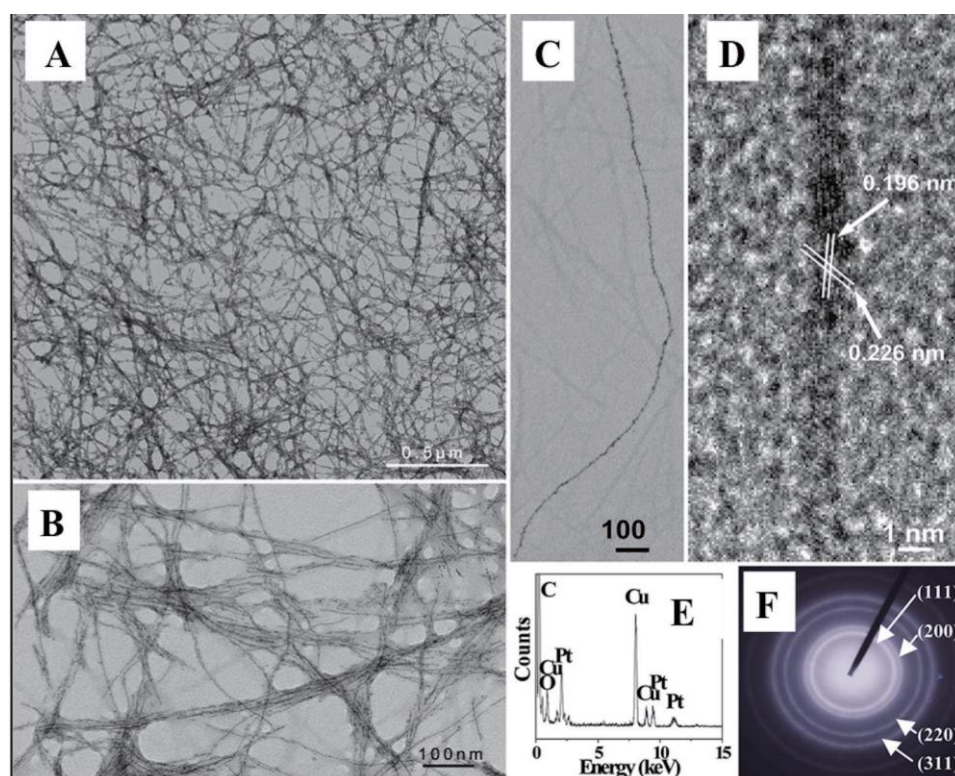


Figure 3. TEM characterisation of Highly uniform single-crystal ultrathin Pt nanowires (UTPtNWs). TEM images of UTPtNWs at diferent conditions: (A) Low magnification; (B) High magnification; (C) Single Pt nanowire and (D) HRTEM image of a single Pt nanowire. (E) EDS spectrum and (F) SAED pattern of UTPtNWs built using insulin amyloid fibrils (INSAFs). “Reprinted with permission from (Zhang et al., 2012)

Biological synthesis

Biological synthesis is a noble green process for the metallic NPs synthesis. Pt NPs can be synthesized by using unicellular and multicellular organisms. Various studies document the monodispersed and stable Pt NPs synthesis by bacteria, cyanobacteria, seaweeds, fungi and plants.^[14,56]

2.2.1 Bacteria mediated synthesis

Bacteria produce different kind of enzymes and metabolites. These enzymes and metabolites act to reduce metal ions into NPs. However, the exact mechanism responsible for the synthesis of metallic NPs by bacterial enzyme is not completely known. Several studies document the probable role of cytochrome C3 and hydrogenase enzyme for the NPs synthesis. Enzymes have tendency to oxidise hydrogen or organic to induce metallic reduction of sulphate as a final electron acceptor.^[57] Enzyme produced by sulphate reducing bacteria has been used for the synthesis of Pt NPs.^[58] Sulphate reducing bacteria obtained from a biosulphidogenic reactor can potentially reduce Pt(IV) to Pt NPs.^[59] Use of a mixture of sulphate reducing bacteria is recommended over pure culture as it is less liable for contamination from other organisms.

^[60] Cell-free extract of a consortium of sulfate-reducing bacteria has also been used for the synthesis of Pt NPs.^[61] In *Streptomyces* sp. mediated synthesis, amino acid moieties acts as reducing agents to synthesize Pt NPs. The NPs were 20- 50 nm in size and possessed *in vitro* anticancer activity.^[62] Likewise, 2-3 nm Pt NPs can be obtained using *Acinetobacter calcoaceticus*. Proteins moieties are the key component responsible for the NPs synthesis.^[63]

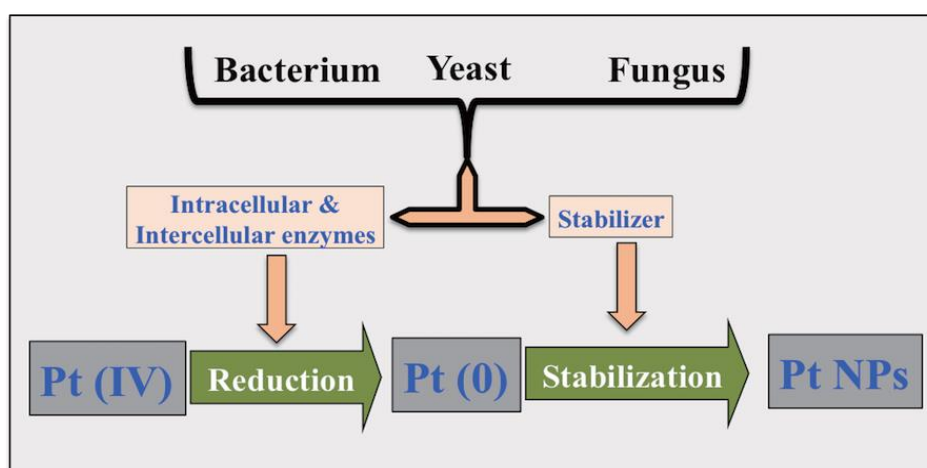


Figure 4. Production of PT NPs by intracellular and extracellular enzymes of bacterial, fungal and yeast cells origin. Enzymes can act as reducing and/or stabilizing agent to synthesize Pt NPs from Pt(IV) precursor ions

Likewise photosynthetic prokaryote, cyanobacteria has also been used for Pt NPs synthesis. Cyanobacteria has been used to treat effluent due to their abilities to uptake metal

ions from surrounding. Further being nitrogen fixing microorganism, cyanobacteria produces enzymes that can reduce precursor metal ions to NPs. The ability of cyanobacteria to reduce metal ions is specifically useful to obtain Pt NPs from precursor metal ions.^[64] So, depending upon the natural abilities of bacterial strains to uptake metal ion and produce reducing enzymes, the synthesis of Pt NPs can be intra as well as extracellular. *Anabaena*, *Calothrix* and *Leptolyngbya* strain of cyanobacteria have been used for Pt NPs synthesis. The NPs are synthesized intra-cellularly by nitrogenase and released in the culture medium where they are stabilized extracellularly by bacterial polysaccharides.^[65]

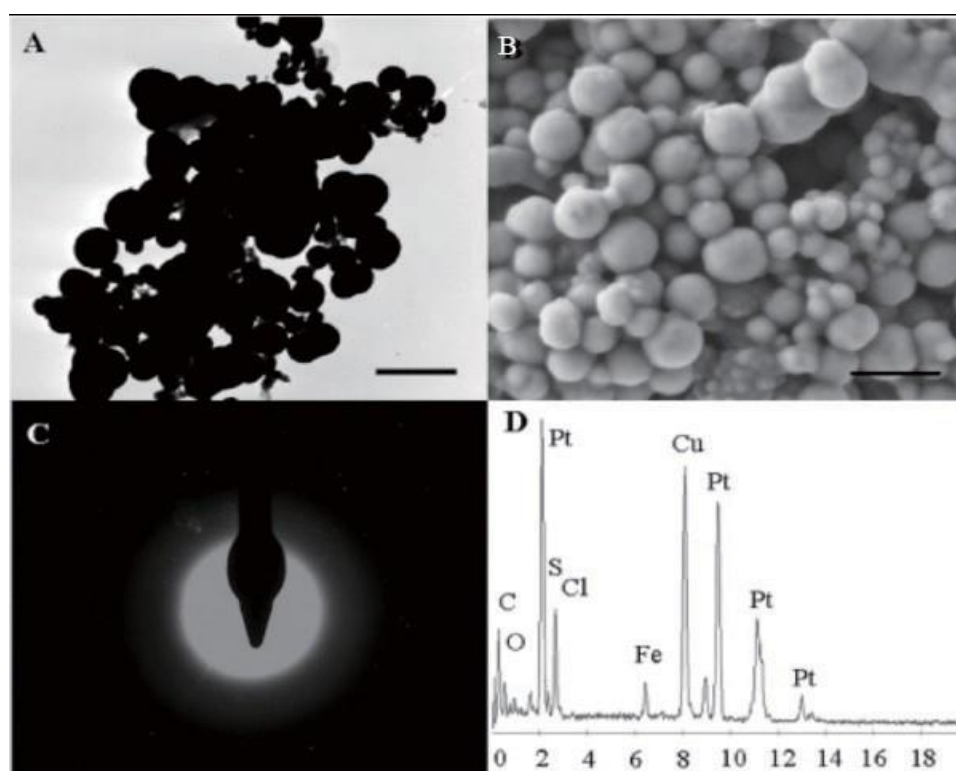


Figure 5. Electron microscopic characterization of Pt NPs synthesized by reduction of Pt(IV)-chloride using cyanobacteria (*Plectonema boryanum* UTEX 485) at an incubation temperature of 25 °C and 28 days: (A) TEM image of amorphous spherical Pt NPs; (B) SEM image of spherical Pt NPs; (C) TEM-SAED diffraction of amorphous Pt NPs; (D) TEM-EDS spectrum for panel A (Cu signal is from the supporting grid). Scale bars in panels A and B are 0.5 μ m. “Reprinted with permission from (Lengke et al., 2006) ^[66]. Copyright (2006) American Chemical Society.”

2.2.2 Fungus mediated synthesis

The physical and chemical methods of metallic reduction facilitating Pt NPs synthesis are comparatively expensive. Hence, use of biological agents is preferred. In addition to bacteria and cyanobacteria mediated NPs synthesis, large scale particle production with the use of fungi has also been reported. Synthesis of Pt NPs by filamentous fungi has more advantage over plant or prokaryotes mediated synthesis approaches. Filamentous fungi can efficiently resist pressure and agitation gradient during the NPs production at industrial scale production. The fungi mediated synthesis is highly stable and prevents molecular agitation.^[67] The filamentous fungi *Neurospora crassa* has been evaluated as reducing agent for the synthesis of Pt NPss. The fungal wild-strain biomass dispersed in aqueous solution reduced hexachloroplatinic (IV) acid to 40-50 nm Pt NPs. The Pt NPs synthesis was completed within 24 hours, but dark condition and continuous agitation was required.^[68,69] One pot Pt NPs synthesis has been reported by using the reducing potential of cell free filtrate of fungus *Penicillium chrysogenum*. The synthesized NPs were spherical and 8.5-15 nm in size.^[70] Likewise, 50-315 nm sized Pt NPs was synthesized using culture filtrate of fungus *Alternaria alternate*.^[71] Likewise, hydrogenase enzyme produced by *Fusarium oxysporum* has been reported for the synthesis of Pt NPs from H_2PtCl_6 . The synthesis of Pt NPs required prior reduction of H_2PtCl_6 to $PtCl_2$ on the enzyme surface such that it was small enough to enter active sites. $PtCl_2$ further underwent reduction process leading to the formation of Pt NPs.^[72] Protein mediated extracellular synthesis of Pt NPs has been reported using *Fusarium oxysporum*. Fungus culture could reduce and stabilize Pt NPs produced by reduction of H_2PtCl_6 . Enzymes were responsible for the reduction and proteins were responsible for the surface stabilization of NPs.^[73]

2.2.3 Plant mediated NPs synthesis

As mentioned earlier, to avoid the use of toxic chemicals during NPs synthesis, greener approaches of synthesis are being formulated and evaluated. Plant mediated NPs synthesis is one of the eco-friendly and green synthesis approach that is fulfilling the principles of green chemistry. Plant extracts has been widely used for the synthesis of metallic NPs.

^[14] Pt NPs have also been synthesized by using plant resources.^[74,75,76] Being synthesized through greener route, plant extract synthesized NPs are specifically useful for applications that warrant NPs to come in contact with living organisms. Further, use of plant material in synthesis prevents use of harmful chemicals that may otherwise contaminate environment. Plant extract used for NPs synthesis contain various phytochemicals of medicinal importance. Such phytochemicals act to stabilize NPs and may enhance the quality of

synthesized NPs. So, synthesis of NPs using medicinally important plant extract is preferred over other biological methods of NPs synthesis. Pt NPs synthesis has already been reported from different plant extracts.^[77,78] The plant tuber extract prepared by boiling dry tuber powder of *Gloriosa superba* has been reported for the Pt NPs synthesis. The tuber extract could reduce precursor PtCl_6^{2-} ions within 5 hours to obtain 0.8-3 nm spherical Pt NPs.^[79] Likewise, leaf extract prepared from traditional medicinal plant *Barleria prionitis* has been used for the synthesis of 1-2 nm Pt NPs.^[78] The studies documenting use of plant extracts for the synthesis Pt NPs is limited as compare to other type of metallic NPs.^[14]

The synthesis of Pt NPs from the extract of *Fumariae herba* has been confirmed by UV-visible spectroscopy, Fourier transform infrared spectroscopy, transmission electron microscopy and scanning electron microscopy with EDS profiling. The synthesized NPs were 30 nm in size and hexagonal and pentagonal in shape.^[80] Likewise, 100-200 nm small cubic and dodecahedron shaped Pt NPs were synthesized using *Jatropha gossypifolia* and *Jatropha glandulifera* leaf extract.^[81] Similarly, 1-6 nm sized spherical Pt NPs were synthesized using black cumin (*Nigella sativa L*) seed extract.^[82]

Table 1. List of plants used for Pt NPs synthesis and their morphological characteristics

Name of plant	Plant part use	Size (nm)	Shape	Reference
<i>Doiopyros kaki</i>	Leaf	2-12	ND	[83]
<i>Fumariae herba</i>	Whole	30	Hexagonal and pentagonal	and [81]
<i>Piper betle L.</i>	Leaf	0.4-2	Spherical	[84]
<i>Ocimum sanctum</i>	Leaf	23	Irregular	[85]
<i>Phoenix dactylifera</i>	Fruit	1.3-2.6	Spherical	[86]
<i>Lantana camara</i>	Leaf	35	Spherical	[87]
<i>Prunus yedoensis</i>	Gum	10-20	Circular	[88]
<i>Camellia sinensis</i>	Leaf	30-60	Flower	[89]
<i>Antigonon leptopus</i>	Whole plant	5-190	Spherical	[90]
<i>B. prionitis</i>	Leaf	1-2	Monodispersed	[78]
<i>Pinus resinosa</i>	Bark	6-8	Irregular	[91]

<i>Gloriosa superb</i>	<i>Tuber</i>	0.83-3	Spherical	[79]
<i>Cacumen platycladi</i>	<i>Whole plant</i>	0.8-2.4	Spherical	[92]
<i>Jatropha</i>	<i>Leaf</i>	100-200	Small cubic and dodecahedron	[81]
<i>Gossypifoliaa</i>				
<i>and Jatropha</i>				
<i>Glaundulifera</i>				
<i>Nigella sativa L.</i>	<i>Seed</i>	1-6	Spherical	[82]
<i>Orange</i>	<i>Peel extract</i>	1.6-4	ND	[93]

Table 2. Advantages and disadvantages of different methods of Pt NPs synthesis

Properties	Chemical synthesis	Physical synthesis	Biological synthesis
Productivity	High	Less	High
Cost	Low	High	Cost-effective
Energy required	High	High	Low
Stability	High	Low	Low
Wastage	High	High	Low
Size and shape tunability	Size controlled	Difficult in size and shape tunability	Definite shape and size
Purity	Low	Low	High
Chemicals	Uses toxic chemicals	No use of chemicals	No use of chemicals
Production	Small scale	Small scale	Large scale

2.3 Application of Pt NPs

With the advent of nanotechnology, new functional materials are being synthesized. Among which metallic NPs are of particular interest due to their wide range of multidisciplinary applications. The Pt NPs have likewise wide range of physical, chemical and biological applications. The factors responsible for their multi -functionality are their

unique physical and chemical properties.^[42] Following section describes the various applications of Pt NPs. There are two review that tried to discuss the biomedical application of Pt NPs.^[94,95] Although Pt NPs have broader scope and applications in various fields so we discuss various application of Pt NPs in detail (Figure 1).

2.3.1 Fuel cell catalyst

2.3.1.1 Proton exchange membrane fuel cells

Proton exchange membrane fuel cells produce electrical energy by chemical reaction at both anode and cathode. The electrochemical reaction between H₂ and O₂ releases water. On anode, the hydrogen gas adsorbed over catalyst surface loses electron that flow to cathode and proton is released from the metallic surface. With the flow of electrons from anode to cathode, proton is also transported. Oxygen is released at cathode and oxygen accepts the proton and a water molecule is released at the metallic surface. Recently, Pt is used as a catalyst for the reactions occurring at anode and cathode.^[96] Pt NPs are preferred over other metallic membrane fuel cell catalyst due to better catalytic activity, stability and selectivity. Hence, Pt NPs offer an ideal catalyst with enhanced usage and reduced economics.^[96] Pt NPs, 4 nm functionalized with Ru ions has shown application as an efficient electro-catalyst for proton exchange membrane fuel cells.^[96] Multiwalled carbon nanotubes Pt nanocomposites have been synthesized by reducing the Pt atoms on multiwalled carbon nanotubes in ethylene glycol solution. The synthesized NPs showed enhanced electro-catalytic potential when the catalysis of NPs synthesis was conducted in alkaline conditions.^[98]

2.3.1.2 Methanol fuel cell

Methanol fuel cells are the electrochemical cells generating electricity by oxidation of methanol in the presence of alkaline electrolyte releasing carbon dioxide and water. To eliminate the carbon dioxide emission, Pt catalysts are used for methanol oxidation in acidic conditions.^[99] Further, various strategies of Pt NPs synthesis are being explored to ensure their direct usage as electro-catalyst in methanol fuel cells. The synthesis of multi-walled carbon nanotubes supported Pt nanocomposites in ethylene glycol solution showed significantly higher performance as electro-catalyst than nanocomposites synthesized in aqueous solution.^[100] Likewise, another such study reports an efficient electrocatalytic potential of Pt₅₂Ru₄₈/C nanocolloids than carbon supported Pt of Pt-ruthinium colloids.^[101]

2.3.2 Electrochemical oxidation of formic acid

Electrochemical oxidation of formic acid is of keen interest because of its use in fuel

cells and secondly, it acts as model system to study the oxidation of complex organic molecules and formic acid is least reactive and non-explosive. Pt metallic electrode has shown highest efficiency of formic acid oxidation than other metallic electrodes.^[102] Number of Pt based nanomaterials is being synthesized to increase their electro-catalytic activity towards formic acid. Pt NPs layered on gold surface has shown enhanced electro-catalytic activity of formic acid oxidation.^[103] Likewise, Pt modified gold NPs showed high electro-catalytic activity than pure Pt NPs.^[104]

2.3.3 Catalytic converters

Pt NPs are used as catalytic converters in car. The exhaust gases from the car react with Pt surface on release as they land on the surface of Pt particles. Pt oxidises the released carbon monoxide and hydrocarbons. Carbon monoxide is toxic in nature and harmful for humans. Breathing of excessive carbon monoxide can leads to death. Pt is more effective under oxygen excessive conditions so it is used in diesel cars. Since Pt has high melting point, it readily interacts with poisonous particles and can be efficiently recycled later.^[105] Pt NPs present on Pt surface of vehicles promotes the chemical reaction occurring on it. They induce the weakening of carbon oxygen bond present in carbon monoxide and oxidize it into carbon dioxide.^[106]

2.3.4 Glucose detection application

PdCuPt trimetallic nanocrystals has been used as electro-catalysts for enzyme free detection of glucose. Nocrystalline electro-catalysts are easy to fabricate and has high electrocatalytic activity, selectivity and stability. So, the Pt based trimetallic nanocrystals can be used for various medical diagnostic and various other industrial applications.^[107] Another study reports the synthesis of glucose enzyme biosensors based on Pt NPs homogenously loaded onto polyaniline hydrogel. These glucose enzyme biosensors showed hydrogel based conductivity and nanoparticle based catalytic potential. Due to the porous structure of the polyaniline hydrogel, the Pt NPs were immobilized and the water soluble molecules penetrated which help in the oxidation of glucose.^[108]

2.3.5 Electrochemical sensor for phenol detection

Phenol and its derivatives are used in many fields. Phenol is ingredient of disinfectants, coating agent, dyes, pharmaceuticals and pesticides. Phenol is also used as vegetables preservative. Phenol and its derivatives also poses some serious ecological threat specifically contaminating the soil surface and ground water.^[106] Phenol can enter the human respiratory

tract and cause severe health problems particularly in children. So, it is important to develop sensitive, rapid, and economic method for phenol detection. Many analytical methods are used for detection of phenol. For instance, gas chromatography, high-performance capillary zone electrophoresis, high performance liquid chromatography and capillary electrophoresis are used for detection of phenol. These methods are time consuming and expensive. Focus in on the development of electrochemical sensors for phenol detection. Electrochemical sensors show high sensitivity, excellent stability, easy operation and low cost. Pt NPs are widely used in the electrochemical sensors because of their significant catalytic and optical activities.^[96] Graphite like carbon nitride is a stable metal free semiconductor material with a smaller visible light driven band gap.^[110] It has high sensitivity, good biocompatibility and low cost. Graphite like carbon nitride has wide application in biosensors, degradation of pollutant in water and carbon dioxide reduction.^[111] Combination of Pt and graphite like carbon nitride showed significant electrochemical sensing. Oxidation peak of phenol was indistinct on carbon paper and high peak was observed on the graphite like carbon nitride/carbon paper electrode. Pt NPs when loaded onto the graphite like carbon nitride as Pt/g-C₃N₄/CP showed highest oxidation peak for significant detection of phenol.^[111]

2.3.6 Biological applications

Pt NPs have various biological applications because of its unique electronic and physiochemical properties. They have emerged as the most potential functional biomaterials to possess application in drug delivery, diagnostics and imaging.^[112] Following sections describes the potent biological applications of Pt NPs.

2.3.6.1 Cancer therapy

2.3.6.1.1 Chemical cancer treatment

Pt has been used in cancer treatment as most available cancer drugs are Pt based. Work is being in progress to develop next generation of Pt drugs with modified nanoformulations.^[113] The spherical shaped bacitracin-Pt NPs (Bac-PtNPs) have been developed to possess significant *in vivo* and *in vitro* anti- tumorous activity. The spherical shaped Bac-PtNPs were aqueous stable and cubic crystalline in shape. The presence of functional groups on bacitracin acted as binding moieties that supported the growth of Pt NPs.^[114] TiO₂ and SiO₂ nanostructures containing 3-4% of Pt have shown anti-cancerous activity and used for the cancer treatment. Treatment with these nanostructures induced significant reduction in size and weight of rat weight tumor.^[115] In brain cancer therapy, Pt NPs have also shown ability

to activate cellular apoptosis in tumors together with the ability to cross the blood barrier.^[116]

2.3.6.1.2 Photothermal therapy and radiotherapy

Due to the toxic side effects of anticancer chemotherapies, more effective and site specific strategy is developed for treatment of malignant tumors. The photothermal therapy is non-invasive due to the use of Pt NPs. In this treatment, Pt NPs increased the cellular temperature upon irradiation causing DNA/RNA damage, membrane rupture, protein denaturation and finally apoptosis.^[117] Researches mostly used carbon nanotubes, graphene NPs, copper sulphide and noble NPs for cancer treatment. These nanomaterials are capable for absorbing NIR laser light and evaporate it into heat. The photothermal therapy has been improved by combining the cyto-compatibility and catalytic properties of Pt NPs.^[118] The recommended size of Pt NPs for photothermal therapy is 5-6 nm. Pt NPs are good material for the photothermal therapy and radiotherapy as they damage the cellular component of the selective area and induce cell death.^[118]

2.3.6.2 Antibacterial agent

The existence of multi drug resistance bacteria is the greatest threat and challenge in the development of antibacterial agents. NPs composed of metals like Ag, Pd, Au, Cu, ZnO and TiO₂ are generally used for the development of bactericidal agents. However, side-effects associated with the use of these NPs have limited their therapeutic applications.^[119] Pt ions have been considered to possess potent antimicrobial activity on *E. coli*. However, the antibacterial potential of Pt NPs is still not well understood. Pt NPs has been reported to induce intracellular ATP hyper production, growth inhibition and DNA damage generating a significant bacteriotoxic response.^[120] Enhanced ATP production on Pt NPs exposure increases the expression of kinase that is responsible for cellular growth arrest.^[121] Small sized Pt NPs have shown significant bacteriotoxic property at low concentration. TEM analysis revealed that size played an important role as larger sized NPs absorbed onto the plasma membrane whereas smaller sized NPs easily invaded the bacterial cells.^[122] Pt NPs have also shown activity against gram negative and gram positive bacteria. Pt ions can invade the peptidoglycan composed cell wall of gram negative bacteria.^[123] Pt NPs has potential even to cure drug resistant *E. coli*.^[124]

2.3.6.3 Nanomedicine

Pt NPs are antioxidant in nature that has the ability to scavenge reactive oxygen species. They are good source as nanozymes for the treatment of oxidative stress related diseases. Pt

NPs have been functionalized by saponins to develop saponins-Pt conjugates that showed significant antioxidant activity. The conjugates regulated macrophage inflammatory protein-2 (*MIP-2*) gene expression and inhibited the mitogen-activated protein (MAP) kinase pathway.^[125] Pt NPs have been reported to prevent cancer and cardiovascular diseases as they possess *in vitro* enzyme like property. Pt NPs have good stability in acidic cellular vesicle environments leading to high *in vivo* tolerance.^[20]

Pt NPs have shown ability to shield the cell from reactive oxygen species that can induce cell death on exposure to UV-A or X-Ray or ultrasound radiations.^[126,127] Pt NPs are defined to possess horseradish peroxidase and catalase mimetic enzyme activities when embedded in the dendrimers.^[128] Pt NPs have ability to quench the peroxide and superoxide ions both in cell free solution and within cell when encapsulated with-in the cavity of apoferitin. It can also increase the antioxidant property.^[129]

2.3.6.4 Nanodignosis

Pt NPs are also significantly used for disease diagnostics. Fluorescent Pt NPs are used in biocompatible bioimaging probe for diagnostic purposes.^[130] Pt nanomaterials is a part of catalytic nanomotors that are used to built-up the molecular devices and detect motion based particles.^[112] Pt NPs are also good source of enzyme alternates used for diagnostic purpose.^[131] Pt NPs have so many advantages including stability, resistance to proteases, high catalytic activity even at high pH and temperature, and affinity for horseradish peroxidase (HRP) substrates.^[132]

Pt NPs colorimetric assay have been develop^[132] for the detection of DNA^[133], cancer cells^[21], tumor marker^[17], metal ions^[134], penicillin antibiotics^[135], drugs^[11], hydrogen peroxide^[28], glucose^[136], cholestrol^[137], L-cysteine^[138], choline, acetylcholine^[139], proteins^[140], viruses^[141], bacteria^[142] and antibodies^[143]. Irregular shape of Pt NPs act as HRP like enzymes when these binds with the anti-RigG antibody which is used in the Enzyme Linked Immunosorbent Assay for the colorimetric detection of rabbit IgG, using 3,3',5,5'- tetramethylbenzidine (TMB) and hydrogen peroxide (H₂O₂) as substrates.^[143] Encapsulated Pt NPs in mesoporous silica matrix are used for the detection of level free DNA.^[144] TMB oxidation catalyzed by 4-mercaptophenylboronic acid functionalized Au@Pt NPs are used.

3. Cytotoxic effect of Pt NPs

Pt NPs has been found to induce cytotoxic response to various cancerous cells.

Exposure of 50-200g/ml of Pt NPs for 48 hours has been documented to induce cytotoxicity to A549, PA-1 and Mia-Pa-Ca-2 cancerous cell lines. MTT assay was used for the determination of cell viability. Pt NPs reduced the growth of cancerous cell by 28-34 in A549, 33-46% in PA-1 and 11-41% in Mia-Pa-Ca-2 cells. However, PA-1 cells showed highest growth inhibitory effect of Pt NPs. Apoptosis, autophagy and necrosis are the three major types of cell death. PA-1 cells treated with 200g/ml of Pt NPs for 48 hours showed enhanced apoptosis.^{[154], [155]} Likewise, treatment of murine leukemia raw 264.7 cells with different concentrations of Pt NPs induced cytotoxicity. Cell morphology evaluation, Annexin V assay, DNA fragmentation and the activity analysis of caspase-3/7 showed promoted apoptosis in the Raw 264.7 cells. The ill effects were due to change in cell morphology, increase in cell density and nucleus fragmentation. Caspase-3 and caspase-7 was found to induce apoptosis in the cells. Pt NPs inactivated the DNA repair system of cells.^[156] Exposure of HEK293 cells to 20-360g/ml of Pt NPs for 6, 24 and 48 hours revealed toxic response of Pt NPs. Cell viability was found to be 99.06%, 96.9%, 98.5% and 88.5% after 6 hours, 95%, 91%, 83%, and 70% after 24 hours; and 90%, 86%, 68.25%, and 54.15% after 48 hours of Pt NPs exposure. The Pt NPs induced cytotoxicity was reported to be time dependent.^[157] Overall Pt NPs may induce toxic response to cancerous cell lines. However, the exact toxicity behaviour of Pt NPs of different sizes needs to be tested using more realistic *in vivo* studies.

4. Conclusion and outlook

The synthesis of Pt NPs can be manipulated to produce NPs of different sizes and shapes. The varying size and shape imparts different physical, chemical and biological properties to the Pt NPs. Stable Pt NPs obtained through greener biological route are suitable for various biological applications. Such greener Pt NPs are significantly useful in cancer diagnosis, photothermal and antibacterial therapy. Pt NPs has the potential of even replacing the conventional drugs for cancer treatment. The Pt NPs are of importance even for some of the non-biological applications like catalysis, nanodiagnosis and development of durable proton exchange membrane fuel cell. Pt NPs being composed of noble metal chemical composition has potential applications because of stable and least reactive surface coating material. Overall, Pt NPs have wide range of biological and non-biological industrial applications. *In vitro* cytotoxicity studies conducted using cell lines indicate toxic behaviour of Pt NPs towards cancerous cells. In depth *in vitro* and *in vivo* toxicity experimentation

proving safety of Pt NPs can help in exploring their new applications in therapeutics and diagnosis.

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ARTICLE-27

**PRODUCTION OF TITANIUM OXIDE NANOPARTICLES AND IT'S
PHYSICOCHEMICAL CHARACTERIZATION STUDIES**

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Abstract

Several methods for the manufacturing of nanoparticles, including chemical synthesis, have emerged as a result of the growing interest in the topic of nanotechnology in recent years. To create nanoparticles of titanium dioxide (TiO₂), the Pechini process has been employed. Nanoparticles of TiO₂ will be synthesized and characterized in this work. The approach constitutes in the reaction between citric acid with titanium isopropoxide, generating as the product the titanium citrate. When ethylene glycol is added, a polymerization reaction takes place, and a polymeric resin is produced. At the end, the resin is calcined to remove any remaining organic material and transform it into TiO₂ nanoparticles. Several techniques, including thermogravimetric analysis (TGA), thermal differential analysis (DTA), X-ray diffraction, infrared absorption spectrophotometry, the boron etchant transfer (BET) method, and scanning electron microscopy, were used to characterize the powders that resulted. Characterization techniques revealed encouraging findings, suggesting the Pechini process may successfully produce nanosized TiO₂.

Keywords: Titanium dioxide, nanoparticles; Pechini method.

Introduction

In recent decades, there has been a dramatic surge in funding for nanotechnology research. The fact that nanoparticles often exhibit physical and chemical properties distinct from those produced by larger- scale materials (such as "bulk") is a major driving force behind this expansion [1]. Because of their useful qualities, such as large surface area, high homogeneity, and stable chemical composition, the development of technologies for the fabrication of nanosized powders has been of major value in recent years. Nanopowders have been prepared using a variety of techniques, including sol-gel processes, inert gas condensation, chemical vapor decomposition, evaporation, and the plasma spray process. The properties of a particle are technique dependent [2]. The Pechini method has emerged as a promising alternative procedure for the synthesis of nanoparticles of titanium dioxide, featuring nanoparticle size, high purity, and chemical homogeneity, and it does not require expensive, specialized equipment to be carried out [2].

Titanium dioxide (TiO_2) has a refractory nature and is a stable, non-volatile, very insoluble chemical. TiO_2 is amphoteric, but more acidic than basic, is also polymorphic and can occur in nature in three unique crystallographic forms: anatase tetragonal, brookite orthorhombic and rutile tetragonal. There is little scientific interest in the unstable phase brookite because of how difficult it is to manufacture. The anatase and rutile phases, as well as the brookite phase, are found in nature but are also easily manufactured in the lab. There are notable distinctions between these two crystal configurations. The rutile crystal structure is more stable than the anatase form because it is denser, has a higher refractive index, and has a smaller atomic size [3].

White pigment, gas sensors, corrosion protective and optical layers [4, 5], solar cells [6, 7], environmental purification [8, 9], high dielectric constant and high electrical resistance [7, 8], carbon dioxide decomposition, and the generation of hydrogen gas [9] are just some of the many industrial uses for TiO_2 . Additionally, it can be used to create self-cleaning glass when applied as coatings on existing glass [10].

This work seeks to manufacture and describe nanoparticles of titanium dioxide because of the critical need to comprehend the behavior of nano-sized particles.

Materials and Methods

The reagents used for the preparation of TiO_2 were titanium IV isopropoxide ($\text{Ti}[\text{OCH}(\text{CH}_3)_2]_4$) 97% PA (Aldrich), citric acid ($\text{C}_6\text{H}_8\text{O}_7$) 99.5% PA (Qhemis) and ethylene glycol ($\text{C}_2\text{H}_6\text{O}_2$) 99.5% PA (Synth). For the preparation of TiO_2 powder, it was first prepared titanium citrate through the reaction between citric acid and isopropoxide titanium (IV) with molar ratio fixed at 3:1. Citric acid was dissolved in water, under stirring and heating on the hotplate at about 70°C . In aqueous solution of citric acid the titanium isopropoxide was dissolved slowly, gradually adding shares of 10 mL, maintaining the same conditions of temperature and agitation for the formation of a clean and stable solution of titanium citrate. After several hours stirring, the solution was filtered. The amount of titanium was determined gravimetrically as TiO_2 .

For the gravimetric analysis, an alumina crucible that was previously cleaned and dried in an oven was used and transferred to an oven at a temperature of 1000°C for heat-treatment. After treatment, the crucible was left cooling and was duly weighed. Soon after, 5 mL of citrate solution of titanium was added, with the help of a pipette. Completing this step,

the crucible was taken to a hot plate to evaporate large amounts of solvent. When dry, the crucible was roasted in muffle furnace to evaporate the organic material with a heating rate of 10 °C / min and the following heat treatment: 900 °C - 120 min. After this calcination, the crucible was weighed again and made the stoichiometric calculation to obtain the concentration of titanium in the solution of titanium citrate.

After the synthesis of citrate, ethylene glycol was added to promote polymerization, which occurs at a temperature of 120 °C under constant agitation, with the polyesterification reaction between of titanium citrate and ethylene glycol. When the solutions reached approximately 50% loss of volume, a clear and very viscous polymeric resin was formed. The molar ratio between citric acid and ethylene glycol was set at 60-40 % by weight. The prepared resin was brought to the furnace at a temperature of 300 °C for 3 hours at a heating rate of 10 °C / min for the formation of the "puff" (polymer pyrolysate), a rich material organic matter, making it a solid black mass. After this step, the material was grinding in a mortar and pestle of agate. The material was then calcined from 400 to 900 °C for 3 hours on plates of alumina sintered at a heating rate of 10 °C / min under ambient atmosphere furnace MAITEC type furnace, for the complete elimination of organic matter and oxidation of metal cation.

The calcinations were performed in three steps: (1^a) rise in temperature to 300 °C with a heating rate of 10 C.min⁻¹ and stay for 2 hours, (2^a) raising the temperature to desired values, ranging from 400 to 900 °C with a heating rate of 10 °C.min⁻¹ and stay for 3 hours, (3^a) cooling to room temperature with a cooling rate of 10 ° C.min⁻¹. The resulting powders were characterized by the following techniques: thermogravimetric analysis (TGA) and thermal differential analysis (DTA) to verify the changes that the sample undergoes during its heating, absorption spectroscopy in the infrared region to identify the functional groups, X-ray diffraction to identify the crystallographic phases present in the samples, method of adsorption nitrogen / helium (BET method) for determining surface area and particle size and scanning electron microscopy to study the morphology of the samples.

Results and Discussion

The thermal decomposition of the powder of titanium dioxide (TiO₂) was followed by thermogravimetric analysis. Fig. 1 shows the thermo gravimetric analysis (TGA) and thermal differential analysis (DTA). We note that the TGA curve shows two mainstages of mass loss. The first, about 6 to 8 %, between 25 °C and 180 °C, corresponding to the loss of

adsorbed water on the surface of the material and the second and main stage, around 35 % between 250 °C and 480 °C, attributed to loss of organic matter remaining after the pyrolysis (rupture of the polymer chain). It can be observed that the DTA curve of TiO₂ calcined at 300 °C showed exothermic peaks at the same temperature ranges corresponding to the loss of mass quoted for TGA. These peaks confirm the output of water and break the polymer chain. It is observed that there was no mass loss after 500 °C, in other words, the mass of the material remains constant, indicating the onset of oxide formation and expected changes in the crystal. Above this temperature the TGA and DTA curves no longer exhibit any peak.

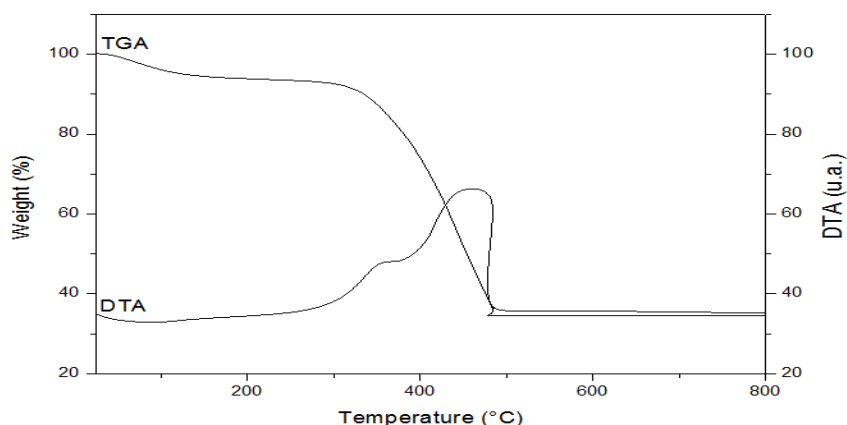


Fig. 1: DTA / TGA curves of TiO₂ calcined at 300 °C.

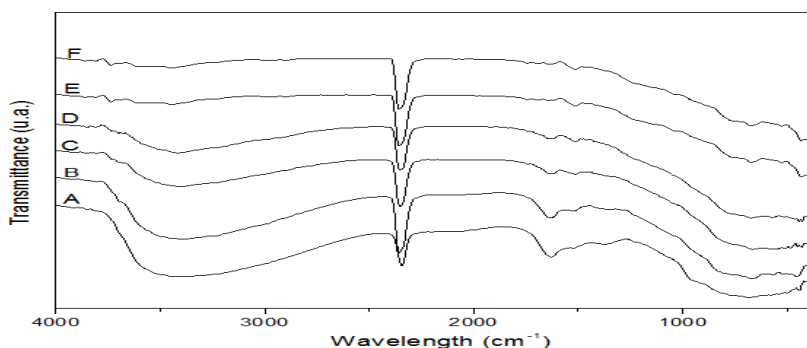


Fig. 2: Infrared spectrum of TiO₂ powder obtained by the following annealing temperatures: A (400 °C), B (500 °C), C (600 °C), D (700 °C), E (800 °C), F (900 °C).

Fig. 2 shows the infrared spectra of TiO₂ powder obtained by the Pechini method. In the range between 3200 and 3600 cm⁻¹ there are connections stretches of C-H and O-H at 6 different temperatures (A to F), in the range from 2300 to 2350 cm⁻¹ connections stretch of C=O, in the range between 1650 to 1680 cm⁻¹ connections stretch of C-C and 1350 cm⁻¹ connections stretch of C-O. It is observed that with increasing calcination temperature the bands of links

stretch will decrease, ie, the organic part is degraded with increasing temperature. Between 400 and 1000 cm^{-1} the links stretch metal-oxygen (Ti- O) are obtained. The formation of bands below 800 cm^{-1} corresponds to the formation of titanate, ie, the desired phase. Thus, it appears that all the organic part of the TiO_2 powder was degraded in calcination between 400 and 900 $^{\circ}\text{C}$.

Fig. 3 shows the XRD (X-ray diffraction) pattern of the TiO_2 obtained by Pechini method, calcined between 400 $^{\circ}\text{C}$ and 900 $^{\circ}\text{C}$ / 3 h. We can observe for the calcination of 400 $^{\circ}\text{C}$ the formation of single phase and crystalline anatase. However, from the calcination of 500 $^{\circ}\text{C}$ on rutile phase was formed and increasing the calcination temperature it can be seen that the rutile phase increases the intensity of their peaks, while the anatase phase will lose its intensity. It can observe that for the calcinations of 800 $^{\circ}\text{C}$ and 900 $^{\circ}\text{C}$ the formation of anatase phase stop, with only the formation of rutile phase. The diffraction peaks showed considerable enlargement, thereby indicating the presence of nanoparticles of TiO_2 powder.

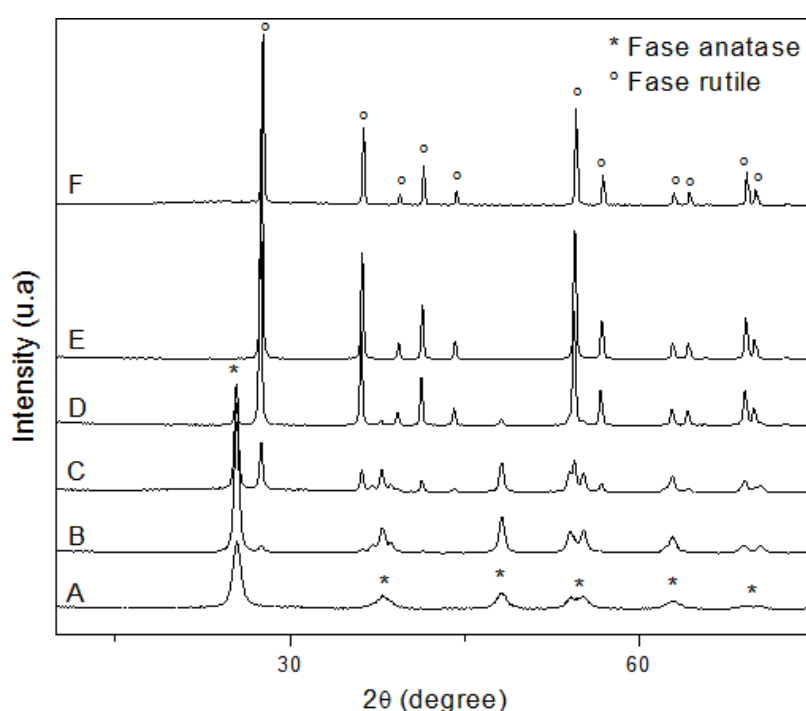


Fig. 3: X-ray diffraction of TiO_2 calcined at the following temperatures: A (400 $^{\circ}\text{C}$), B (500 $^{\circ}\text{C}$), C (600 $^{\circ}\text{C}$), D (700 $^{\circ}\text{C}$), E (800 $^{\circ}\text{C}$), F (900 $^{\circ}\text{C}$).

The morphology of the TiO_2 powder was evaluated by analysis of scanning electron microscopy. Fig. 4 shows micrographs of TiO_2 calcined at 400 $^{\circ}\text{C}$, 500 $^{\circ}\text{C}$, 700 $^{\circ}\text{C}$ and 800

°C. The images revealed the formation of clusters in the form of irregular, disordered and heterogeneous plates consisting of fine particles. We can observe a wide distribution cluster sizes. Usually, clusters larger than 10 micrometers present characteristics of hard clusters - consisting of primary forces. However, it was observed experimentally that the clusters of TiO₂ obtained by the Pechini method have soft agglomerates - formed by weak forces of van der Waals forces - they are easily broken in agate mortar. In image (a) we also observed the emergence of the fraction of organic material in the sample, however, with increasing calcination temperature the disappearance of the organic material can be observed, a fact that can be seen in infrared spectra.

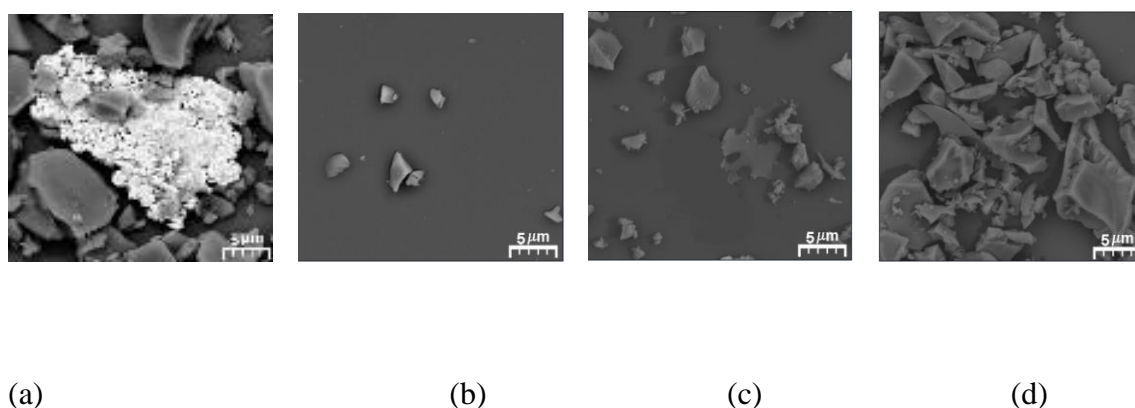


Fig. 4: Micrographs obtained for the powder of TiO₂ in: (a) 400 °C, (b) 500 °C, (c) 700 °C and (d) 800 °C.

Table 1 shows the values of surface areas, together with the particle size [11], for the TiO₂ powder calcined from 400 °C to 900 °C calculated from the BET method. It can be observed that the TiO₂ powder produced by the Pechini method showed a decrease in surface area and an increase in particle size as the temperature increases. This result is usually expected since the particles tend to agglomerate with increasing temperature.

Table 1: Surface areas of powder of TiO₂ synthesized by the Pechini method.

Temperatures of calcination (°C)	400	500	600	700	800	900
Surface areas (m ² /g)	61,59	23,89	9,38	8,84	7,10	6,25
Particle size (nm)	25	64	165	174	217	246

Conclusions

The Pechini method was efficient to obtain crystalline pure TiO₂ nanoparticles. The results of thermo gravimetric analysis, thermal differential analysis and infrared analysis showed the degradation of the polymer and the formation of the phases of anatase and rutile TiO₂ crystal. The analysis of X-ray diffraction showed the formation of anatase and rutile phases and the enlargement of peak proved the presence of nanoparticles of TiO₂ powder. The micrographs of TiO₂ powder showed the formation of clusters with heterogeneous disordered structure without structural definition. The surface area of TiO₂ particles calculated by the BET method showed the expected results, the higher the calcination temperature the lower the value of the area and the larger the particle size, since they tend to cluster.

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ARTICLE-28

EXPLORING APPLICATIONS OF AGRICULTURAL NANOTECHNOLOGY: A COMPREHENSIVE REVIEW

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Abstract:

Nanotechnology has emerged as a transformative force across a wide range of scientific disciplines, and its applications in agriculture, known colloquially as agricultural nanotechnology, hold enormous promise for addressing contemporary challenges in food production, resource management, and sustainability. This paper provides an in-sight into the various applications of nanotechnology in agriculture, with the goal of contributing to a better understanding of this rapidly evolving field.

Keywords:

Agriculture, Nanotechnology, Crop Production, Soil Management, Applications, Review

Introduction:

Agriculture, being the cornerstone of human civilization, is undergoing a transformative phase driven by cutting-edge technologies. Among these, nanotechnology has emerged as a revolutionary force, promising unprecedented advancements in crop production, resource management, and environmental sustainability. This paper embarks on a journey to explore the multifaceted applications of agricultural nanotechnology, delving into the realms of precision farming, enhanced nutrient delivery, and eco-friendly pest management.

As global challenges such as population growth, climate change, and resource depletion intensify, the agricultural sector faces an urgent need for innovative solutions. Nanotechnology, dealing with materials at the nanoscale, offers a myriad of opportunities to address these challenges.

At this scale, the unique physicochemical properties of materials bring about novel functionalities that can be harnessed to optimize various aspects of agriculture.

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Precision farming, characterized by site-specific crop management, stands out as a key application of nanotechnology in agriculture. Nanosensors and nanodevices facilitate real-time monitoring of soil conditions, crop health, and environmental parameters, empowering farmers to make informed decisions for optimal yield. This level of precision not only enhances resource efficiency but also minimizes environmental impact by reducing the excessive use of water, fertilizers, and pesticides.

Another compelling facet of agricultural nanotechnology lies in the realm of nutrient delivery systems. Nano-formulations of fertilizers and micronutrients exhibit enhanced nutrient uptake by plants, ensuring improved crop nutrition and productivity. This not only addresses concerns related to food security but also contributes to sustainable agriculture by mitigating nutrient run-off and soil degradation.

Furthermore, the paper explores the role of nanotechnology in pest management, offering eco-friendly alternatives to conventional pesticides. Nanopesticides, with their targeted delivery systems, minimize collateral damage to non-target organisms and reduce the environmental persistence of chemical residues. This approach aligns with the growing global emphasis on sustainable agricultural practices and biodiversity conservation.

In essence, this exploration into the applications of agricultural nanotechnology underscores its potential to revolutionize traditional farming practices. As we delve into the intricate world of nanoscale materials, their synthesis, and application in agriculture, we unravel a tapestry of innovation that holds the promise of ushering in a new era of sustainability, productivity, and resilience in global agriculture.

Literature review

With the global population soaring to 7.77 billion, and projections estimating a surge to approximately 9.6 billion by 2050, the imperative to produce more food is evident, particularly with around 59% residing in Asia¹. Addressing this escalating food demand has led to an exploration of diverse scientific and technological avenues². In this context, nanotechnology has emerged as a potent tool, offering promising prospects for innovative research across various domains³. Coined by Taniguchi in the 1960s, the term 'nanotechnology' gained traction through the groundbreaking work of Dr. Richard Feynman^{4,5}. Nanotechnology involves the scientific study, design, modeling, control, and utilization of functional materials, devices, and systems at the nano-scale, typically ranging from 1nm to 100nm^{6,7,8}. Nanotechnology is a multidisciplinary field encompassing chemistry,

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biology, and other integrative areas^{8,9}. The unique feature of nanomaterials lies not only in their size but also in their ability to manipulate and control various properties at the molecular level, including enhanced conductivity, optical characteristics, and reactivity¹⁰.

Nanotechnology emerges as a promising tool for enhancing agricultural potential, ensuring higher yields in an eco-friendly manner even in challenging environments¹¹. Its role extends to the development of genetically improved crops, facilitated by the integration of nanotechnology with genome editing tools like CRISPR/Cas, thereby contributing to effective and economical food production¹². DNA nanotechnology offers a revolutionary approach to plant breeding, allowing for the precise design of artificial nucleic acids with desired target structures through an understanding of complementary base pairing properties¹³.

Nanotechnology has proven instrumental in overcoming challenges related to nutrient deficiencies, population growth, industrialization, water resource depletion, and soil nutrient variations. Nano-based fertilizers enhance nutrient use efficiency, combat soil toxicity, and facilitate efficient spraying, even in aquatic conditions¹⁴.

In conclusion, nanotechnology stands as a beacon of transformative research in agriculture, offering the potential to revolutionize traditional practices and contribute to global food security.

Applications of Agricultural Nanotechnology



Figure 1: Schematic representation of applications of nanotechnology in agriculture.⁶⁹

1. Precision Farming

Precision farming (PF) is defined as a management philosophy rather than a specific prescriptive system, with the goal of identifying critical factors limiting yield due to controllable factors and addressing inherent spatial variability. It entails precise farm management made possible by modern technology, allowing for more precise decision-making. PF detects and maps variations in crop or soil properties within a field, and management actions are constantly adjusted in response to the assessment of spatial variability. Geomatics technology, such as remote sensing (RS), GPS, and geographical information systems (GIS), has aided in the adoption of site-specific management systems. By addressing spatial variability, PF represents a paradigm shift from traditional soil and crop management. It is a refined approach to whole-field management that adjusts decisions to account for variations in resource availability. The precision of farming

(P) is expressed as 1 minus the standard deviation (SD), where $P=1$ indicates a highly homogeneous field, and $P=0$ signifies maximum field variability^{15, 16, 17,18,19}.

By increasing precision in monitoring soil conditions and insect infestations, optimizing resource utilization, and minimizing environmental effects, nanotechnology provides creative solutions to agricultural problems^{20,21}. Furthermore, nanotechnology can aid in the development of crop types that are resistant to stress, allowing farmers to adapt to climate change and ensure long-term food production sustainability. The goal of nanotechnology research in agriculture is to develop farming methods that are more robust, environmentally friendly, and effective. Over one-third of crops in conventional farming are lost due to insect infestation, microbial attacks, natural disasters, poor soil quality, and decreased nutrient availability. Novel technologies are required to solve these problems²². Precision nanotechnology has enabled the agro-technological revolution and sustainable agriculture, which have the potential to change the agricultural system and provide food security. The green revolution assisted in addressing the problem of indiscriminate use of pesticides and chemical fertilizers, which reduced soil biodiversity and created resistance to diseases and pests. Improved biosensors for precision farming could be created by combining nanomaterials, nanoparticles, and nanochips to transport ingredients to plants. Precision agriculture has undergone a transformative revolution with the integration of wireless field networking and nanosensors, providing a sophisticated framework for observing and controlling farming practices⁷¹. This approach extends beyond conventional methods, managing site-specific crops and addressing both pre- and post-harvesting aspects.

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In the realm of precision agriculture, the utilization of functional materials in the construction of nanobiosensors has emerged as a fascinating avenue⁷². These nanobiosensors play a crucial role in accurately analyzing soil parameters such as humidity, water content, nutrient levels, and the presence of phytopathogens (Figure 2). The integration of nanotechnology into biosensors contributes to enhanced precision and real-time monitoring, empowering farmers with critical information for decision-making. One notable application of nanobiosensors is in the development of "electronic noses"⁷³. These sensors are designed to detect odors associated with food spoilage and operate based on the principles of gas sensing. An electronic nose comprises an array of gas sensors, and the gas-sensitive materials, including nanoparticles like ZnO nanowires and nanorods, enable the detection of impurities in vapor mixtures^{74,75,76}. The key mechanism involves changes in the resistance of the gas sensors when exposed to different gases, resulting in distinct electrical signals that serve as a unique fingerprint for gas detection.

A typical biosensor configuration involves four essential units: (1) a sensor, (2) a signal conditioning block, (3) a microprocessor chip, and (4) a radio module for wireless communication between the sensor and the monitoring station⁷⁷. This comprehensive setup ensures seamless data transmission and enables remote monitoring of the agricultural environment. The integration of nanobiosensors into precision agriculture not only enhances the efficiency of monitoring but also contributes to sustainable farming practices. Farmers can receive real-time data on soil conditions, allowing for precise resource management and targeted interventions. As technology continues to advance, the synergistic relationship between precision agriculture and nanobiosensors holds the promise of further innovations, ultimately shaping the future of smart and sustainable farming practices.

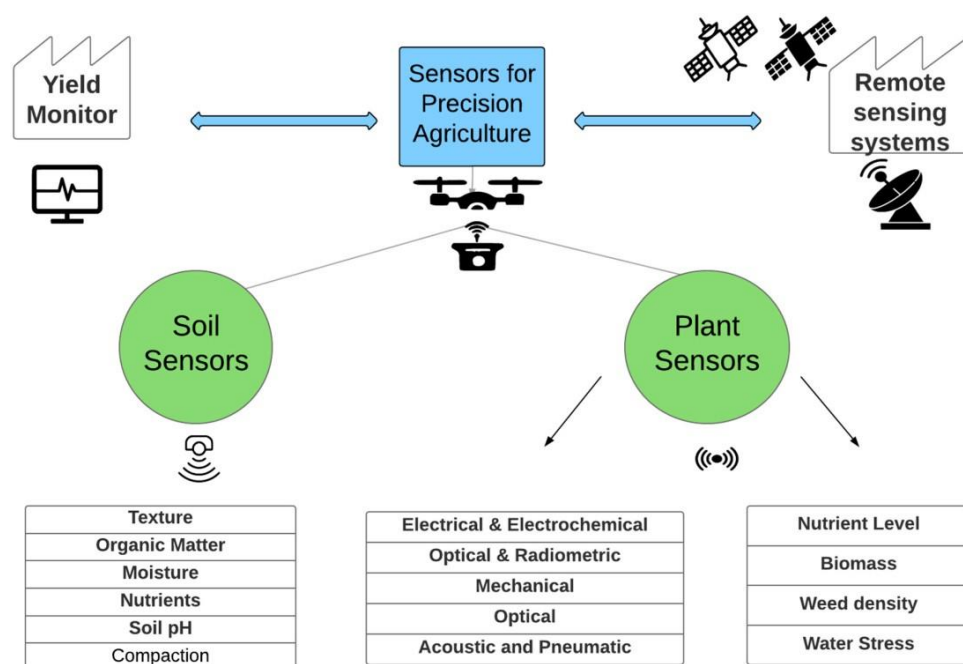


Figure 2: Functional representation of nanosensors in precision agriculture.

2 Nano-Biofertilizers

The conventional use of traditional fertilizers poses challenges such as low nutrient uptake efficiency, rapid chemical transformation, and adverse environmental impacts. Nanofertilizers, designed for gradual nutrient release, offer a promising solution by improving nutrient use efficiency and reducing environmental harm. These nanofertilizers release nutrients slowly over time, ensuring sustained benefits for soil fertility and crop yield without the drawbacks associated with traditional fertilizers^{23,24,25}.

Nanofertilizers play a crucial role in preventing eutrophication, enhancing nutrient use efficiency, and promoting sustainable agriculture. Their controlled release mechanisms help minimize nutrient leaching, groundwater contamination, and environmental pollution. Nanofertilizers, when applied to the soil, undergo aggregation, influencing their mobility and interactions with organic and inorganic soil components^{26,27,28}. The application of nanofertilizers has demonstrated positive effects on plant growth through direct or foliar methods. The organic matter in the soil, environmental conditions, and nanofertilizer properties collectively influence their effectiveness. Additionally, nanofertilizers impact soil microorganisms, contributing to enhanced nutrient use efficiency and overall nutrition management^{29, 30, 31, 32}.

To address food security challenges, the agricultural sector is urged to shift towards alternative fertilizers, such as nanofertilizers, known for their efficiency and eco-friendly characteristics. Various nanomaterials, including silver, gold, zinc oxide, copper, and titanium dioxide, exhibit high receptivity, allowing plants to absorb nutrients effectively^{33, 34, 35}. "Smart fertilizers" with controlled release mechanisms prove preferable over traditional counterparts³⁶.

Efficiency factors for nanofertilizers include intrinsic elements like surface coatings and particle size, as well as extrinsic factors such as soil texture, pH, and organic matter. The absorption of nanofertilizers through roots and leaves significantly influences their behavior, bioavailability, and crop absorption. These advancements highlight the potential of nanofertilizers in revolutionizing nutrient management for sustainable agriculture^{37,38}.

Nanofertilizers play a pivotal role in addressing micronutrient deficiencies in crops, enhancing the nutritional quality of fruits and vegetables. These nanofertilizers, encompassing elements like nitrogen (N), potassium (K), phosphorus (P), zinc (Zn), iron (Fe), copper (Cu), manganese (Mn), molybdenum (Mo), and carbon nanotubes (CNTs), exhibit targeted delivery when applied at specific concentrations for various crops³⁹. The presence of nanoparticles (NPs) in soil, particularly in the form of "Nanosols," with sizes ranging from 1 to 100 nm, introduces unique characteristics like high specific surface area and strong interactions with other soil particles. NPs exhibit resistance to degradation and accumulate gradually in the soil, contributing to their long-lasting impact. The conventional use of urea, herbicides, and pesticides can harm soil fertility and human health when reaching certain concentrations^{40,41}. However, studies suggest that the addition of NPs to the soil can enhance enzymatic activity and stimulate soil nutrient storage. Various types of NPs, including gold, silver, alloy, and magnetic iron oxides such as Fe₃O₄ (magnetite) and Fe₂O₃ (maghemite), offer diverse applications in nanofertilizer development⁴². Nanofertilizers are categorized based on their nutrient content into macronutrient and micronutrient nanofertilizers, while the emerging concept of nanobiofertilizers involves combining nanomaterials with microorganisms, providing an alternative approach in agricultural innovation.

3. Nano-Pesticides

Nanopesticides refer to pesticides formulated in nanomaterials for applications in agriculture. These formulations, employing materials like silica, lipids, polymers, copolymers, ceramics, metals, and carbon, aim to enhance water solubility, bioavailability, and environmental

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stability of agrochemicals⁴³. The use of nanopesticides has the potential to revolutionize pest, weed, and insect control in crops, but their unique properties may also pose challenges such as cytotoxicity and genotoxicity⁴⁴.

The indiscriminate use of traditional pesticides poses risks to ecosystems and human health. Nanopesticides offer a promising alternative but necessitate a comprehensive assessment of their benefits and potential risks. The impact of nanopesticides on the environment, agricultural workers, consumers, and the entire agricultural chain remains partially understood. Nano formulations play a critical role in reducing active ingredient degradation, improving water solubility, and enhancing biological availability to mitigate pest infestations, plant injuries, and economic losses⁴⁵.

Concerns arise from the runoff of nanopesticides into water supplies during precipitation events, affecting water quality and increasing human exposure. Nanoparticles, due to their biomimetic properties and high distribution and bioaccumulation capabilities, may cause toxicological effects in soil, water, food, and various animals, especially mammals. Human susceptibility and exposure time to nanoparticles can lead to acute and chronic health issues, including respiratory, cardiovascular, lymphatic, autoimmune, and neurological problems, as well as an increased risk of certain cancers. The use of nanopesticides requires careful consideration and monitoring to ensure safe and sustainable agricultural practices.^{46,47,48}.

4 Smart Delivery Systems:

The challenges associated with conventional agrochemicals have led to increased scientific research on controlled release systems (CRSs). CRSs are designed to target specific organisms and employ innovative technology to release active ingredients (AIs) slowly and efficiently in plants and soil. This approach aims to reduce the demand for agrochemicals in agriculture, thereby minimizing environmental impact and human exposure while promoting sustainable agriculture. Key advantages of CRSs include efficient and slow AI release, reduced human exposure, and less ecosystem alteration. Additionally, CRSs offer benefits such as durability, low toxicity, and effectiveness, contributing to advancements in sustainable agriculture. Nanoencapsulation of AIs in organic matrices has been shown to enhance stability, dispersibility, and solubility, allowing for the encapsulation of hydrophobic compounds and minimizing applied doses. This controlled release system ensures a gradual dissolution of compounds over time, decreasing environmental AI degradation and increasing the solubility of hydrophilic compounds. Consequently, CRSs contribute to reduced leaching losses, soil

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degradation, phytotoxicity, and agrochemical volatilization.

Nanoagrochemical formulations address environmental challenges, including variations in pH, wind, temperature, rain, and UV radiation, which can hinder the efficacy of conventional agrochemicals. The advantages of nanoagrochemicals extend to higher crop protection, increased nutrient efficiency, and enhanced soil fertility. As a result, nanoagrochemicals are anticipated to outperform conventional counterparts, with an estimated median gain of 20 to 30% in crop production.^{49, 50, 51}

5. Seed enhancement

Recent studies highlight the diverse effects of nanoparticles on seeds and plants^{52,53}. Some nanoparticles exhibit inhibitory effects on germination or phytotoxicity in seedlings, while others act as stimulants, enhancing seed metabolism, seedling vigor, and overall plant growth by influencing cellular signaling pathways⁵⁴. The specific effects depend on the physical-chemical properties of nanoparticles, including size, zeta potential, and concentration, which play crucial roles in determining biological responses^{53,54}. Nanoparticle characteristics also influence their uptake and translocation within plants. Small-sized nanoparticles are more efficient at crossing biological barriers. The surface charge of nanoparticles is a decisive factor; both positively and negatively charged nanoparticles can be taken up by leaves and translocated to the roots, while only negatively charged nanoparticles are taken up by the roots. Positive charges induce mucilage production, preventing uptake by plants.⁵⁵

Nano-priming, a technique applied to seeds, offers various benefits such as seed protection during storage, improved germination, germination synchronization, and enhanced plant growth⁵⁶. Additionally, nano-priming can increase crop resistance to abiotic or biotic stress conditions, potentially reducing the need for pesticides and fertilizers. Studies indicate that seed nano-priming activates different genes related to plant stress resistance during germination. This emerging area of research shows promising results for seed protection, as certain nanoparticles possess antimicrobial activities and can load antimicrobial agents. Nano-priming also holds potential for seed biofortification, contributing to increased food quality and production⁵⁷.

6. Soil remediation

Nanoremediation, a relatively new application of nanotechnology, is gaining traction in the fight against environmental pollution. Zero-valent iron (ZVI) nanoparticles were initially proposed as a permeability barrier for decontaminating water-halogenated contaminants and

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have been used to treat hazardous waste^{58,59,60}. Researchers have looked into using nanomaterials to remediate pollutants such as organic halocarbons, nitrates, heavy metals (HMs), pesticides, and dyes^{62,63}. Nanoparticles have been shown in studies to adsorb pollutants and aid in their degradation via processes such as redox reactions, surface reactions, ion exchange, surface complexation, electrostatic contact, and adsorption.

Nanoparticles, particularly ZVI nanoparticles, have been investigated for their effectiveness in removing contaminants from soil and water. The use of carrier materials like bentonite has been explored to enhance the efficiency of ZVI nanoparticles, reducing aggregation and improving the active surface area⁶⁴. Zero-valent iron nanoparticles trapped in silica microspheres have demonstrated the ability to decompose environmental pollutants like polybrominated diphenyl ethers⁶⁵.

Studies on nanoremediation have covered a range of contaminants, including chlorinated organic compounds, insecticides, phenols and amines, organic acids, and more. Nanoremediation has shown promise in degrading contaminants in both water and soil environments. The injection of nanoparticles into the soil has demonstrated effectiveness for up to 56 days, with significant removal of pollutants like trichloroethene (TCE)^{67,68}.

Nanoencapsulation of active ingredients based on organic matrices has been explored for controlled release systems (CRSs) in agriculture. These nanoagrochemicals offer benefits such as increased stability, dispersibility, solubility, and reduced environmental degradation of active ingredients. Nanoagrochemicals have the potential to significantly improve crop protection, increase nutrient efficiency, and enhance soil fertility.

Conclusion:

Agricultural nanotechnology emerges as a transformative force, revolutionizing traditional farming practices. From precision farming to nano-biofertilizers, smart delivery systems, and soil remediation, nanotechnology offers innovative solutions for sustainable agriculture. As global challenges escalate, embracing nanotechnology in agriculture holds the promise of ensuring food security, environmental sustainability, and resilience in the face of evolving agricultural needs. The ongoing research and application of nanotechnology in agriculture mark a paradigm shift towards a more efficient, eco-friendly, and sustainable future for global agriculture.

Conflict of Interests

The authors have not declared any conflict of interests.

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ARTICLE-29

Microbes in E-waste Removal

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Abstract

The area of information technology and communication is constantly evolving due to scientific research and development. The production of new electrical and electronic equipment also thus uplifting in this era of revolution. These technological advancements certainly have problematic consequences which is the rise of huge amounts of electronic waste (e-waste). Improper management of both hazardous and non-hazardous substances of e-waste led to a major concern in our digital society and environment. Therefore, a sustainable approach including microbial candidates to tackle e-waste is the need of the hour. As microbes are omnipresent and diverse in their physiology and functional aspects, they offer a wide range of bioremediation. The microbe produces an enzyme that converts glycine to hydrogen cyanide, and the cyanide ions in liquid solution bind to gold atoms, grabbing them from solid electronic scrap. several microorganisms including bacteria and fungi have been reported for recovery of base (Cu, Fe, Ni, Pb, Zn) and precious metals (Ag, Au, Co, Pd, Pt) from e-waste. Genetic engineering of the right traits of organisms could help more efficiently. And some scientists are already confident enough in the approach to commercialize it.

Keywords: Microbes, enzymes, bioremediation, e-waste, genetic engineering

ARTICLE-30

Role of Bioinformatics in the field of medicine

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Introduction

The study of gathering and evaluating intricate biological information, including genetic codes. A branch of science known as bioinformatics, which is connected to genetics and genomics, collects, stores, analyses, and disseminates biological data and information, such as DNA and amino acid sequences or annotations about those sequences.

As a result of the fusion of biology and information technology, bioinformatics is a new area of biological study. Information technology is used in this diverse field to understand biological data using a variety of computational and analytical tools. It combines a number of disciplines, including computer science, math, statistics, biology, and chemistry. The field of bioinformatics focuses on creating new hardware and software for use in biotechnology, biological research, and medical applications. The following are the main uses and applications of bioinformatics: To understand the function of genes

- Cell organizations and function
- Analysis of drug targets
- Examine the characteristics of various diseases

USE OF BIOINFORMATICS

The basic purpose of bioinformatics is to extract knowledge from biological data through the use of algorithms and software. The study of genomics, proteomics, 3D structural modelling of proteins, image analysis, interior design, and many more fields make extensive

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use of bioinformatics.

The bioinformatics covers many specialized and advanced areas of biology. Such areas are:

- Functional Genomics
- Structural Genomics
- Comparative Genomics
- DNA Microarrays and
- Medical Informatics.

The basic purpose of bioinformatics is to extract knowledge from biological data through the use of algorithms and software. The study of genomics, proteomics, 3D structural modelling of proteins, image analysis, interior design, and many more fields make extensive use of bioinformatics.

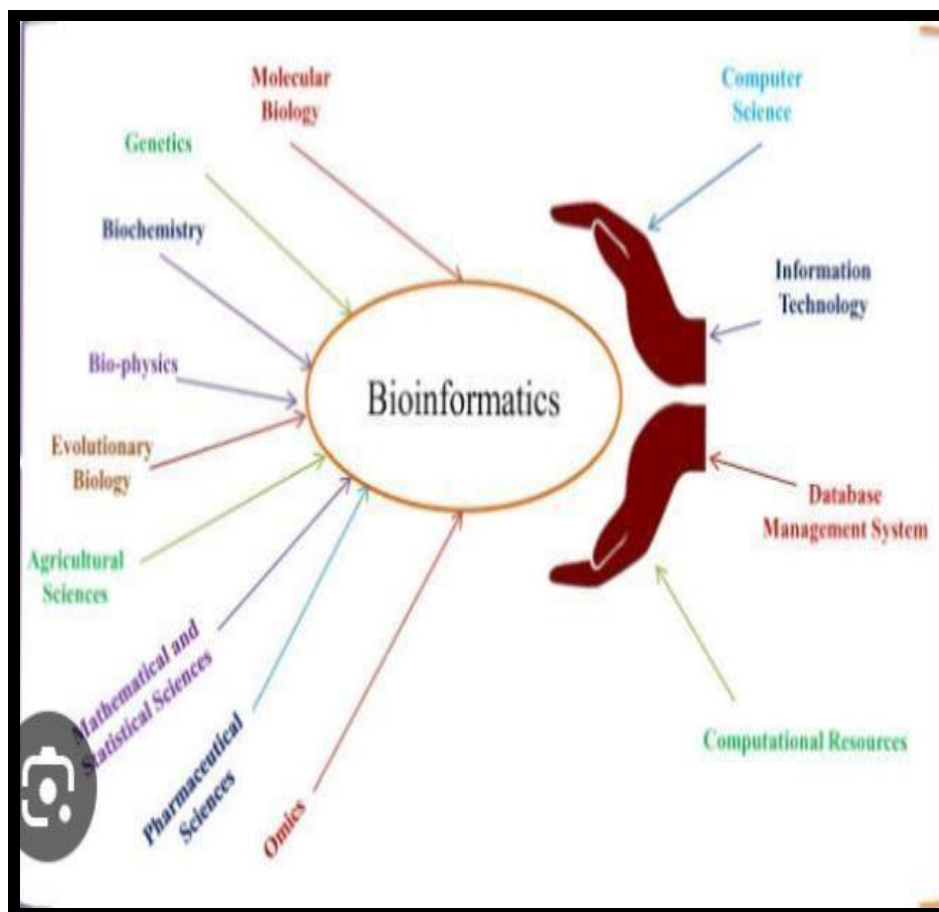


Fig – 1 Various uses of Bioinformatics

However, the current objectives of bioinformatics are integrative and focused on figuring out how different forms of data can be used to understand natural phenomena, such as diseases and organisms.



Fig -2 Different View on Bioinformatics

Scope of Bioinformatics;

The main scope of Bioinformatics is to fetch all the relevant data and process it into useful information. It also deals with

- ❖ Wide-ranging biological data management and analysis;

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- ❖ Particularly useful for handling massive data volumes in human genome sequencing.
- ❖ The study and advancement of the biomedical area rely heavily on bioinformatics.
- ❖ Applications of computational coding in bioinformatics include determining the sequences and functions of genes and proteins, creating evolutionary links, and examining the three-dimensional protein structures. Bioinformatics is the sole foundation for research on genetic and microbiological disease, where the data generated can be crucial for creating individualized medications.

What is Bioinformatics and How it is Used in Medicine?

- ❖ Bioinformatics is an interdisciplinary area of the biological sciences that integrates biology and IT. The analysis of molecular sequences and genomics data is one of its applications.
- ❖ The goal of bioinformatics, which combines several life science disciplines, is to provide methodology and tools for studying massive amounts of biological data in order to organise, store, systematise, visualise, annotate, query, comprehend, and interpret that data. Modern computer science is used in bioinformatics, including molecular modeling/algorithms, cloud computing, statistics, mathematics, and even pattern recognition, reconstruction, machine learning, simulation, and iterative techniques.

In simpler terms, bioinformatics involves the application of computer technology to manage large volumes of biological information.

Applications of bioinformatics in medicine

Bioinformatics has proven quite useful in medicine as the complete sequencing of the human genome has helped to unlock the genetic contribution for many diseases. Its applications include drug discovery, personalized medicine, preventative medicine and gene therapy.

Bioinformatics is being applied in the realm of healthcare to create new and improved treatments for diseases. Scientists can determine which genes are linked to a particular disease, for instance, by analysing the genomes of various patients with the disease.

Bioinformatics can frequently detect diseases before they even start to show signs by analysing a person's DNA. This enables early treatment, which is frequently more efficient. More and

more, personalised medicine is being developed using bioinformatics.

The study of transcriptomic data for disease-disease relationships, meta-analyses of genomic data and diseases, the discovery of redundant molecular pathways, and the compilation of microarray data sets are a few of the various bioinformatics techniques that have been employed for this purpose.

Tools for bioinformatics are widely used to categorise, classify, and type every type of pathogen. The widespread use of genomic approaches to the diagnosis and treatment of viral, bacterial, and fungal illnesses led to this.

The science of information as applied to or researched within the setting of biomedicine is known as biomedical information science. By defining information science's goal of study as data plus meaning, the area is clearly separated from related disciplines like computer science, statistics, and biology, each of which has a different object of study.

According to Kaikabo and Kalshingi (2007), bioinformatics tools are used to generate data for research, mining, retrieval, and analyses of biological data, predict and identify proteins in a sequence to produce and create vaccines, and have laboratory applications.

To maximise the therapeutic value of drugs, bioinformatics is utilised in the identification and validation of drug targets as well as in the creation of biomarkers, toxicogenomic, and pharmacogenomic techniques.

It is an interdisciplinary field that encompasses biology, math, physics, and computational science. The handling of data in modern biology and medicine requires the use of bioinformatics.

1. Drug discovery

At the moment, infectious diseases constitute the leading cause of death for children and young people worldwide. Over 13 million fatalities each year are attributed to infectious diseases, according to the WHO. The majority of infectious illness mortality occur in developing nations, and this is mostly due to the lack of access to affordable medications and the high price of those that are available. The development of affordable and effective medications for a disease is one of the major issues that can be resolved by rational drug design employing bioinformatics.

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A logical and structure-based approach to medication design has replaced the trial-and-error method of drug discovery in the pharmaceutical business. The time and expense required to generate efficient pharmacological agents can be decreased using an effective and dependable drug design approach.

On the basis of molecular modelling and simulation, the processes of drug target discovery and drug candidate screening can be hastened and safer/more effective medications can be developed.

2. Personalized medicine

Personalised medicine is a type of healthcare that is created specifically for each individual based on their genetic makeup.

A patient's genetic makeup can help the doctor forecast a patient's propensity for developing a particular condition and help him or her choose the right drug and dosage to minimise side effects. It is used in the treatment of HIV, diabetes-related diseases, and personalised cancer medication.

In personalised medicine, bioinformatics is used to examine data from genome sequencing or microarray gene expression studies in search of mutations or gene variants that could change a patient's prognosis for their disease or impact how they respond to a particular therapy.

3. Preventive medicine

The focus of preventive medicine is on the wellbeing of specific populations, communities, and individuals. To comprehend the patterns and causes of health and disease, it employs a variety of research techniques, such as biostatistics, bioinformatics, and epidemiology. This knowledge is then transformed into programmes that aim to avoid illness, disability, and death.

Screening babies for diseases like genetic problems or metabolic disorders that are curable but not clinically obvious in the newborn period is an example of preventative medicine.

Researchers examine genomes, proteomics, and metabolomics data for potential disease biomarkers using bioinformatic methods in order to develop such screening tests to detect the disease at an early stage.

4. Gene therapy

The process of replacing dysfunctional genes in the patient's cells with healthy ones is known as gene therapy. Because each person's genetic profile is unique and creating a general gene treatment procedure is highly challenging, gene therapy has not been extensively adopted.

By taking into account each person's genetic profile; bioinformatics may be able to determine the ideal gene target site for them. This can lessen the possibility of unwanted side effects.

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ARTICLE-31

IMPACT OF ROCK PHOSPHATE AMENDED BIOGAS SLURRY AND PHOSPHATE SOLUBILIZING MICROORGANISMS ON CHILLY PLANT GROWTH

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Abstract

The chilly plants used in this experiment were treated with biologically digested manure from a biogas plant together with Phosphate Solubilizing Microorganisms (PSM) and Rock Phosphate (RP) in four treatments with a control (T0, T1, T2, T3, and T4). For the purpose of identifying phenotypic traits such root length, shoot length, total height, wet weight, dry weight, chlorophyll content, and yield, samples were taken during the seedling, pre-flowering, blooming, and terminal stages of the plant. In comparison to the non-enriched slurry, the slurry

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enriched with rock phosphate (RP) and phosphate solubilizing microorganisms (PSMs) promoted the aforementioned phenotypic features and good yield. The combination of PDS+PSM+RP (T4) produced the best results among the enriched manures (6.314 tons/hectare), followed by CDS+PSM+RP (T2) (5.280 tons/hectare), PSM+RP (5.010 tons/hectare) (T3), inorganic manure (3.454 t/hectare) (T1), and control (1.821 tons/hectare) (T0). The NPK consumption is more in final stage when compare to other stages. The fields that had biologically digested fertilizer had more microbial development than they did before application, according to a study of the microbiome.

Keywords: Biodigester slurry, PSM, RP

INTRODUCTION

According to Goroji *et al.*, (2008) and Jiaqi Chen *et al.*, (2021), phosphorus is one of the crucial nutrients that affect plant growth and metabolism. It is also one of the necessary macronutrients required for healthy plant growth. Phosphorus, which is regarded as the limiting plant nutrient component in soil, is essential for the balanced feeding of plants. A pool of insoluble phosphate eventually accumulates in the soil as a result of the chemical and microbial conversion of a large portion of the soil's accessible phosphate (Vora and Shelat 2015).

Phosphate solubilizing microorganisms are found at a much higher concentration in the Rhizosphere. A variety of microorganisms are known to solubilize phosphates, including but not limited to bacteria (Bhagyaraj, 2000) and fungi (Rudresh, 2004). Some soil bacteria (genera) are the most effective phosphate solubilizes and are able to convert insoluble phosphate forms in the soil to soluble forms by secreting organic acids (Formic, Acetic, Propionic, Lactic, Glycolic, Fumaric, Succinic acids). These acids lower pH and dissolve bound phosphate forms (Rudresh, 2004).

To this end, an experiment was conducted to evaluate the bioavailability of PSM, biodigested slurry with RP in Chilly plants in order to determine the growth, nutrient, and microbial burden of the experiment plant.

MATERIALS AND METHODS

Isolation of PSM from soil

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One gram of rice field rhizospheric soil was weighed using an electronic balance, then dissolved in 100 ml of distilled water, which was diluted to a maximum of 10^8 dilutions. Each dilution was then poured into sterile Petri plates, which were then supplemented with approximately 15 ml of hydroxy apatite agar Medium. The Petri plates were rotated in order to distribute evenly, and the plates were allowed to harden. Subsequently, the plates were placed in a 37°C environment for a period of 7 to 14 days, during which the colonies were incubated in a manner that indicated that the phosphate source had been, utilized (Kannan 1996).

Preparation of HAM media

One kilogram of rhizosphere soil was combined with two liters of distilled water. It was sterilized with steam for an hour before being filtered through rough filter paper. The pH of the filtrate was lowered to 6.5 with the use of either acid or alkali. The soil extract was applied to further procedures.

The soil extract was divided into 100 ml aliquots and each was given one gram of filter-sterilized glucose. Five milliliters of 10% calcium chloride and 2.5 milliliters of 10% di potassium hydrogen phosphate were added to the previously sterilized mixture while it was sterile. Hydroxy apatite has now finely precipitated in the media. To create a solid medium, 2 g of agar was then added to the soil extract. Phosphate enrichment was accomplished using the phosphate solubilizing organisms that were isolated from the rhizosphere soil and grown in the medium HAM for at least two weeks.

Cultivation in mass level

To harvest and provide PSMs to the experimental fields, PSMs must be grown in artificial media. For this, cultures were grown in 20 ml of HAM broth with a 1% inoculum concentration. This was kept at $26 - 20^\circ\text{C}$ for seven days. Before being aseptically transferred to 300 ml of sterile media in a 500 ml Erlenmeyer flask, the cultures underwent purity checks.

The cultures were then incubated on a revolving shaker for 7 days at 26°C to 20°C . They were then placed in Erlenmeyer flasks of a 2-liter capacity that had 1000 ml of HAM. Once it achieved the required concentration (not less than $10^8/10^9$ cells/ml), PSM was combined with the finely powdered and sieved biogas slurries that contained rock phosphate

(RP). These additives were applied in the experimental field to see if the growth of the chilly plants might be enhanced.

Enrichment of Biodigested slurry

The biodigested slurries were processed and utilized in two different ways after being converted to biogas. One set was used as is for use as bio fertilizers in the field, and the other was improved with rock phosphate and phosphate solubilizing organisms. Enrichment of biodigested slurry using RP as phosphate source was carried out in a trench measuring 170x145x40cm. 500g of RP and 1 liter of PSO, both isolated from rhizosphere soil, were added to nutritious broth. A second coat was applied once the first had dried. The pit's contents were exposed to bacterial development for a period of 21 days. This experiment was carried out in the open on a private farm in the Sankaran kovil neighbourhood using an RBD (Randomised Block Design).

Analytical Approach

Prior to adding the enriched and non-enriched biodigested organic amendments, the initial soil nitrogen, phosphorus, and potassium were measured using the Microkjeldhal methods of Jackson (1958), Fiske and Subbarow (1925), and the flame photometric method specified in APHA, respectively. The same measurement was made at every stage of plant growth and production. Using the full drying process outlined in APHA (1975), the dry weight of the plant samples was calculated. All field experiments' chlorophyll content was calculated using Aneja's (1996) methodology.

Laboratory Design

After applying enriched and non-enriched biodigested organic amendments in the field (Table 1), chilly plant seedlings that were 20 to 25 days old were collected and replanted.

Table 1. Different treatments for experimental fields

Treatment	Nature of the treatment
T0	CONTROL
T1	INORGANIC AMENDMENT
T2	PSM+RP
T3	CDS+PSM+RP

T4	PDS+PSM+RP
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Five locations in each experimental plot were selected using a multistage sampling strategy. The sample units were randomly selected using the systemic random sampling technique. Samples were taken during the seedling (Figure 1-3), preflowering, flowering, and final stages in order to assess morphological traits such root length, shoot length, total height, wet weight, dry weight, and chlorophyll content. The chilies in each treatment plot were periodically collected, weighed, and recorded. The cumulative yield from each plot was expressed in tons per hectare for comparison between various treatments.

RESULTS AND DISCUSSION

INFLUENCE OF BIO-DIGESTED MANURIAL SOURCES AT THE PRE-FLOWERING STAGE

When compared to other biologically digested organic fertilizers, plants grown in the field with PDS+PSM+RP as a biologically digested organic fertilizer had higher preflowering root length, branch length, total height, wet weight, dry weight, and chlorophyll content (Figure 1).

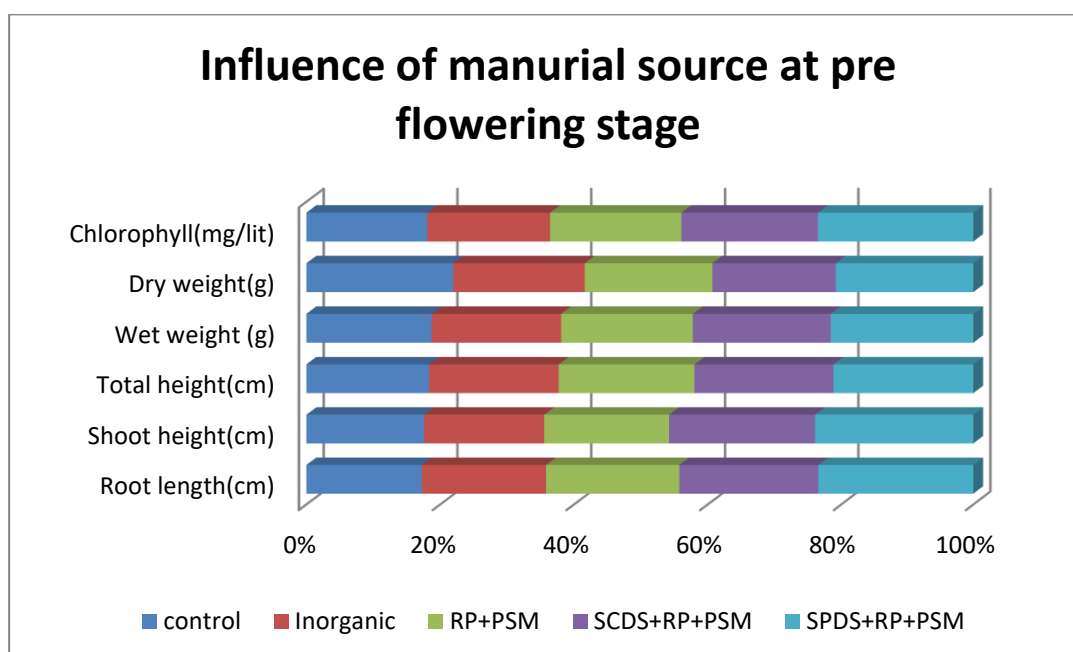


Figure 1. Influence of manurial sources on the morphological parameters and chlorophyll content of Chilly grown at the pre-flowering stage

INFLUENCE OF MANURIAL SOURCES AT THE FLOWERING STAGE

In pots treated with PDS+PSM+RP, the peak wet weight (8.1710.17g), dry weight (8.30.62g), and chlorophyll content (22.40.20/liter) were measured at the flowering stage. The SPDS+PSM+RP treated fields also had the longest shoot length (33.20.45cm), overall height (44.81.47cm), and longest root length (10.10.12cm) (Figure 2).

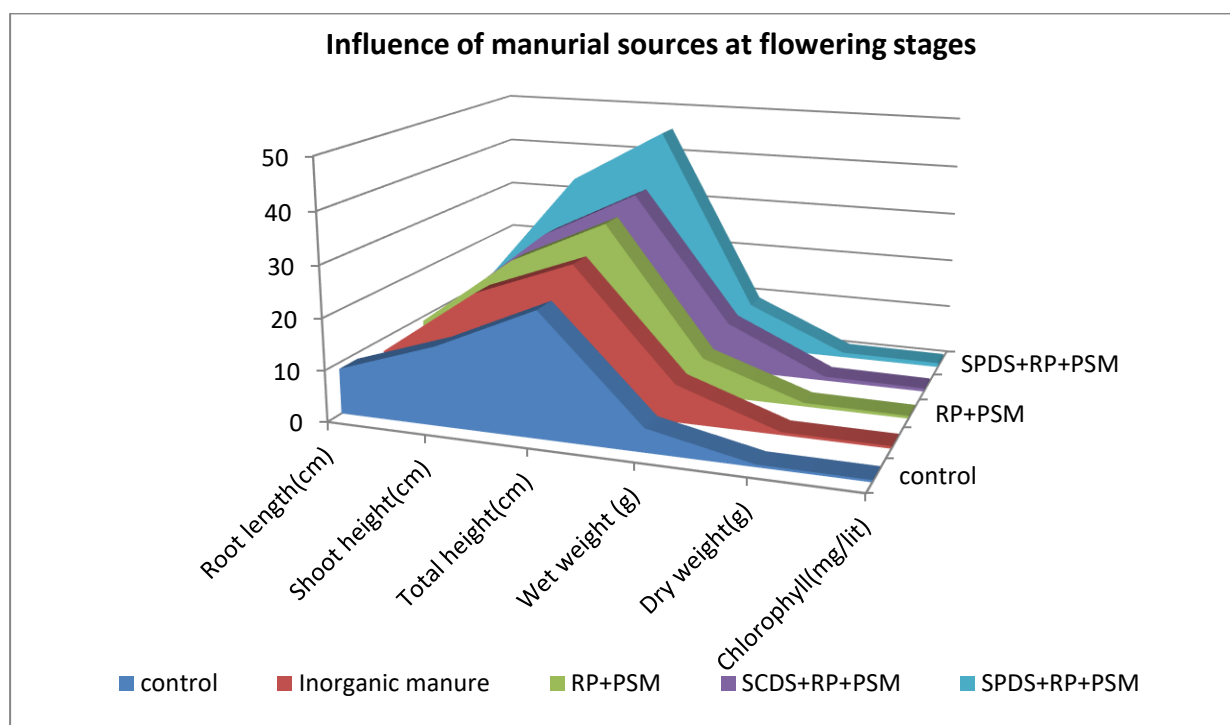


Figure 2. Influence of manurial sources on the morphological parameters and chlorophyll content of chilly grown at the flowering stage.

INFLUENCE OF MANURIAL SOURCES AT THE FINAL STAGE

The plants in the plots treated with SPDS+PSM+RP had the longest shoot length (39.90.75), the longest root length (12.41.17cm), the highest wet weight (0.9610.16g) and dry weight (0.7630.18), and the highest overall height (52.20.45cm).

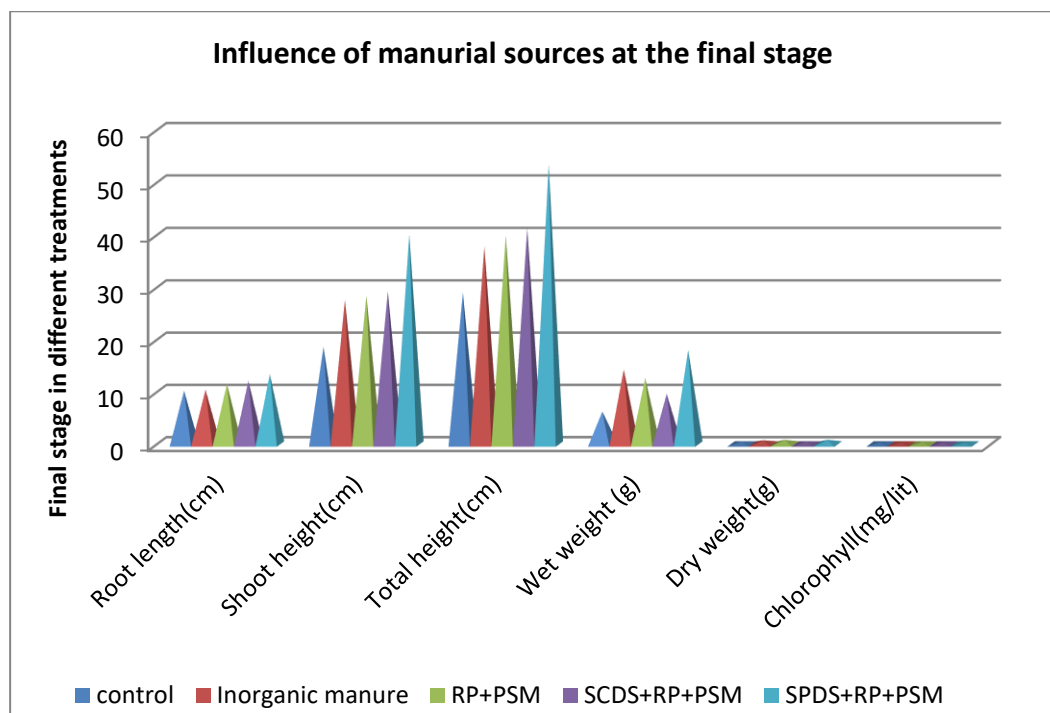


Figure 3. Influence of manurial sources at the final stage

Effect of manurial sources on the NPK content grown at different stages of growth

Due to the use of these nutrients to boost the output of the product, the NPK content of chilly plants also increased from the seedling stage to the blooming stage and decreased in the final stage of its growth.

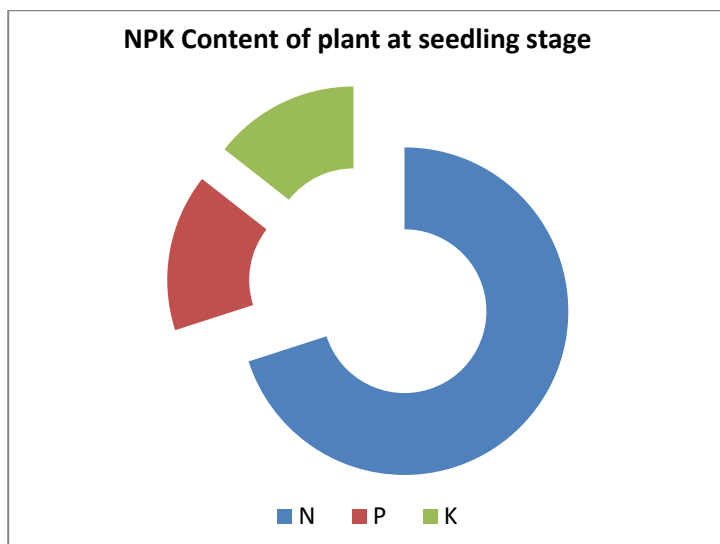


Figure 4. Effect of biodigested manurial sources on the NPK content of plant at seedling stage

Table 2. Effect of manurial sources on the NPK content
at different stages of growth.

Manurial sources	Pre-flowering (%)			Flowering (%)			Final (%)		
	N	P	K	N	P	K	N	P	K
T0	2.126±0.018	0.180±0.002	0.32±0.010	2.760±0.029	0.32±0.010	0.30±0.020	2.4±0.100	0.28±0.026	0.28±0.010
T1	1.898±0.026	0.174±0.004	0.32±0.017	2.868±0.048	0.38±0.010	0.28±0.017	1.8±0.100	0.26±0.017	0.26±0.906
T2	2.126±0.009	0.178±0.005	0.28±0.010	3.000±0.065	0.40±0.026	0.28±0.026	2.8±0.264	0.38±0.026	0.22±0.026
T3	2.26±0.013	0.168±0.007	0.34±0.017	2.768±0.017	0.39±0.020	0.29±0.017	1.9±0.173	0.28±0.017	0.24±0.017
T4	2.826±0.037	0.192±0.004	0.38±0.017	3.845±0.014	0.48±0.017	0.32±0.010	2.8±0.100	0.39±0.010	0.28±0.020

Values in Mean±Standard Deviation

Effect of biologically digested manure on chilly yield

The enriched rock phosphate, phosphate solubilizing organisms, and biodigested chicken manure had the highest cumulative yield of chilly (6.314 tons/hectare), followed by SCDS+ PSO+RP (5.280 tons/hectare), PSO+RP (5.016 tons/hectare), inorganic manure (3.454 tons/hectare), and control (1.128 tons/hectare) (Figure 5).

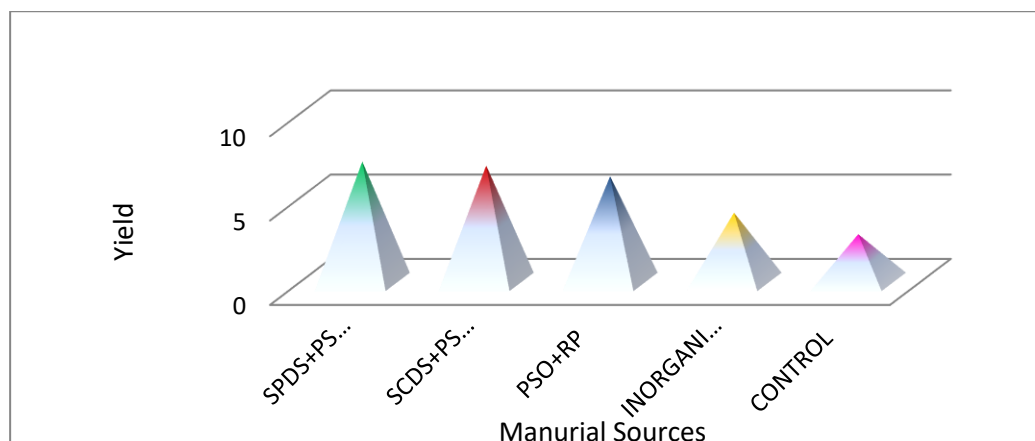


Figure 5. BIODIGESTED MANURIAL SOURCES ON THE YIELD OF CHILLIES
(TONES/HECTARE)

In comparison to the *digestate* used without enrichment, the digestate from the biogas plant that had been enriched with rock phosphate and phosphate-solubilizing organisms provided superior yields.

In order to boost crop output, alternative sources of fertilizers have been taken into account due to the dramatic rise in the price of chemical fertilizers and the associated health risks (Logakanthi *et al.* 2006). The plants inoculated with PDS and PSM together with rock phosphate (T4) and T3 had the highest germination percentages (71.3 and 68.9, respectively), according to Figure 5. T2 (62.6%) and T1 (41%), on the other hand, had the lowest germination percentages. The control group had the lowest yield (28.2%).

The outcomes of the current investigation were also improved by manure enhanced with rock phosphate and phosphate solubilizing microbes (RP+PSM). According to Al Masri (2001), enhanced root growth and nodulation as a result of P fertilization led to an increase in nitrogen fixation in legumes. As PSM and RP were added to slurry in T4, the shoot length increased significantly as compared to the control. With plant age, shoot and root fresh and dry weights rose, with treatment T4 having the greatest values. The other therapies had little in common with this one. Figure 4 explains the NPK content at the seedling stage, and Table 2 shows how useful NPK is at every stage of growth. Because bacteria can produce plant growth hormones, Aziz *et al.*, (2000) hypothesised that bacteria may affect plant development. These compounds may have an impact on a plant's early stages of development. Phosphate ions chemically produced from RP may be directly absorbed by the plant with more thorough soil exploration (Bronson *et al.*, 1997).

According to Masse *et al.* (2004), and Kumar (2004), the application of RP in addition to PSO increased the amount of P that was readily available to plants. In contrast to plants inoculated with RP alone, Figure 1-3 demonstrates that plants inoculated with slurry, PSM, and RP had increased NPK content in the shoots and roots of Chilly. According to Algwadi and Gaur (1988), nutrient uptake differs according on the cultivar, soil type, cultural practices, and fertilizers used.

Conclusion

The value of bio slurry as fertilizer is fairly high because the nutrients are available in a form that is easily absorbed. The bio slurry's nutritional content may vary depending on the type of dung used. On the other hand, biological agents like Phosphate Solubilizing Microorganism and Rock Phosphate could be used in place of chemical fertilizers to increase productivity and reduce environmental pollution in agroforestry production. They can be used

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for many different things. In light of this, it can be said that organic manure, such as PDS with PSM and RP, may be useful in enhancing and stabilizing cultivable land. Additionally, it improves soil's physical characteristics, organic content, and ease of phosphorus availability to plants. It also considerably raises chilling yield while cutting on-farm costs.

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