

Conference Proceeding

# NATIONAL CONFERENCE

ON

EMERGING FRONTIERS IN BIOTECHNOLOGY AND  
LIFE SCIENCES FOR SUSTAINABLE DEVELOPMENT

# 2026

20<sup>th</sup> - 21<sup>st</sup>  
February



## NCEFBLS - 2026



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# **NCEFBLSD - 2026**

**Proceedings of National Conference on Emerging Frontiers in Biotechnology and Life Sciences for Sustainable Development '26**

(20th & 21st February, 2026) Organized by SET Science College & PG Centre  
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## **First Published: 2026**

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Proceedings of National Conference on **Emerging Frontiers in Biotechnology and Life Sciences for Sustainable Development - 2026**.

## **ISBN: 978-93-5626-049-8**

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## **Typeset by:**

SET Science College & PG Centre,  
Bhakta Kavi Narsinh Mehta University,  
Junagadh – 362001 (Gujarat), India

## **Printed in India:**

SET Science College & PG Centre,  
Bhakta Kavi Narsinh Mehta University,  
Junagadh – 362001 (Gujarat), India



## Dr. (Prof.) Pratapsinh Chauhan

Vice Chancellor

Bhakta Kavi Narsinh Mehta University,  
Junagadh, Gujarat



### Message from the Vice-Chancellor

It gives me immense pleasure to note that S.E.T. Science College, Junagadh, an affiliated institution of Bhakta Kavi Narsinh Mehta University, is organizing the National Conference on “Emerging Frontiers in Biotechnology and Life Sciences for Sustainable Development” on 20–21 February 2026.

Over the past one decade, India has achieved remarkable progress in science, technology, and innovation, strengthening its position as a knowledge-driven economy. Scientific research has increasingly become a cornerstone of national development, contributing not only to societal well-being but also to economic growth, global competitiveness, and technological self-reliance. The vision of Viksit Bharat places science and innovation at the heart of India’s developmental journey.

The present generation of students and young researchers—particularly Generation Z—stands at a unique crossroads, where access to technology, interdisciplinary learning, and global scientific networks offers unprecedented opportunities. Biological sciences today provide a dynamic platform for Gen Z to combine creativity, scientific rigor, and social responsibility, transforming research outcomes into solutions that support India’s emerging bioeconomy. I urge students, researchers, and scientists to view scientific research not only as an academic endeavor but as a vital contributor to the nation’s economic progress, innovation ecosystem, and sustainable future. Conferences such as this encourage critical thinking, collaboration, and the confidence to pursue ambitious scientific goals aligned with national and global needs.

I congratulate the organizing committee for this timely and meaningful initiative and extend my best wishes for the successful conduct of the conference. I am confident that this academic gathering will inspire young minds to contribute actively to scientific excellence, economic development, and the realization of a scientifically empowered and developed India.

**Prof. Pratapsinh Chauhan**

Vice-Chancellor  
Bhakta Kavi Narsinh Mehta University  
Junagadh

**Shri Natubhai Ranmalbhai Bhatu**  
**President,**  
**Shri Saurashtra Education Trust, Junagadh**  
**Founder & Chairman,**  
**Pramukh Group, Surat**



### President's Message

Dear Delegates,

It gives me immense pleasure to extend my warm greetings on the occasion of the **National Conference on "Emerging Frontiers of Biotechnology & Life Sciences for Sustainable Development"**, organized by SET Science College & PG Centre, Junagadh on 20<sup>th</sup> and 21<sup>st</sup> February 2026.

Biotechnology and life sciences are playing a transformative role in addressing global challenges related to health, agriculture, environment, and sustainability. Platforms such as this national conference are vital for bringing together academicians, researchers, scientists, and students to exchange ideas, share innovations, and explore emerging research trends that contribute to sustainable development.

I sincerely appreciate the efforts of the organizing committee, faculty members, and students for taking the initiative to organize such a meaningful academic event. I am confident that the deliberations, research presentations, and interactions during this conference will inspire young researchers and strengthen scientific collaboration.

I wish the conference a great success and hope that it will significantly contribute to the advancement of knowledge and research in biotechnology and life sciences.

With best wishes to all participants.

**Shri Natubhai Ranmalbhai Bhatu**

**ભગવાનભાઈ ધાનાભાઈ બારડ**  
ધારાસભ્ય, ૯૧-તાલાલા વિધાનસભા  
મોબાઈલ : ૯૮૨૫૨ ૨૦૨૩૩



**Bhagvanbhai D. Barad**  
M.L.A., 91-Talala Assembly  
Mobile : 98252 20233



Dear Participants,

I am delighted to convey my best wishes to **SET Science College & PG Centre, Junagadh** for organizing the **National Conference on “Emerging Frontiers of Biotechnology & Life Sciences for Sustainable Development”** on 20–21 February 2026.

In today’s rapidly evolving scientific world, biotechnology and life sciences have become key drivers for sustainable solutions in healthcare, agriculture, industry, and environmental conservation. This conference provides an excellent platform for researchers, academicians, and students to present their research, exchange innovative ideas, and discuss recent advancements in these vital fields.

Such academic gatherings play a crucial role in nurturing scientific temper, encouraging interdisciplinary research, and motivating young minds to pursue excellence in research and innovation. I commend the dedicated efforts of the organizing committee and faculty members for their commitment to academic excellence and knowledge dissemination.

I am confident that this conference will be intellectually enriching and will foster meaningful collaborations among participants from various institutions.

I wish the conference grand success and extend my best wishes to all delegates and contributors.

**Shri Bhagvanbhai Dhanabhai Barad**

## **Prof. Suhas Vyas**

Dean, Faculty of Life Sciences  
Bhakta Kavi Narsinh Mehta University  
Junagadh



### **Message from the Dean, Faculty of Life Sciences**

It is a matter of great pride and academic enthusiasm that S.E.T. Science College, Junagadh, is organizing the National Conference on “Emerging Frontiers in Biotechnology and Life Sciences for Sustainable Development” during 20–21 February 2026, under the aegis of Bhakta Kavi Narsinh Mehta University.

During the past one decade, India has made substantial progress in the field of life sciences, supported by strong research infrastructure, expanding innovation ecosystems, and increasing integration of science with societal and industrial needs. Research and development in biological sciences have emerged not only as engines of knowledge creation but also as powerful pathways toward entrepreneurship, innovation, and employment generation. Today, life sciences offer immense entrepreneurial opportunities in areas such as biotechnology-based solutions, healthcare innovation, agriculture and food systems, bio-based industries, environmental management, and sustainable technologies. Translational research, startup incubation, intellectual property generation, and industry–academia collaboration have transformed the biological sciences into a dynamic sector capable of driving economic growth alongside societal well-being.

I encourage students, research scholars, and young scientists to embrace research and development as a foundation for innovation and entrepreneurship, and to develop scientific ideas that can evolve into sustainable enterprises. Academic forums like this conference play a vital role in nurturing scientific curiosity, encouraging problem-solving, and inspiring researchers to move from laboratories to real-world applications. I commend the organizing committee for their dedicated efforts and wish the conference a grand success. I am confident that the interactions and scientific contributions presented in this abstract volume will motivate participants to pursue excellence in research and to explore entrepreneurial pathways in the life sciences for the benefit of society and the nation.

**Prof. Suhas Vyas**  
Dean, Faculty of Life Sciences  
Bhakta Kavi Narsinh Mehta University  
Junagadh

## Shri Laxmanbhai Pithiya

Managing Trustee,  
Shri Saurashtra Education Trust,  
Junagadh



### Managing Trustee's Message

It is a matter of great pride and satisfaction for me to be associated with the **National Conference on “Emerging Frontiers of Biotechnology & Life Sciences for Sustainable Development”**, organized by **SET Science College & PG Centre, Junagadh** on **20th and 21st February 2026**.

The theme of the conference is highly relevant in the present context, as scientific research in biotechnology and life sciences holds the key to achieving sustainable development goals. This conference offers a valuable opportunity for scholars, researchers, and students to showcase their research work, learn from experts, and engage in meaningful academic discussions.

I appreciate the sincere efforts of the organizing team for planning and executing this national-level academic event. Such initiatives not only enhance the research culture of the institution but also contribute to the overall development of society through scientific advancement.

I am confident that the outcomes of this conference will inspire future research and innovation. I extend my best wishes for the successful conduct of the conference and congratulate all participants.

શ્રી લક્ષ્મણભાઈ પિઠિયા

**Shri Laxmanbhai Pithiya**

## Dr. Hardik Bhatt

Principal,  
SET Mahila Arts, Commerce, BBA,  
BCA & Science College, Junagadh



It is with great pleasure that I extend my heartfelt greetings on the occasion of the **National Conference on “Emerging Frontiers of Biotechnology & Life Sciences for Sustainable Development”**, organized by **SET Science College & PG Centre, Junagadh** on **20th and 21st February 2026**.

In the present era, biotechnology and life sciences have emerged as powerful tools for addressing critical challenges related to sustainable development, public health, environmental protection, and food security. This national conference provides a valuable academic platform for researchers, academicians, and students to present their scholarly work, exchange ideas, and engage in meaningful scientific discussions.

Such conferences not only promote research culture but also encourage innovation, critical thinking, and interdisciplinary collaboration among young scientists and educators. I sincerely appreciate the dedicated efforts of the organizing committee and faculty members for planning this academic event with a forward-looking theme.

I am confident that the deliberations and research outcomes of this conference will contribute significantly to scientific knowledge and inspire future research initiatives. I wish the conference every success and extend my best wishes to all participants and contributors.

A handwritten signature in red ink, appearing to read 'Dr. Hardik Bhatt'.

**Dr. Hardik Bhatt**  
**Principal**  
**SET Mahila Arts, Commerce,**  
**BBA, BCA & Science College,**  
**Junagadh**

**National Conference on Emerging Frontiers in Biotechnology and Life Sciences  
for Sustainable Development (NCEFBLSD-2026)**

**NCEFBLSD – 2026**

**Chief Guest :**

**Prof. (Dr.) Pratapsinh Chauhan**  
Vice Chancellor, BKNMU, Junagadh

**Distinguished Guest :**

**Prof. Suhas Vyas**  
Dean, Faculty of Life Sciences, BKNMU, Junagadh

**Special Guest :**

**Shri Natubhai Bhatu**  
President

**Shri Bhagvanbhai Barad**  
Vice President

**Shri Laxmanbhai Pithiya**  
Managing Trustee

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- Ms. Hina Solanki

## Speakers:



**Dr. Togapur Pavan Kumar**  
Principal Scientist  
CSIR - IMMT



**Dr. Rohini R. Nair**  
Assistant Professor  
GBU - Gandhinagar



**Dr. Mangal S. Rathore**  
Sr. Principal Scientist  
CSMCRI, Bhavnagar



**Dr. Sanjay Lal**  
Associate Professor  
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**Prof. (Dr.) H. P. Gajera**  
Head  
JAU, Junagadh



**Dr. Santlal Jaiswar**  
Sr. Technical Officer  
CSMCRI – Bhavnagar



**Dr. Sougata Ghosh**  
Associate Professor  
RKU, Rajkot



**Dr. Imran Pancha**  
Assistant Professor  
GBU – Gandhinagar



**Prof. (Dr.) Suhas J. Vyas**  
Head  
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**Dr. Dushyant Dudhagara**  
Assistant Professor  
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Dr. Vijay Nandaniya



Mr. Rahul Makwana



Dr. Ridhdi Karangiya



Ms. Prima Vyas



Mr. Chirag Chandra

## Words of Thanks

The Organizing Committee of the **National Conference on “Emerging Frontiers of Biotechnology & Life Sciences for Sustainable Development”**, held on **20th and 21st February 2026** at **SET Science College & PG Centre, Junagadh**, expresses its sincere gratitude to all those who contributed to the successful organization of this academic event.

We are deeply thankful to the management of **Shri Saurashtra Education Trust, Junagadh**, for their constant guidance, encouragement, and unwavering support. Our heartfelt thanks are extended to the invited keynote speakers, resource persons, and session chairs for sharing their valuable knowledge, expertise, and research insights, which greatly enriched the deliberations of the conference.

We also acknowledge with appreciation the enthusiastic participation of researchers, academicians, and students from various institutions across the country. Their research presentations and scholarly interactions added immense academic value to the conference.

Special thanks are due to the organizing committee members, faculty, non-teaching staff, and student volunteers for their dedicated efforts and teamwork in planning and executing the conference smoothly. Finally, we express our gratitude to all contributors of abstracts and papers, whose scholarly work forms the foundation of this abstract book.

## Dr. Togapur Pavan Kumar

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### **Innovation and Intellectual Property– Science, Technology, Art and Research (STAR) Strategy**

#### **Abstract**

Innovation Technology is widely recognised as an essential feature of strategic thinking and management efforts in contributing for economic growth. The innovative technological development depend increasingly on collaborations between different stakeholders. Exploring the role of IPR in technology and innovation processes on a strategic level and utilization of IPR aspects for decision making may find huge and unexploited potential for an effective outcome in any kind of organization. It is intended to enable any organization to assess the value of road-mapping in its own particular context by means of a rapid first application. This session/lecture gives an overview on integrating IPR aspects for strategic planning and technology road-mapping of the research activities and throws a light on how IPR plays a crucial role in design and planning for conducting an effective R&D works and the need of effective strategic trade and policy frame work.

**Keywords:** Innovation, Intellectual Property Rights (IPR), Patents, Technology Development, Strategy, Policy Frame work.

## Dr. Mangal S. Rathore

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### Turning the Ocean Genetics into Solutions for Salinity-Resilient Agriculture: Rewiring the Salt Resilience towards Climate-Smart Agriculture

#### Abstract

Marine ecosystems are the richest yet least explored sources of genetic diversity. The Marine Genetic Resources (MGRs) contain unique genes and adaptive traits that have evolved under extreme environmental conditions such as high salinity, tidal fluctuations, and temperature stress. Today, as climate change intensifies and agricultural lands become increasingly saline and degraded, these marine resources offer powerful bio-solutions for climate-resilient and sustainable agriculture, thus offers transformative potential for advancing the UN Zero Hunger targets and enabling the environmentally sustainable agriculture. At **CSIR–Central Salt and Marine Chemicals Research Institute (CSIR–CSMCRI) Bhavnagar**, we explore seaweeds and extreme halophytes as reservoirs of stress-resilient genes and translate the unique traits in crop plants. Our research focuses on understanding how these organisms naturally survive in high-salinity habitats and translating those adaptive mechanisms into conventional crops. Detailed physiological and molecular analyses—including ion homeostasis, salt sequestration, membrane transport, osmolyte accumulation, photosynthetic performance, chlorophyll fluorescence, and ROS detoxification—have helped identify the key biological modules responsible for salinity tolerance.

Seaweeds thriving in intertidal zones not only provide valuable industrial products but also serve as genetic blueprints for engineering crops capable of growing on marginal lands. We demonstrate the translational potential of seaweed-derived genes such as ***Cytochrome b<sub>6</sub>*, *Cytochrome c<sub>6</sub>*, and *Na<sup>+</sup>/H<sup>+</sup> antiporters***, which significantly improved photosynthetic efficiency, biomass production, and abiotic stress tolerance in transgenic plants. Additionally, the halophyte *Salicornia brachiata* serves as a rich genomic resource for stress-responsive genes. Functional characterization and validation of novel tolerance determinants have been achieved, supported by the successful development of somatic embryogenesis protocols that enable *in vivo* gene studies and downstream crop translation.

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### **Biotechnology for a Sustainable Future: Integrating Environmental Restoration and Bioeconomic Innovation**

#### **Abstract**

Sustainable development in the 21st century demands integrated strategies that balance economic growth with ecological preservation. Biotechnology plays a pivotal role in this transformation, offering innovative solutions to global challenges such as climate change, pollution, and resource scarcity. This lecture explores two core aspects of sustainable biotechnology: environmental restoration and bio-based economic transformation. Advances in phytoremediation and microbial bioremediation now enable plants and microorganisms to detoxify contaminated ecosystems, reclaim degraded soils, and restore ecological balance. Cutting-edge tools like genetic engineering and metagenomics further enhance pollutant degradation and system resilience. Concurrently, industrial and agricultural biotechnology are revolutionizing production systems by promoting renewable resource utilization. Developments in biofuels, bioplastics, and bio-based chemicals—derived from sustainable feedstocks such as sugar beet—support the transition to a circular and low-carbon bioeconomy. Precision breeding and cellular agriculture further advance sustainable food and material production. The lecture emphasizes the significance of translational biotechnology in bridging laboratory innovation to large-scale implementation, guided by strong policy, ethics, and public engagement. Ultimately, biotechnology represents more than scientific advancement—it is a catalyst for sustainable progress, integrating innovation with environmental stewardship to build a cleaner, resilient, and bio-based global economy for a sustainable future.

## Dr. Sougata Ghosh

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### **Bioinspired materials for sustainable environmental remediation**

#### **Abstract**

The physico-chemical and opto-electronic properties of the nanoscale materials are size and shape-dependent. Synthesis of nanoparticles through physical and chemical methods involves hazardous reaction conditions and toxic chemicals that render them unsuitable for biomedical applications. Hence, several environmentally benign biological routes have been designed to synthesize metal and metal oxide nanoparticles using viruses, bacteria, fungi, algae, and medicinal plants. The biogenic nanoparticles can be exploited for various environmental applications, such as the removal of heavy metals, dyes, pesticides, and even bioconcrete production. As a part of our growing interest in novel nanomedicine, we have developed methods to use various medicinal plants found in nature, like *Dioscorea bulbifera*, *Gnidia glauca*, *Plumbago auriculata*, and *Leucophyllum frutescens*, for synthesizing nanospheres, nanohexagons, nanotriangles, and nanorods. Careful optimization of time, temperature, pH, and concentration of metal salts may help in the synthesis of nanomaterials with well-defined shape and size. Further, naturally occurring bioactive principles like curcumin, diosgenin, plumbagin, rutin, and quercetin may stabilize and enhance the anticancer, antioxidant, antidiabetic, antimicrobial, and antibiofilm activities of the biogenic nanoparticles. In view of the background, it can be concluded that there is a huge scope for further research towards the translation of the biogenic nanoparticles as potential nanomedicine in the future.

**Keywords:** Nanobiotechnology, medicinal plants, bioactive principles, functionalization, bioremediation, nanomedicine, photocatalysis.

## Prof. (Dr.) Suhas J. Vyas

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### **CANCER CELL METABOLISM: FROM THE WARBURG EFFECT TO TARGETED THERAPEUTIC STRATEGIES**

#### **Abstract:**

At present, cancer is classified as not only a genetic divergence but also a metabolic illness distinguished by major shifts in cellular biochemical interactions. Variations in metabolism support cancer cells in their relentless growth, escaping apoptosis, and surviving in territories that are short of oxygen and necessary nutrients. This dialogue analyze the detailed links between fluctuations in metabolic rates and the fast evolution of cancer, while also considering novel techniques for therapies based on these biological structures. One important factor in the way that cancer cells produce energy is called the Warburg effect, where these irregular cells often choose aerobic glycolysis rather than depending on mitochondrial oxidative phosphorylation, even with sufficient oxygen present. This change in energy dynamics enhances quick ATP synthesis and offers key building materials necessary for the creation of nucleotides, amino acids, and fats. In conjunction with glycolysis, cancer cells reveal harmonized alterations in the tricarboxylic acid cycle, pentose phosphate pathway, amino acid metabolism, and lipid biosynthesis, culminating in an exceptionally adaptable metabolic system that fosters tumor expansion and defiance against treatment. MYC and RAS genes are important in navigating this metabolic alteration by managing pivotal enzymes and transporter proteins. Recent innovations in metabolomics and mass spectrometry have profoundly enhanced our awareness of metabolic transformations in cancer, revealing that tumor cells intentionally direct metabolic processes rather than simply boosting standard cellular operations. Importantly, cancer's metabolic processes have appeared as a valuable weakness for treatment. This talk goes into detail about research from natural product investigations, which imply that bioactive materials obtained from flora can selectively affect the metabolic processes of cancer cells. Explorations into unexplored, a coastal medicinal flora with traditional roles, have disclosed an extensive range of metabolites that may affect glycolysis, lipid metabolism, mitochondrial mechanisms, and redox equilibrium. In silico molecular docking and pharmacokinetic assessments revealed robust interactions between selected phytochemicals and proteins associated with cancer metabolism and apoptosis, while in vitro experiments confirmed dose-dependent cytotoxicity against neoplastic cells. Ultimately, this presentation highlights the essential role of cancer metabolism as a significant target for treatment and emphasizes the possibilities that arise from merging metabolomics with studies of natural substances to create new anticancer approaches driven by metabolism.

**Keywords:** Cancer metabolism; Metabolic reprogramming; Warburg effect; Phytochemicals; Metabolism-targeted therapy

## **Dr. Rohini R Nair**

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### **Exploiting ribosome heterogeneity for biofuel and biologic production**

#### **Abstract**

Ribosomes, which are central to gene expression regulation, are found in heterogeneous populations within cells, with different ribosome subtypes showing distinct affinities for specific mRNA subsets. In yeast, 59 out of 79 ribosomal proteins exist in paralog pairs that arose from ancient genome duplication events ~100 million years ago 5. Moreover, under different conditions (oxidative stress, hypoxia, anaerobic conditions, etc.), specific ribosomal protein paralog is present in a particular ribosome. In yeast RPL1b, RPL2b, RPS11a, and RPS26b, each deletion mutant fails to grow on nonfermentable carbon sources. Similarly, ribosome paralog genes RPL7a, RPL12b, and RPL22a are involved in bud site mRNA localization and translation regulation 7. Our preliminary findings reveal that deletion of ribosomal proteins RPL12b leads to alterations in signalling pathways independent of TOR regulation. Based on these insights, we aim to harness ribosomal heterogeneity to enhance the production of biologics and fatty acid-derived biofuels. Our initial data demonstrate that deletion of specific ribosomal protein paralogs in *S. cerevisiae* results in elevated fatty acid and proinsulin levels compared to wild-type strains. These results provide proof of concept that distinct ribosome subpopulations can be exploited for improved biosynthetic output.

## Dr. Sanjay Lal

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### **DNA Barcoding: A Molecular Imperative for Medicinal Plant Authentication and Sustainable Development**

#### **Abstract**

Medicinal plants are important to world health, with estimated 80% of the global population using them for primary healthcare. Yet, the fast-growing demand for herbal medicines means that stringent authentication is required to guarantee quality, efficacy, and consumer safety against rampant fraud and adulteration. Traditional morphological and chemical methods are usually not reliable, especially when applied to fragmented, processed, or closely related species.

This article stresses the essential function of DNA barcoding as a strong, standardized molecular tool. A Universal Product Code for life, DNA barcoding employs short, distinctive genetic signatures to accomplish quick and accurate species identification, complementing traditional taxonomy and answering the pressing need to inventory the millions of species that are now threatened with extinction. For plants, the fundamental barcode system, which has been adopted by the Consortium for the Barcode of Life (CBOL), uses the chloroplast genes *rbcl* (for universality) and *matK* (for high resolution). This two-locus system is often complemented with the nuclear marker ITS2, which has achieved up to 92.7% successful identification, particularly at telling closely related medicinal species apart. Through the delivery of verifiable genetic information, DNA barcoding is essential to quality control, forensic science, and the sustainable conservation and resource management of the global medicinal plant flora.

## Dr. Santlal Jaiswar,

Senior Technical Officer II and Assistant Professor  
Applied Phycology and Biotechnology Division  
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### **Effective utilization of nutrients using agricultural fertilizers to increase feedstock production in *Ulva lactuca*.**

#### **Abstract**

The present study utilized two of the most commonly used agricultural fertilizers namely Urea and Di-ammonium Phosphate (DAP) as a source of nitrate and phosphate respectively to ascertain their effect on growth, pigments, gross primary productivity (GPP) and total activity non-enzymatic antioxidant assay (TAC) at different combination (Media 1-5) in *U. lactuca*. Although DGR was statistically non-significant but in terms of fresh weight gain it was 4.6; 2.97; 4.06 times more in Media 1, 2 and 3 respectively as compared to control. Media 1 and 3 exhibited a higher concentration of GPP compared to the control, and this difference was statistically significant. This suggests that nitrogen supply positively influences photosynthesis. The linear regression model predicts enhancement in biomass by 13.85% ( $R^2=0.79$ ) using both urea and DAP (media 3) under 0.81:0.48 g L<sup>-1</sup> concentration. The outcome could be best to enhance the feedstock production for the commercial exploitation of *Ulva*.

## Dr. Imran Pancha

Gujarat Biotechnology University,  
Gandhinagar, Gujarat



### **Target of rapamycin (TOR) signalling: A major regulator for Starch metabolism in red microalga**

#### **Abstract**

The target of rapamycin (TOR) signalling pathway is a key regulator of cellular metabolism in eukaryotes, yet its role in starch metabolism remains poorly understood. Here, we investigated the molecular mechanisms by which TOR controls starch accumulation and degradation in the unicellular red alga *Cyanidioschyzon merolae*. Inhibition of TOR activity by rapamycin increased cellular starch content approximately 10-fold without affecting the expression of genes involved in carbohydrate metabolism, indicating post-transcriptional regulation. Phosphoproteomic analysis identified 52 potential TOR substrates, including CmGLG1, a glycogenin-like priming protein required for starch synthesis initiation. Rapamycin treatment reduced phosphorylation of CmGLG1 at Ser613. Overexpression of CmGLG1 significantly enhanced starch accumulation, whereas a phosphomimic mutant (Ser613Asp) showed markedly reduced starch levels, demonstrating that TOR modulates starch synthesis through CmGLG1 phosphorylation. We further examined CmGWD, an  $\alpha$ -glucan water dikinase homolog implicated in starch degradation. CmGWD knockout increased starch accumulation and decreased starch phosphorylation. Phosphomimic (Ser264Asp) and dephosphomimic (Ser264Ala) variants revealed that phosphorylation at Ser264 promotes starch degradation. Rapamycin-induced starch accumulation was abolished in the phosphomimic strain, indicating that TOR regulates starch degradation by controlling CmGWD phosphorylation. Together, these findings establish dual roles for TOR in coordinating starch synthesis and degradation.

## Dr. Dushyant R. Dudhagara

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### **Microbial calcite a next generation sustainable construction materials**

#### **Abstract**

Microbially Induced Calcite Precipitation (MICP) has emerged as an effective and sustainable approach due to its ability to utilize natural microbial processes to induce calcite formation. These biologically driven mechanism offers an eco-friendly alternative to conventional chemical and cement-based methods by reducing carbon emissions and energy consumption. MICP producing bacteria were selected from calcareous brick mine soils and marine environment. The microbes have potential role in the production of hydrolyzing enzymes, which indicated the MICP formation abilities. Microbes exhibiting high urease activity play a crucial role in MICP by catalyzing the hydrolysis of urea into ammonia and carbonate ions. Efficacy of the isolates have been tested by various techniques as sand solidification test, preparation of mortal block, crack healing mechanism etc. In addition to calcite formation, MICP processes demonstrate significant heavy-metal removal potential. During calcite precipitation, toxic metal ions such as lead, cadmium, and mercury can be immobilized through co-precipitation, adsorption. Thus, MICP represents a sustainable and environmentally friendly alternative to conventional chemical treatments in the construction industry. Therefore, the use of naturally occurring microbes reduces carbon emissions, minimizes chemical usage, and supports long-term stability, making it a promising green technology for infrastructure development, soil stabilization, and eco-restoration aspects.

**Keywords:** MICP; Calcite precipitation; Urease enzyme; Heavy metal removal; Green technology

**GENETICALLY MODIFIED ORGANISMS: MOLECULAR  
TECHNOLOGIES, APPLICATIONS, BIOSAFETY ASSESSMENT AND  
FUTURE PERSPECTIVES.**

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**ABSTRACT**

Genetically modified organisms (GMOs) are organisms whose genetic composition has been deliberately altered using modern biotechnological techniques to introduce, modify or delete specific genes in order to confer desirable traits. This abstract presents a comprehensive overview of GMO technology, encompassing its underlying objectives, methodological approaches, major achievements, safety considerations, associated challenges and future directions. GMOs are developed through established techniques such as recombinant DNA technology, *Agrobacterium tumefaciens*-mediated gene transfer, particle bombardment and advanced genome-editing systems, notably CRISPR/Cas, which enable precise, targeted and efficient genetic modifications. These technologies have led to significant advancements in agriculture, including enhanced crop productivity, improved nutritional quality, resistance to pests and

diseases, tolerance to abiotic stresses and reduced reliance on chemical pesticides. Beyond agriculture, GMOs have contributed substantially to medicine and industry through the production of vaccines, therapeutic proteins, enzymes and other bio-based products. Comprehensive risk assessments conducted by international scientific and regulatory bodies indicate that approved GMOs are not intrinsically harmful to human health or the environment when subjected to rigorous evaluation and regulatory oversight and their safety is comparable to that of conventionally bred organisms. Despite these benefits, GMO development faces challenges related to biosafety assessment, regulatory frameworks, ethical concerns and public perception. Future progress in genome editing, gene stacking and synthetic biology is expected to further enhance the precision, efficiency and sustainability of genetic modification, facilitating the development of climate-resilient crops and innovative biotechnological solutions. Overall, GMOs represent a scientifically validated and transformative technology with significant potential to address global challenges in food security, healthcare, and environmental sustainability when applied responsibly.

**Keywords:** Genetically Modified Organisms, Biotechnology, Genome Editing, CRISPR-Cas, Agricultural Biotechnology, Biosafety, Food Security and Molecular Biology.

## **ASSESSMENT OF HEAVY METALS RETENTION IN SEDIMENTS AND MANGROVES ALONG THE SAURASHTRA COAST, GUJARAT**

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### **ABSTRACT**

This study aimed to investigate the impact of heavy metal pollution on the mangrove ecosystem on the Gujarat coast, which is facing pressure due to rapid industrialization. The concentrations of 5 heavy metals, including Pb<sup>+2</sup>, Cd<sup>+2</sup>, Zn<sup>+2</sup>, Cu<sup>+2</sup>, Fe<sup>+2</sup> and Mn<sup>+2</sup>, were measured in the sediments and tissues of 4 mangrove species, *Avicennia marina*(Family: Acanthaceae), *Rhizophora mucronata*(Family: Rhizophoraceae), *Ceriops tagal*(Family: Rhizophoraceae) and *Aegiceras corniculatum*(Family: Primulaceae), in 8 habitats along the coast of Gujarat, India. The results indicated that the sediments in the study sites had relatively

high heavy metal accretion ( $Pb^{+2} > Cu^{+2} > Fe^{+2} > Zn^{+2} > Mn^{+2} > Cd^{+2}$ ), but *A. marina* selectively accumulated only Cu (3.59 ppm) and Zn (0.63 ppm), while avoiding other heavy metals. The morphology of the plants did not show any visible impact from heavy metals stress. These findings highlight the significance of comprehending how industrial pollution affects mangrove ecosystems and the potential processes by which these plants can adapt to survive in such settings. Another advantage of mangroves is their capacity to absorb pollutants from many environments. Mangrove stems play a major role in absorbing pollutants.

**Keywords:** Adaptation, Coastal habitat, Heavy metal, Mangroves, Pollution

## NATURE'S NIGHTLIGHT: FROM FUNGI TO BIOTECHNOLOGICAL INNOVATION

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### ABSTRACT

There are some species of fungi which emit light in dark. According to research 64 species of bioluminescent fungi belonging to at least three distinct evolutionary lineages, termed *Omphalotus*, *Armillaria* and *mycenoid*. The emission of visible light by living organisms mediated by an enzyme-catalysed ('**luciferase**') reaction of molecular oxygen with a substrate ('**luciferin**'). Molecular oxygen is the only common feature of bioluminescence reactions, indicating that the luminescent systems in most organisms may have evolved independently. Some bioluminescent fungi may utilize their light as a warning signal to deter potential predators, signalling the presence of toxins or unpalatability. The genes responsible for fungal bioluminescence have been isolated and used as **reporter genes** in genetic engineering.

**Keywords:** Bioluminescent fungi, Molecular oxygen, Luciferin, Luciferase.

## ALGAE-BASED BIOTECHNOLOGY FOR SUSTAINABLE FOOD, FUEL, AND FERTILIZERS

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## **ABSTRACT**

Algal biotechnology focuses on the utilization of algae for applications in food, biofuel production, and agriculture. Algae are photosynthetic organisms characterized by rapid growth, high biomass productivity, and the ability to grow in non-arable environments. Microalgae such as Spirulina and Chlorella possess high nutritional value, being rich in proteins, essential amino acids, vitamins, antioxidants, and omega-3 fatty acids, and are widely used as dietary supplements and functional foods. Algae also serve as an efficient feedstock for biofuel production, including biodiesel, bioethanol, and biogas, due to their high lipid and carbohydrate content. In agriculture, algal biomass and nitrogen-fixing cyanobacteria are employed as biofertilizers and soil conditioners, improving soil fertility and reducing dependence on chemical fertilizers. Despite these advantages, large-scale application of algal biotechnology is constrained by challenges such as high cultivation costs, harvesting difficulties, and scalability issues. Recent advances in cultivation systems, bioprocess optimization, and genetic engineering are expected to enhance the commercial feasibility of algal-based products. Algal biotechnology thus represents a promising interdisciplinary approach within life sciences and agricultural biotechnology.

**KEYWORDS:** Algal biotechnology; Microalgae; Spirulina; Chlorella; Biofuels; Biofertilizers; Agricultural biotechnology; Sustainable agriculture

## **GREEN SYNTHESIS OF BIO-FERTILIZER FROM KITCHEN WASTE USING COW URINE**

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## **ABSTRACT**

The green synthesis of bio-fertilizer from kitchen waste using cow urine presents an eco-friendly and sustainable approach to waste management and soil nutrient enrichment. Kitchen waste, rich in organic matter, is biologically decomposed and fermented using cow urine, which acts as a natural microbial activator and nutrient source. The process enhances the availability of essential plant nutrients such as nitrogen, phosphorus, and potassium while promoting beneficial microbial activity. This method reduces dependence on chemical fertilizers, minimizes environmental pollution, and provides an efficient way to recycle household organic waste. The resulting bio-fertilizer improves soil fertility, supports plant growth, and contributes to sustainable agricultural practices.

**Keywords:** Green synthesis, Bio-fertilizer, Kitchen waste, Cow urine, Organic waste management, Sustainable agriculture, Soil fertility, Microbial activity

## **BIOCHEMICAL MODIFICATION OF ANOGEISSUS LATIFOLIA POLYSACCHARIDES VIA POLYMER BLENDING FOR SUSTAINABLE BIOMATERIAL APPLICATIONS**

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### **ABSTRACT**

Plant-derived polysaccharides are increasingly explored in biochemistry for their renewability, biodegradability, and biocompatibility. *Anogeissus latifolia*, a traditionally valued tree species, yields polysaccharides with promising functional characteristics; however, native forms often exhibit limited mechanical strength and functional adaptability. This study focuses on the biochemical modification of *Anogeissus latifolia* polysaccharides through polymer blending as an eco-friendly approach to enhance their physicochemical properties.

Polysaccharides extracted from *A. latifolia* were blended with natural polymers such as starch, alginate, and chitosan under aqueous conditions. The blending process promotes intermolecular interactions including hydrogen bonding, electrostatic attractions, and polymer chain entanglement, resulting in the formation of interpenetrating polymer networks. The modified blends were evaluated for solubility,

viscosity, swelling behaviour, and stability. Compared to native polysaccharides, blended systems demonstrated improved gel-forming ability, enhanced viscosity, greater structural stability, and tunable hydrophilicity.

Importantly, this modification strategy avoids chemical derivatization and the use of toxic reagents, aligning with the principles of green and sustainable biochemistry. The enhanced functional performance of the blended polysaccharides highlights their potential application in food stabilization, controlled drug delivery, biodegradable films, and biomedical hydrogel systems. Overall, polymer blending represents an effective biochemical approach to valorize *Anogeissus latifolia* polysaccharides and supports their utilization in sustainable biotechnological applications.

**Keywords:** *Anogeissus latifolia*, Polysaccharide, Blending, viscosity, swelling behaviour.

## **BIOCHEMICAL MODIFICATION OF BUTEA MONOSPERMA POLYSACCHARIDES VIA POLYMER BLENDING FOR BIOMEDICAL AND DRUG-DELIVERY APPLICATIONS**

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### **ABSTRACT**

Natural polysaccharides have gained considerable attention in biomedical and pharmaceutical research due to their biocompatibility, biodegradability, and structural versatility. *Butea monosperma*, a medicinally important plant widely used in traditional Indian systems, is a rich source of bioactive polysaccharides containing functional groups amenable to biochemical modification. The present work explores the biochemical modification of *Butea monosperma* polysaccharides through polymer blending techniques to develop advanced biomaterials for biomedical and drug-delivery applications. Polysaccharides extracted from *Butea monosperma* were blended with selected biodegradable polymers using green and solvent-minimized processing approaches to enhance mechanical stability, swelling behaviour, and controlled-release characteristics. The resulting biopolymer blends were systematically characterized using FT-IR, NMR, thermal analysis, and morphological studies to elucidate intermolecular interactions, structural

compatibility, and polymer network formation. The modified systems exhibited improved physicochemical properties, including enhanced stability and tunable diffusion behaviour, compared to native polysaccharides, while retaining biodegradability and biocompatibility. In vitro evaluations indicated their suitability for biomedical applications such as wound-healing matrices, tissue engineering scaffolds, and sustained drug-delivery platforms. The polymer-blended polysaccharide matrices demonstrated potential for controlled and targeted release of therapeutic agents, highlighting their relevance in pharmaceutical formulations. This study establishes biochemical modification via polymer blending as an effective and sustainable strategy to transform *Butea monosperma* polysaccharides into functional biomaterials, contributing to eco-friendly healthcare technologies and sustainable drug-delivery systems.

**Keywords:** *Butea monosperma*, polysaccharides, biomedical polymers, drug delivery, polymer blending, sustainable biomaterials

## MICROBIAL PLASTIC DEGRADATION

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### ABSTRACT

Plastic pollution has become a major environmental concern due to the persistence and accumulation of synthetic polymers in terrestrial and aquatic ecosystems. Microbial plastic degradation offers a promising eco-friendly approach to mitigate this problem. Certain bacteria, fungi, and algae have evolved the ability to utilize plastic polymers as a carbon and energy source by secreting specific enzymes such as hydrolases, esterase, and oxygenates. These enzymes break down complex plastic polymers like polyethylene (PE), polyethylene terephthalate (PET), polypropylene (PP), and polystyrene (PS) into smaller, less harmful molecules. Microbial degradation occurs through processes including surface colonization, biofilm formation, enzymatic DE polymerization, and mineralization into carbon dioxide, water, and biomass. Advances in molecular biology, genetic engineering, and metagenomics have enhanced the identification and efficiency of plastic-degrading microorganisms. Although microbial plastic degradation is environmentally sustainable, challenges such as slow degradation rates and limited efficiency under natural

conditions remain. Further research and technological improvements are essential to enhance microbial activity and apply this approach effectively for large-scale plastic waste. *Pseudomonas*, *Bacillus*, *Ideonella sakaiensis* (PET degrader) bacteria use for plastic degradation.

**Keywords:-** pollution, microbial ,plastic , biomass, *Pseudomonas* , *Bacillus* , *Ideonella sakaiensis* (PET degrader)

## **OMICS-GUIDED (METABOLOMICS–MICRORNAOMICS) AND NANO-ENABLED DEVELOPMENT OF A MULTI-STRESS-TOLERANT TRICHODERMA FUSANT FOR CLIMATE-RESILIENT STEM ROT MANAGEMENT IN GROUNDNUT**

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### **ABSTRACT**

Groundnut (*Arachis hypogaea* L.) productivity is severely limited by stem rot disease caused by *Sclerotium rolfsii*, while extensive reliance on chemical fungicides poses serious concerns related to environmental pollution and the emergence of resistant pathogen populations. To overcome these constraints, the present study integrates microbial biotechnology, functional omics, and green nanotechnology to develop a climate-resilient and eco-friendly biocontrol strategy. A multi-stress-tolerant *Trichoderma* fusant was developed through protoplast fusion between *T. virens* NBAITvs12 (mycoparasitic) and *T. koningii* MTCC 796 (multistress-tolerant). Among 36 stable fusants, *Tricho-Fu21* emerged as the most potent, exhibiting strong antagonism against *S. rolfsii* (92.88% inhibition) along with enhanced tolerance to fungicides, drought, and salinity, supported by high genetic heterogeneity and gene flow. Integrated microRNAomics and intracellular metabolomics during pathogen interaction elucidated a complex regulatory network governing biocontrol efficacy and stress adaptation. Novel miRNAs (e.g., cel-miR-8210-3p, mml-miR-320c, and mmu-miR-6980-5p) were identified and associated with key pathways involved in amino acid metabolism, phenylpropanoid biosynthesis, signal transduction, and secondary metabolite production. Concurrently, intracellular metabolites such as L-proline, mannitol, myo-inositol, arabinitol, and D-fructose were significantly elevated, indicating their crucial roles in mycoparasitism and

abiotic stress tolerance. Chitin-induced exometabolites of Tricho-Fu21 were further exploited for the green synthesis of silver nanoparticles (AgNPs), yielding stable, spherical nanomaterials (~54 nm; +53.7 mV). The resulting nanoformulation completely inhibited *S. rolfsii* at a minimum inhibitory concentration of 20  $\mu\text{g Ag ml}^{-1}$  and reduced stem rot incidence by 86.7% under field conditions, accompanied by significant improvements in pod yield and seed quality. By enhancing the stability, bioavailability, and effective delivery of biocontrol agents, this nano-enabled system enables precise and eco-friendly crop protection while minimizing chemical inputs. Overall, the study presents a synergistic omics-guided and nano-enabled biocontrol innovation for sustainable and climate-resilient groundnut production.

**Keywords:** Groundnut; *Sclerotium rolfsii*; *Trichoderma fusant*; microRNAomics; Metabolomics; Green nanotechnology

## **MEDICINAL SIGNIFICANCE OF PHYLLANTHUS NIRURI L. LEAVES REVEALES BY PHYTOCHEMICAL, ANTIOXIDANT, AND SPECTROSCOPIC ANALYSES**

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### **ABSTRACT**

Medicinal plants remain a cornerstone of traditional healthcare systems, yet systematic biochemical and analytical validation is essential to substantiate their therapeutic relevance. *Phyllanthus niruri* L. is a well-documented ethnomedicinal species with broad pharmacological claims. The present study elucidates the medicinal significance of *P. niruri* leaves through integrated phytochemical quantification, in vitro antioxidant evaluation, and advanced spectroscopic characterization using a methanolic extract. Quantitative phytochemical analysis revealed high concentrations of total phenolics ( $92.17 \pm 0.05$  mg GAE/g), tannins ( $93.12 \pm 0.19$  mg TAE/g), flavonoids ( $37.62 \pm 0.05$  mg RE/g), alkaloids ( $20.23 \pm 0.01$  mg QE/g), and saponins ( $1.25 \pm 0.00$  mg DE/g) (mean  $\pm$  SEM), indicating a rich repository of secondary metabolites with redox-active properties. Antioxidant potential assessed by the DPPH free radical scavenging assay demonstrated a strong activity with an  $\text{IC}_{50}$  value of 22.5  $\mu\text{g/mL}$ , corroborating the

substantial polyphenolic content of the extract. GC-MS profiling identified several predominant bioactive constituents, including 1-(3,4-dimethoxyphenyl) decane-3,5-diyl diacetate (36.49%) and a 3,4-dimethoxy-benzylamino methyl furanone derivative (29.10%), alongside other phenolic and terpenoid derivatives. FTIR spectral analysis confirmed the presence of functional groups corresponding to hydroxyl, carbonyl, amine, and aromatic moieties, further validating the chemical diversity of the extract. Collectively, these findings provide robust analytical evidence supporting the medicinal relevance of *P. niruri* leaves and highlight their potential as a valuable source of bioactive compounds for natural product-based therapeutic exploration.

**Keywords:** *Phyllanthus niruri* L., Phytochemical profiling, Antioxidant activity, DPPH assay, GC-MS analysis, FTIR spectroscopy, Medicinal plants, Bioactive compounds.

## COMPARATIVE ANALYSIS OF PHOTOSYNTHETIC PIGMENTS IN GREEN AND BROWN SEAWEEDS OF PORBANDAR

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### ABSTRACT

Marine algae possess diverse photosynthetic pigments, including chlorophylls and carotenoids, which vary among algal groups. The present study comparatively analyse pigment profiles of green and brown seaweeds collected from the Porbandar coastal region. Pigments were characterized using thin layer chromatography (TLC) and quantified spectrophotometrically using standard equations. Seawater pH associated with green and brown algal habitats was alkaline 8.16 and 8.32, respectively. TLC analysis revealed distinct R<sub>f</sub> values corresponding to major pigments in both algal groups, including chlorophylls, carotenoids, and fucoxanthin in brown algae. Quantitative analysis showed higher chlorophyll a and chlorophyll b in green algae, while brown algae exhibited elevated chlorophyll a, total carotenoids, and fucoxanthin, with absence of chlorophyll b. These differences reflect habitat-specific pigment adaptation and ecological niche differentiation. The varied pigment composition highlights the potential of marine

algae as valuable sources of bioactive compounds with applications in biotechnology, pharmaceuticals, cosmetics, dyes, natural indicators and high source of primary productivity. This study provides a low-cost and effective analytical approach suitable for academic and applied research.

**Keywords:** Seaweed, Chlorophyll, Carotenoid, Xanthophyll, Fucoxanthin, TLC, Spectrophotometric

## **ETHNOPHARMACOLOGICAL VALIDATION OF FICUS LEAVES: COMPARATIVE PHYTOCHEMISTRY, ANTIOXIDANT ENZYME KINETICS AND GREEN SYNTHESIZED SILVER NANOPARTICLES**

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### **ABSTRACT**

This study explores the complex interplay between the biochemical and therapeutic potential of green and red leaves of *Ficus benghalensis* and *Ficus amplissima* in relation to cardiovascular health. Comprehensive analyses of phytonutrient composition, enzyme activity, heavy metal content, antioxidant and antimicrobial properties, and silver nanoparticle synthesis as key parameters. Red leaves exhibited markedly higher levels of phenols, flavonoids, tannins, alkaloids, and saponins particularly in methanolic extracts indicating superior antioxidant and cardioprotective potential. Enzyme activities of catalase, peroxidase, and polyphenol oxidase were also observed and red leaves showed relatively higher Cu and Mn contents, enhancing their role in antioxidant enzyme activation. Biosynthesized silver nanoparticles showed absorption maxima between 410-450 nm FBR extracts demonstrating the strongest antioxidant capacity. Antimicrobial analysis revealed that FBR and FAR extracts and nanoparticles produced the highest inhibition against pathogenic bacteria. Enzyme kinetic parameters ( $V_{max}$  and  $K_m$ ) were estimated using Michaelis-Menten modelling and Lineweaver-Burk plots. K-means clustering explaining the majority of variance between various phytochemical composition of *Ficus* species while Pearson correlation analysis showed strong positive relationships among heavy metal constituents. This finding provides valuable insight in to Red leaves of *Ficus* emerged as the most potent future research for cardiovascular applications.

**Keyword:** Phytonutrient, Enzyme, Antioxidant, Antimicrobial, Nanoparticle, Heavy metal Cardiovascular.

## **NITROGENASE ENZYME SYSTEM AND REGULATION OF BIOLOGICAL NITROGEN FIXATION IN AGRICULTURAL SOILS**

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### **ABSTRACT**

Biological nitrogen fixation is a biochemically complex process mediated by the nitrogenase enzyme system, which enables the conversion of inert atmospheric nitrogen into ammonia. This process is carried out by symbiotic, associative, and free-living diazotrophic microorganisms. The nitrogenase complex consists of dinitrogenase reductase and dinitrogenase, both of which require ATP and strong reducing power for catalytic activity. The enzyme is highly sensitive to oxygen, and microorganisms employ protective biochemical mechanisms such as high respiratory rates, slime layers, and leghaemoglobin in root nodules to maintain suitable conditions. This presentation highlights the biochemical pathways, genetic regulation, and environmental factors influencing nitrogenase activity in agricultural soils. It also discusses the contribution of biological nitrogen fixation to soil nitrogen pools and its significance in reducing chemical fertilizer inputs. Enhancing BNF through microbial inoculants and crop rotation with legumes offers a sustainable approach to improving soil fertility and crop productivity. Thus, biochemical understanding of nitrogen fixation is essential for developing efficient nutrient management strategies in modern agriculture.

**Keywords:-**Biological nitrogen fixation, Nitrogenase, Diazotrophs, Soil fertility, Sustainable agriculture

## **DEVELOPMENT OF A DNA APTAMER-BASED BIODEGRADABLE SMART PACKAGING FILM FOR FOOD SPOILAGE DETECTION**

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## **ABSTRACT**

Food spoilage continues to pose a serious challenge to food safety, public health, and supply chain efficiency, highlighting the need for packaging systems that can provide real-time information on food freshness. In this work, a biodegradable smart packaging system is proposed for the rapid and visual detection of food spoilage using a biomolecular sensing approach. The packaging is based on eco-friendly bioplastic films embedded with DNA-based nanosensors (aptamers) that selectively recognize biogenic amines such as putrescine, cadaverine, and histamine, which are typically produced during the spoilage of protein-rich foods. The smart film is prepared using biodegradable biopolymers including starch, gelatin, or alginate, with glycerol incorporated to improve flexibility and mechanical stability. A functional sensing layer containing DNA aptamers linked to natural color indicators is integrated within the bioplastic matrix. When exposed to spoilage-associated amines, the aptamers undergo structural rearrangement, leading to changes in the local chemical environment and inducing a clear color shift from yellow to red. This visible response enables straightforward assessment of food quality without the requirement for external instruments or power sources. The developed system exhibits high sensitivity, rapid response under ambient conditions, and improved selectivity when compared with conventional chemical spoilage indicators. Practical demonstrations using fresh and spoiled food samples show noticeable color changes within a short time frame, confirming its suitability for real-world use. Temperature-based observations further indicate accelerated spoilage detection at higher temperatures, closely reflecting actual storage and transportation conditions. Overall, this DNA-programmed biodegradable smart packaging offers a sustainable and innovative solution for monitoring food freshness. By combining environmentally friendly materials with biomolecular recognition, the system shows strong potential for applications in smart food packaging, cold-chain logistics, household food safety, and quality monitoring in food distribution. Future developments may focus on integrating multiple sensing functions, antimicrobial properties, and digital traceability features.

**Keywords:-** DNA aptamer, Biodegradable smart packaging, Food spoilage detection, Biogenic amines

## **EARTHWORMS AS BIOLOGICAL TOOLS FOR ASSESSING SOIL POLLUTANTS**

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### **ABSTRACT**

Soil contamination has increased significantly over the last few decades due to anthropogenic activities such as industrial waste disposal, agricultural practices, urbanization, construction, mining and drilling, waste dumping, and lack of regulation and enforcement. These activities cause soil contamination with pollutants such as heavy metals, pesticides, industrial chemicals, and pathogens. These pollutants disrupt the food chain, contaminate crops and water, and threaten living beings and the environment. To effectively assess soil pollution, it is essential to establish non-hazardous threshold technologies for determining the quantity of pollutants in the soil. A bio-monitoring approach that focuses on metal toxicity and its availability in the soil, as well as its impact on unidentified metabolites, is appropriate. As a major component of soil biota, earthworms play a crucial role in organic matter decomposition and soil reconstruction in terrestrial ecosystems. Several studies have indicated that earthworms can serve as biological tools for monitoring soil pollutants and exhibit stress responses to contaminants. Their density and biomass are significantly affected by local soil pollution because they are directly exposed to the soil environment. This review article summarizes various research studies on how earthworm species function as bioindicators or biomonitors and their response to different soil pollutants. Further research is required to identify the species-specific responses of earthworms and to understand their biochemical, anatomical, physiological, and genetic changes in particular pollutant-contaminated soils. These efforts are aimed at helping us maintain soil health for sustainability.

**Keywords:** Bioindicators, Biomonitors, Earthworm, Food chain, Pollutant, Soil biota, Sustainability

## **NANOCELLULOSE: STRUCTURE, BIOCHEMICAL PROPERTIES AND APPLICATIONS**

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### **ABSTRACT**

Nanocellulose has gained increasing attention as a sustainable nanomaterial due to its unique structural and biochemical characteristics. Derived from natural cellulose sources, it occurs as cellulose nanocrystals, nanofibrils, and bacterial nanocellulose, each exhibiting distinct morphology and crystallinity. The presence of abundant hydroxyl groups contributes to high mechanical strength, biocompatibility, biodegradability, and chemical versatility. These properties enable its application in biomedical engineering, food and packaging industries, environmental purification, and energy-related systems. This overview highlights the structure, biochemical properties, and emerging applications of nanocellulose, emphasizing its potential in sustainable material development.

**Keywords:** Nanocellulose, Biodegradability, Environmental purification

## **ISOLATION AND PRILIMINARY ENZYME PROFILING OF HALOPHILES**

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### **ABSTRACT**

Halophiles are excellent sources of enzymes that are not only salt stable but also can withstand and carry out reactions efficiently under extreme conditions. The aim of the study was to isolate and study the diversity among halophilic bacteria producing enzymes of industrial value. Screening of halophiles from

various saline habitats of Gujarat coastal region led to isolate the 43 halophilic bacteria producing industrially important hydrolases (amylases, cellulases and lipases) were obtained from the marine water sample collected from various villages between Somnath to Diu. Characterization of 30 potential isolates by morphological and biochemical analysis. Then tested for primary screening of enzymes. Results indicate that out of the 43 isolates 7 showed amylase activity, 10 showed Cellulase activity and 13 showed lipase activity. It is Concluded that these halophilic isolates are not only diverse in phylogeny but also in their enzyme characteristics. Their enzyme may be potentially useful for catalysis under harsh operational conditions encountered in industrial processes.

**Keywords:** Halophilic bacteria, Industrial enzymes, Primary screening

### **Prospective use of Earthworm for medicinal purposes**

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### **ABSTRACT**

Earthworms (phylum Annelida, class Oligochaeta) have been integral to ecosystems for millions of years and are now gaining attention as potential biomedical resources. Traditionally used in Chinese, Ayurvedic, and Islamic medicine, earthworms have been shown to be effective in treating fever, hypertension, inflammation, and wounds. Modern pharmacological studies confirm that earthworm extracts contain diverse bioactive compounds, including enzymes, peptides, and polysaccharides with promising therapeutic properties such as wound healing, antimicrobial, anticancer, antioxidant, and fibrinolytic effects. This review consolidates the current evidence on the medicinal applications of earthworms, emphasizing the biochemical basis of their pharmacological activities, methodological approaches to extract characterization, and potential for clinical translation. Using a systematic literature review and qualitative content synthesis, this paper discusses how earthworms may serve as a renewable source of novel bioactive compounds for future drug development.

**Keywords:** Earthworms, Eisenia fetida, lumbrokinase, wound healing, antimicrobial peptides, fibrinolytic enzymes, traditional medicine, pharmacology

## **A COMPREHENSIVE REVIEW ON THE COMPOSTING POTENTIAL OF EARTHWORMS**

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### **ABSTRACT**

Vermicomposting has emerged as an efficient and sustainable approach for organic waste management and soil fertility enhancement. Earthworms accelerate decomposition of organic matter through physical fragmentation and microbial stimulation, improving nutrient cycling, enhancing soil structure, and reducing pathogen loads. Widely used species such as *Eisenia fetida*, *Eudrilus eugeniae*, and *Perionyx excavatus* exhibit varying composting efficiencies due to differences in feeding behavior, growth rate, and environmental tolerance. Key factors influencing vermicomposting performance include temperature, moisture, pH, carbon-to-nitrogen ratio, aeration, and the presence of contaminants. Various composting systems- ranging from conventional vermicomposting to hybrid worm–microbial systems-offer distinct operational advantages and limitations. Earthworm activity significantly increases the availability of essential nutrients, including nitrogen, phosphorus, potassium, and micronutrients, thereby enhancing plant growth and crop productivity. Environmentally, vermicomposting reduces landfill burden, improves soil health, enhances carbon sequestration, and lowers greenhouse gas emissions, while economically supporting reduced fertilizer inputs and increased agricultural yields. Despite challenges related to scalability, cost, and regulatory frameworks, future research should focus on system optimization and technological innovation. This comprehensive information about earthworm composting represents a promising strategy for sustainable waste management and agro-ecosystem resilience.

**Keywords:** Vermicomposting; earthworm; organic waste management; soil fertility; sustainable agriculture.

**“EARTHWORM UNDER THREAT: IT’S POSSIBLE CONSEQUENCE AND  
CONSERVATION MEASURE”**

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## **ABSTRACT**

Earthworms are vital soil organisms, often referred to as “ecosystem engineers,” due to their critical roles in nutrient cycling, soil structure formation, water regulation, and carbon sequestration. They enhance soil fertility, support plant growth, and contribute to overall ecosystem functioning, directly influencing agricultural productivity and food security. However, earthworm populations are increasingly threatened by habitat loss, soil degradation, climate change, chemical pollution, overexploitation, and invasive species. Declines in earthworm abundance and diversity can lead to soil compaction, reduced organic matter incorporation, altered water dynamics, decreased carbon storage, and lower crop yields, posing risks to environmental sustainability and human well-being. This review highlights the ecological importance of earthworms, examines the drivers and consequences of their decline, and outlines conservation measures. Strategies such as habitat preservation, reduced tillage, organic farming, organic matter amendments, and minimization of pesticide use are crucial for maintaining earthworm biodiversity. Implementing these measures ensures sustainable soil management, enhances ecosystem services, and promotes long-term agricultural productivity.

**Keywords:** Earthworms, Soil Health, Ecosystem Services, Biodiversity Conservation, Climate Change, Pesticide Impact, Sustainable Agriculture, Habitat Preservation, Organic Matter, Reduced Tillage

## **PHYSICOCHEMICAL EVALUATION OF *PROSOPIS CINERARIA* GROWING IN THE ARID ECOSYSTEM OF SIROHI DISTRICT, RAJASTHAN**

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## **ABSTRACT**

*Prosopis cineraria* (L.) Druce, commonly known as Khejri, is a keystone desert tree species of arid and semi-arid regions of Rajasthan, valued for its ecological resilience and ethnobotanical significance. The present study investigates the physicochemical characteristics of *Prosopis cineraria* collected from different locations of the Sirohi district, Rajasthan, with the objective of assessing its chemical composition and quality attributes in relation to environmental conditions. Plant materials were subjected to standard physicochemical analyses including moisture content, ash value, acid-insoluble ash, water- and alcohol-soluble extractive values, pH, electrical conductivity, and elemental composition. Additionally, spectroscopic techniques such as FT-IR and UV-Visible spectroscopy were employed to identify functional groups and major phytochemical constituents. The results revealed significant variations in physicochemical parameters, reflecting the influence of soil type, climatic stress, and local edaphic factors prevalent in the Sirohi region. The presence of functional groups corresponding to phenolics, polysaccharides, and nitrogenous compounds indicates the plant's potential for medicinal, nutritional, and agro-industrial applications. This study provides baseline physicochemical data for *Prosopis cineraria* of the Sirohi district and highlights its importance as a sustainable natural resource for arid-zone ecosystems, phytopharmaceutical exploration, and value-added product development.

**Keywords:** *Prosopis cineraria*, Physicochemical analysis, Sirohi district, Arid plants, Spectroscopic studies.

## **SEASONAL DYNAMICS OF AVIFAUNAL DIVERSITY IN FRESHWATER ECOSYSTEM: A STUDY IN SOUTHERN RAJASTHAN**

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### **ABSTRACT**

Freshwater ecosystems serve as vital habitats for aquatic avifauna by providing essential resources for feeding, breeding, and seasonal migration. Aquatic birds are commonly considered as accurate indicators

of ecological conditions because their diversity and distribution reflect changes in habitat quality, hydrological regimes, and seasonal environmental variables. The current study assesses the richness, distribution patterns, and seasonal dynamics of aquatic avifauna in selected freshwater environments in southern Rajasthan. Over a three-year period, systematic avifaunal surveys were carried out on typical freshwater bodies during the summer, monsoon, and winter seasons. Standard field observation techniques were used to determine the species composition, abundance, and geographic distribution of aquatic birds. Species were divided into resident and migratory groups, and quantitative analyses of avifaunal diversity were conducted using recognised biodiversity indices such as species richness, Shannon-Wiener diversity index, and Simpson's dominance index. The study found a varied assemblage of aquatic avifauna with significant regional and seasonal differences among the studied freshwater environments. Species richness and abundance were maximum during the winter season, owing to the arrival of migrating waterbirds and better habitat conditions. In contrast, variety was reduced during the summer months, which was most likely due to lowering water levels and restricted food supply. Variations in avifaunal distribution were closely related to changes in water permanence, habitat heterogeneity, and the level of anthropogenic disturbances. Freshwater environments with stable hydrological conditions and well-developed aquatic vegetation promoted greater avifaunal variety and more balanced community structures. The findings highlight the ecological importance of Southern Rajasthan's freshwater ecosystems as homes for both resident and migratory aquatic birds. Long-term monitoring and appropriate management of these waterbodies are critical for preserving aquatic avifaunal variety and maintaining ecological integrity in semi-arid areas.

**Keywords:** Aquatic avifauna; freshwater ecosystems; biodiversity indices; seasonal variation; migratory birds; Southern Rajasthan.

## **BLOOD PHYSIOLOGICAL DISRUPTION AND TISSUE-LEVEL TOXICITY INDUCED BY CHRONIC EXPOSURE TO THE SURFACTANT NONYLPHENOL ETHOXYLATE IN *CATLA CATLA*.**

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## ABSTRACT

Nonylphenol ethoxylate (NPE) is a common nonionic surfactant frequently found in household detergents and industrial formulations. NPE and its degradation products are poorly removed by conventional wastewater treatment methods. Consequently, these compounds are continuously released into freshwater habitats, where they persist and exert long-term toxic effects on aquatic life. Its durability, lipophilicity, bioaccumulation, and endocrine-disrupting capabilities have elicited a major concern about its long-term ecological effects.

Freshwater bodies that get untreated or only partially treated municipal and industrial waste, like polluted rivers that flow away from cities, lakes that get sewage, industrial drains, and reservoirs, are "red zones" for contamination. This means that aquatic organisms, especially fish, are at high risk of being poisoned by NPE over time.

Healthy specimens of *Catla catla* were treated with a sub-lethal dose of NPE in a controlled laboratory environment for extended durations of 30, 60, 90, and 120 days. We examined hematological markers such as red blood cell count (RBC), hemoglobin concentration (Hb), and hematocrit (Hct) to see how the body's systems got affected by this chemical. Histopathological studies of essential organs (gills, liver, and kidney) were performed employing conventional histological methods to assess tissue-level damage due to continuous exposure.

The findings revealed a significant decline in red blood cell count, hemoglobin concentration, and hematocrit values in NPE exposed fishes compared to the control group. These changes suggest the gradual development of anemia and a reduction in the oxygen-carrying capacity of the blood. Histopathological examination showed distinct structural damage across vital organs, characterized by epithelial lifting, lamellar fusion, and vascular congestion in the gills; marked hepatocellular degeneration accompanied by cytoplasmic vacuolization and sinusoidal dilation in the liver; and pronounced tubular degeneration along with glomerular impairment in the kidney. Collectively, these tissue level alterations indicate substantial physiological stress, metabolic imbalance, and compromised organ function resulting from prolonged exposure to nonylphenol ethoxylate.

Chronic exposure to nonylphenol ethoxylate causes marked disturbances in blood physiology and organ-specific tissue damage in *Catla catla*, even at sub-lethal concentrations, highlighting the substantial ecological risk posed by detergent-derived surfactants. The observed hematological and histopathological responses provide early warning signals of aquatic environmental stress and emphasize the urgent need for stricter regulation, improved wastewater treatment, and the adoption of environmentally safer surfactant alternatives to safeguard aquatic biodiversity.

**Keywords:** Nonylphenol ethoxylate; Chronic toxicity; Hematological biomarkers; Histopathological alterations; Surfactant pollution; Freshwater fish; *Catla catla*

## **LOOP-MEDIATED ISOTHERMAL AMPLIFICATION (LAMP): A RAPID AND FIELD-DEPLOYABLE MOLECULAR DIAGNOSTIC TOOL FOR EARLY DETECTION OF PLANT PATHOGENS – A REVIEW**

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### **ABSTRACT**

Plant diseases caused by fungi, bacteria, viruses, and phytoplasmas significantly constrain agricultural productivity and threaten global food security. Early, accurate, and rapid detection of pathogens is essential for effective disease management and minimizing yield losses. Conventional diagnostic approaches such as visual inspection, culture-based identification, ELISA, and polymerase chain reaction (PCR) are often time-consuming, labor-intensive, and dependent on sophisticated laboratory infrastructure and skilled personnel, limiting their application in field conditions. Loop-Mediated Isothermal Amplification (LAMP) has emerged as a powerful alternative molecular diagnostic technique that overcomes these limitations through rapid, sensitive, and cost-effective nucleic acid amplification under isothermal conditions. Operating typically at 60–65°C with four to six specific primers and *Bst* DNA polymerase, LAMP enables exponential DNA amplification within 30–60 minutes and allows simple visual detection via turbidity, fluorescence, or colorimetric changes without the need for advanced equipment. Its high specificity, robustness, and tolerance to crude samples make it particularly suitable for on-site and resource-limited settings. LAMP and reverse transcription LAMP (RT-LAMP) assays have been successfully applied to detect a wide range of plant pathogens across diverse crops. For instance, RT-LAMP protocols enable rapid detection of Wheat Spindle Streak Mosaic Virus (WSSMV) directly from crude leaf extracts with sensitivity comparable to RT-PCR and high specificity against non-target viruses, facilitating real-time field surveillance. This review summarizes the principles, advancements, and applications of LAMP-based diagnostics and highlights their potential in sustainable agriculture. The integration of LAMP into routine

disease monitoring offers a practical strategy for early intervention, improved crop protection, and enhanced food security.

**Keywords:** RT-LAMP; Isothermal Amplification; Plant Disease Surveillance; Rapid Detection; Viral Diagnostics; Agricultural Biotechnology

## **ARTIFICIAL INTELLIGENCE–ASSISTED MICRORNA ANALYSIS FOR PREDICTING ABIOTIC STRESS RESPONSES IN PLANTS: A REVIEW**

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### **ABSTRACT**

Abiotic stresses such as drought, salinity, heat, and cold severely restrict plant growth, productivity, and crop yield, threatening global food security under rapidly changing climatic conditions. MicroRNAs (miRNAs), a class of small non-coding RNAs, have emerged as key post-transcriptional regulators that fine-tune gene expression during stress perception, signal transduction, hormonal crosstalk, and metabolic adaptation. Despite their critical regulatory roles, the identification and functional characterization of stress-responsive miRNAs and their targets remain challenging due to the complexity, heterogeneity, and high dimensionality of omics datasets. Recent advances in Artificial Intelligence (AI) and Machine Learning (ML) provide powerful computational frameworks to overcome these limitations by enabling rapid and accurate analysis of large-scale transcriptomic, small RNA sequencing, degradome, and epigenomic data. AI-driven approaches—including supervised and unsupervised learning, deep learning, and network-based modelling—facilitate the prediction of stress-responsive miRNAs, elucidation of miRNA–target interactions, and discovery of hidden regulatory networks underlying stress tolerance. Deep learning architectures such as convolutional and recurrent neural networks further enhance the identification of novel miRNAs and improve target prediction accuracy. Moreover, AI-assisted models can classify stress types, assess stress severity, and distinguish tolerant and susceptible genotypes based on miRNA expression signatures. Integrating AI with miRNA

research accelerates the discovery of candidate regulatory molecules and supports precision breeding, marker-assisted selection, and genomic improvement strategies. This review highlights recent developments, commonly used algorithms, available datasets, and current challenges, emphasizing the potential of AI-enabled miRNA analysis to develop climate-resilient crops and promote sustainable agriculture.

**Keywords:** Plant Stress Genomics; miRNA–Target Interaction; Deep Learning; Precision Breeding; Sustainable Agriculture; Crop Improvement

## **SNP GENOTYPING TECHNOLOGIES FOR PRECISION CROP IMPROVEMENT: TOOLS AND STRATEGIES FOR CLIMATE-RESILIENT AGRICULTURE – A REVIEW**

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### **ABSTRACT**

Single Nucleotide Polymorphisms (SNPs) represent the most abundant, stable, and widely distributed form of genetic variation in plant genomes, making them powerful molecular markers for modern crop improvement. Compared with conventional markers such as SSRs and RFLPs, SNPs offer superior precision, high-throughput capacity, automation, and genome-wide coverage, enabling more accurate genetic analysis and selection. This review summarizes recent advances in SNP genotyping technologies and highlights their transformative applications in plant breeding programs. Current SNP platforms can be broadly categorized into three technical domains: PCR-based methods, including TaqMan, ARMS-PCR, and Kompetitive Allele-Specific PCR (KASP), which are widely used for targeted validation and marker-assisted selection; array-based technologies that enable rapid, large-scale genome-wide screening; and sequencing-based approaches such as Genotyping-by-Sequencing (GBS) and Whole-Genome Sequencing (WGS), which facilitate comprehensive SNP discovery and genomic selection. The integration of these high-throughput tools supports precise trait mapping, quantitative trait loci (QTL) identification, and accelerated breeding cycles. A case study on genomic profiling of 182 rice genotypes using trait-linked

SNPs demonstrates the practical utility of these platforms in detecting yield-associated QTLs under drought stress, underscoring their relevance for developing climate-resilient varieties. Overall, SNP genotyping technologies provide a robust framework for precision breeding, enabling faster development of high-yielding, stress-tolerant crops. Harnessing these advances is essential for strengthening sustainable agriculture and ensuring global food security under changing environmental conditions.

**Keywords:** SNP Genotyping; Marker-Assisted Selection; Genomic Selection; Crop Improvement; Climate-Resilient Agriculture

## **HYBRID ZnO NANOFLOWERS: A NANOBIOLOGICAL APPROACH TO CONTROL ENVIRONMENTAL POLLUTION AND ANTIMICROBIAL RESISTANCE**

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### **ABSTRACT**

The rapid urban growth and industrialization have given unpredictable societal benefits, but also increased concerns for public health and environmental pollution. Particularly, the release of dye-contaminated wastewater from textile, paper, and plastic industries has appeared as a serious environmental issue owing to the persistent and toxic nature of these pollutants in aquatic ecosystems. Simultaneously, the cumulative spread of antimicrobial resistance (AMR) in bacterial pathogens poses a major global health challenge, highlighting the urgent need for alternative and effective antimicrobial solutions. Against this backdrop, nanotechnology has gained considerable attention, with phytofabrication, a green and sustainable approach that employs plant-derived biomolecules to produce biocompatible nanoparticles. In this study, zinc oxide (ZnO) nanoflowers doped with silver (Ag) and copper (Cu) were fabricated using the medicinal plant *Leucophyllum frutescens* and evaluated for their photocatalytic and antibacterial performance. UV-visible spectroscopy revealed the absorption peaks at 378, 380, 397, and 392 nm for ZnO, Ag@ZnO, Cu@ZnO, and Ag-Cu@ZnO nanoparticles (NPs), respectively, while all samples revealed a prominent photoluminescence emission at 423 nm. The bandgap analysis using Tauc plots exhibited a clear drop from 3.36 eV for pristine ZnO to 3.26, 3.21, and 3.24 eV for Ag@ZnO, Cu@ZnO, and Ag-Cu@ZnO

nanostructures, respectively, indicating effective bandgap tuning through metal doping. Electron microscopy studies using field-emission scanning electron microscopy and high-resolution transmission electron microscopy revealed well-defined nanoflower morphologies, and elemental analysis confirmed the uniform incorporation of Zn, O, Ag, and Cu. X-ray diffraction further proved the crystalline nature of the synthesized nanomaterials, with average crystallite sizes ranging from 11.22 to 13.23 nm. Among the fabricated NPs, Ag-Cu@ZnONPs showed the highest efficiency for methylene blue degradation, following pseudo-first-order kinetics, while Ag@ZnONPs displayed robust antibacterial activity and notable synergistic effects with conventional antibiotics against *Bacillus subtilis*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa*. Overall, these findings demonstrate that *L. frutescens* mediated Ag-Cu doped ZnO nanoflowers hold considerable promise as multifunctional materials for environmental cleanup and antimicrobial applications.

**Keywords:** Phytofabrication, biocompatible, nanoflower, MDR, photocatalytic, antibacterial synergy.

## **HARNESSING THE POWER OF PLANT GUMS: A REVIEW OF THEIR BIOACTIVE COMPOUNDS AND THERAPEUTIC BENEFITS**

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### **ABSTRACT**

Plant gums are natural hydrocolloids obtained from the bark of various arboreal species. Gums contain bioactive components, such as saponins, flavonoids, tannins, soluble phenolic compounds, and terpenoids. A vital conclusion is that these gums consist of many monosaccharides, particularly rhamnose, arabinose, and galactose, alongside glycosides, proteins, and important vitamins that elevate their functional roles. Their biological activities further encompass antioxidant functions, modulation of lipid metabolism, and therapeutic interventions for renal, gastrointestinal, and cardiovascular ailments. Moreover, besides their health-maintaining benefits, plant gums have been employed for managing conditions like canker sores, throat soreness, tonsillitis, and the common cold. Their effectiveness in alleviating menopausal symptoms, arthritic discomfort, diarrhea, fatigue, headache, and jaundice highlight their adaptability within both

traditional and contemporary medical practices. This paper presents a review of gums, focusing on their ongoing investigation as multifunctional components in food and healthcare applications.

**Keywords:** Plant Gum; Bioactive compounds; Traditional medicine; Medicinal properties; Pharmaceutical properties

## **INTEGRATED *IN SILICO* AND EXPRESSION PROFILING IDENTIFIES KEY HEAT-RESPONSIVE HSP GENES ASSOCIATED WITH THERMOTOLERANCE IN CHILLI (*CAPSICUM ANNUUM* L.)**

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### **ABSTRACT**

Heat stress is a major abiotic constraint affecting growth and productivity of chilli (*Capsicum annuum* L.). Heat Shock Proteins (HSPs) are known to play a critical role in protecting plants against temperature-induced cellular damage. In the present study, *in silico* gene expression profiling followed by experimental validation was carried out to investigate the expression dynamics of *CaHSP* genes under heat stress conditions. RNA-seq-based expression data retrieved from the NCBI SRA database were analysed across multiple heat stress time points (0, 3, 6, 9, and 24 h). The *in silico* analysis revealed time-dependent differential expression of *CaHSP* genes, with certain genes showing early induction during initial heat exposure, while others were expressed during prolonged stress, suggesting their involvement in both immediate and sustained heat stress responses. Some *CaHSP* genes exhibited constitutive expression across the time points, indicating their role in basal cellular defence mechanisms. Based on the *in silico* analysis, forty-six *CaHSP* genes were selected for experimental validation. Gene-specific primer screening confirmed the amplification of 45 genes on genomic DNA and cDNA templates, indicating high primer fidelity and transcriptional activity. Tissue-specific expression analysis of *CaHSP* genes revealed differential expression across the tissues (flower buds, flowers, leaves, and fruits), with several genes showing higher expression in leaf and fruit tissues, while minimal expression was observed in unopened flower buds. Furthermore, expression analysis of 12 selected *CaHSP* genes under induced heat stress in heat-tolerant (DLS-161-1) and heat-susceptible (Pusa Sadabahar) genotypes revealed that seven genes were

significantly upregulated in the tolerant genotype, suggesting their association with heat stress tolerance mechanisms in chilli. Collectively, this study highlights the dynamic, tissue-specific, and genotype-dependent regulation of *CaHSP* genes and identifies key candidate genes potentially involved in thermotolerance in chilli.

**Keywords:** Chilli, Digital gene expression, Heat stress, SRA Blast, Tissue-specific expression

## **AN OVERVIEW OF MOLECULAR STRATEGIES FOR IRON AND ZINC BIOFORTIFICATION IN CEREALS**

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### **ABSTRACT**

Micronutrient malnutrition, particularly iron (Fe) and zinc (Zn) deficiency, poses a significant public health challenge affecting billions worldwide, especially in developing countries where cereals constitute the primary dietary staple. Biofortification of cereal grains through molecular and biotechnological interventions offers a sustainable strategy to enhance micronutrient density and nutritional security. The present review highlights integrated molecular approaches aimed at improving Fe and Zn uptake, transport, storage, and bioavailability in major cereals such as rice, wheat, and maize. Gene discovery through quantitative trait loci (QTL) mapping, genome-wide association studies (GWAS), and genomic prediction has facilitated the identification of loci and markers associated with high grain Fe/Zn content, thereby accelerating marker-assisted and genomic selection in breeding programs. Genetic engineering strategies, including ferritin overexpression and manipulation of metal transporters such as ZIP and YSL family proteins, have demonstrated enhanced mineral loading in seeds. In parallel, targeted reduction of phytic acid through genome editing or enhanced phytase activity improves micronutrient bioavailability by minimizing mineral chelation. Recent advances in CRISPR/Cas-mediated gene editing enable precise modification of endogenous genes controlling mineral homeostasis without introducing

foreign DNA, providing a rapid and regulatory-friendly alternative to conventional transgenic approaches. Additionally, modulation of microRNAs and the nicotianamine–phytosiderophore pathway further enhances metal translocation and accumulation in edible tissues. Integrating these molecular strategies with conventional breeding and supportive agronomic practices ensures stable expression of biofortified traits under field conditions. Collectively, these approaches present a robust framework for developing nutritionally enhanced cereal varieties, contributing to sustainable agriculture, improved human health, and long-term food and nutritional security.

### **Keywords**

Biofortification, Iron, Zinc, Cereals, QTL mapping, CRISPR/Cas9, Ferritin, Metal transporters, Phytate reduction, Molecular breeding

## **MICROBIAL-INDUCED STRUVITE PRECIPITATION (MISP) AS A SUSTAINABLE PLATFORM FOR NUTRIENT RECOVERY AND METAL IMMOBILIZATION**

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### **ABSTRACT**

The exponentially increasing world population and rapid industrialization have generated a large quantity of wastewater, which harms ecosystems by causing eutrophication, reducing biodiversity, and contributing to climate change by releasing greenhouse gases (GHGs) and heavy metal contamination, including toxic and carcinogenic chromium. The wastewater is typically enriched with large amounts of nutrients such as N and P, which create several significant environmental problems. The MISP is a promising and attractive eco-friendly biotechnological approach for sustainable nutrient recovery, metal immobilization and mitigating environmental pollution. The primary aim of the study is to isolate, characterize and evaluate MISP bacterial strains for susceptibility to nutrient recovery in wastewater matrices. To achieve such a goal, initially, site-specific samples were screened to identify efficient struvite-producing isolates under controlled conditions, followed by assessment in real wastewater matrices. The isolates successfully recovered  $\text{NH}_4^+$  and P as struvite ( $\text{MgNH}_4\text{PO}_4 \cdot 6\text{H}_2\text{O}$ ), a valuable slow-release fertilizer with

biocementation potential. Process monitoring revealed increased  $\text{NH}_4^+$  levels, decreased P concentration, and medium alkalization, confirming microbial-induced struvite formation. Therefore, crystals observed in a stereomicroscope undergo primary screening, which is carried out by different spectrophotometric methods. Potassium dichromate ( $\text{K}_2\text{Cr}_2\text{O}_7$ ) was added to the growth medium to evaluate Cr (VI) removal during MISP activity. Chromium (VI) concentration, bacterial growth, pH, P, and ammonia levels were monitored spectrophotometrically at regular time intervals. The results showed a progressive decrease in medium colour intensity and Cr (VI) concentration with increasing incubation time, accompanied by changes in pH and nutrient dynamics, which confirm the ability of MISP to immobilize toxic. Overall, the study demonstrated that several MISP driven by selected isolates offer a robust, biological-driven platform for nutrient recovery, wastewater treatment, metal immobilization, and contribute to a circular economy for resource management in environmental systems.

**Keywords:** Microbial-Induced Struvite Precipitation (MISP), Nutrient Recovery, Wastewater Treatment, Circular Economy, Biocementation, Metal immobilization.

## AN EFFICIENT MICROWAVE SYNTHESIS OF NITROGEN AND OXYGEN-INFUSED HETEROCYCLIC COMPOUNDS AS POTENTIAL ANTICANCER ACTIVITY

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### ABSTRACT

Heterocyclic compounds, particularly nitrogen and oxygen-containing ones, are gaining attention in medicinal chemistry for their potential as anticancer agents. These compounds influence crucial cellular processes and interact with biomolecules like DNA and proteins. In this study, we synthesized imidazo[1,2-*a*]pyridine-furan hybrids using the Groebke-Blackburn-Bienayme multicomponent reaction method with PEG 400 and microwave irradiation. We explored the anticancer efficacy of these hybrids against NCI-60 cell lines, suggesting their potential for more precise and effective cancer treatments in the future.

**Keywords:** Heterocyclic compound, Imidazo[1,2-*a*]pyridine-furan, Groebke-Blackburn-Bienayme Reaction, PEG 400, Microwave Irradiation, Anticancer agent

**MAINSTREAMING BIODIVERSITY: ENSURING WILDLIFE  
CONSERVATION IS A CORE OUTCOME OF DEVELOPMENT  
PLANNING.**

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**ABSTRACT**

Development planning has historically treated biodiversity conservation as a secondary concern, often leading to habitat fragmentation, species loss, and ecosystem degradation. This paper argues for the imperative of mainstreaming biodiversity—the systematic integration of wildlife conservation objectives and safeguards into the policies, plans, and practices of all economic and development sectors. Moving beyond isolated protected areas, mainstreaming positions healthy ecosystems and wildlife as foundational assets for sustainable development, essential for climate resilience, water security, livelihoods, and long-term economic stability. The paper outlines a framework for ensuring wildlife conservation becomes a core outcome of development planning. This requires: (1) Policy and Regulatory Alignment to embed biodiversity-positive measures in national and sub-national strategies; (2) Proactive and Strategic Spatial Planning, utilizing tools like Strategic Environmental Assessment (SEA) to avoid critical habitats and direct development to less sensitive areas; (3) Cross-Sectoral Integration in key drivers such as agriculture, infrastructure, energy, and urban expansion, promoting nature-based solutions and mitigation hierarchies; and (4) Inclusive Governance and Finance that recognizes local and Indigenous knowledge, secures dedicated resources, and aligns public and private investments with conservation goals. The paper concludes that effective mainstreaming is not a constraint on development but a recalibration towards true sustainability. It reduces long-term risks, unlocks green economies, and ensures that development pathways contribute to, rather than erode, the ecological infrastructure upon which all societies depend. Achieving this paradigm shift demands strong political commitment, institutional coordination, and robust

monitoring to hold development accountable for delivering tangible, positive outcomes for wildlife and the ecosystems they inhabit.

**Keywords:** Biodiversity, Ecosystem, Wildlife, Conservation, Planning, Development.

## **INTEGRATING METHANOTROPH PHYSIOLOGY AND ECTOINE DETECTION INTO SUSTAINABLE BIOPROCESSES AND ONE HEALTH APPROACHES**

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### **ABSREACT**

Methanotrophic bacteria are central to carbon cycling and biotechnological innovation, yet their tolerance to methanol remains a key challenge for industrial application. This presentation combines a literature review with experimental insights to explore methanol stress responses and the role of compatible solutes. The review highlights mechanisms of tolerance, including membrane adaptation, detoxification of formaldehyde, and regulation of central metabolism. Complementing this, my research in nitrate mineral salts medium supplemented with methanol revealed growth responses and extracellular polymeric substance (EPS) formation under varying methanol concentrations. A major focus was the detection of ectoine, a protective osmolyte implicated in solvent stress resistance. Using biochemical assays, ectoine production was confirmed under methanol stress, underscoring its role in microbial resilience. By bridging established knowledge with new findings, this work advances understanding of methanotroph physiology and identifies ectoine as a promising biomarker for stress tolerance in sustainable bioprocesses.

**Keywords:** Methane, Methanol, Ectoine, One Health Approach

## **EFFECT OF NPK ON GROWTH, YIELD AND ECONOMICS OF HYBRID MAIZE**

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## **ABSTRACT**

A field experiment was conducted at College Farm, Navsari Agricultural University, Navsari (Gujarat) during *Rabi* season of the year 2019-20 to study the effect of NPK on growth, yield and economics of hybrid maize. The results revealed that application of nitrogen 180 kg/ha recorded significantly the higher growth parameters, yield attributes and grain (51.58 q/ha) and straw (103.69 q/ha) yields as well as net realization (₹ 88,379/ha) with BCR value (2.68) of maize. Application of phosphorus 60 kg/ha dominated and established its superiority in respect to almost all growth parameters, yield attributes and yields (49.05 q/ha of grain and 98.33 q/ha of straw) with highest net realization (₹ 81,803/ha) and BCR of (2.44). All the growth, yield attributes, grain yield (49.16 q/ha) and straw yield (96.68 q/ha) as well as highest net realization (₹ 83,469/ha) and BCR (2.64) were recorded with the application of potassium 30 kg/ha. Profitable yield of maize can be obtained by the application of 180 kg nitrogen/ha (50 % at basal, 25 % at knee high stage and 25 % at pre-flowering stage), 60 kg phosphorus/ha and 30 kg potassium/ha under south Gujarat condition.

**Keywords:** Maize, nitrogen, phosphorus, potassium, yield, yield attributes, economics

## **DEVELOPMENTAL TOXICITY OF DI-BUTYL PHTHALATE IN ZEBRAFISH LARVAE: A MORPHOLOGICAL ASSESSMENT**

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## **ABSTRACT**

Di-butyl phthalate (DBP) is a widely used plasticizer and an environmental contaminant of growing concern due to its potential developmental toxicity. Early life stages are particularly sensitive to chemical

exposure, making the assessment of developmental effects crucial for environmental and toxicological risk evaluation. Zebrafish (*Danio rerio*) larvae are an established vertebrate model for early developmental toxicity studies owing to their rapid development, optical transparency, and sensitivity to toxicants.

In the present study, the developmental toxicity of DBP was evaluated in zebrafish larvae using morphological endpoints. Embryos were exposed to different concentrations of DBP during early developmental stages, and toxicity was assessed through survival rate, hatching rate or delay, and the incidence of specific morphological deformities up to 96 HPF. Larvae were systematically examined under light microscopy to identify spinal deformities, yolk sac edema, pericardial edema, and tail malformations.

DBP exposure resulted in a clear manifestation of developmental toxicity, characterized by reduced survival, delayed or impaired hatching, and a dose-related increase in morphological abnormalities. Prominent deformities included abnormal spinal curvature, fluid accumulation in the yolk sac and pericardial regions, and structural tail malformations. These effects indicate disruption of normal embryonic and larval development following DBP exposure and highlight the vulnerability of early developmental stages to environmental phthalates.

Overall, the findings demonstrate that zebrafish larvae serve as a sensitive and reliable vertebrate model for assessing early developmental toxicity using morphological parameters. The study underscores the value of simple, observable morphological endpoints as effective tools for rapid screening of developmental toxicants in environmental and toxicological research.

**Keywords:**- Di-butyl phthalate (DBP); Zebrafish larvae; Developmental toxicity; Morphological endpoints; Early life stage toxicity, Environmental contaminants

## **Machine Learning Approaches for Identification of Abiotic Stress-Responsive Genes in Plants: A Review toward Sustainable Crop Improvement**

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### **ABSTRACT**

Abiotic stresses such as drought, salinity, heat, and oxidative stress severely constrain global crop productivity and represent a major challenge to sustainable agriculture under rapidly changing climatic conditions. The identification of stress-responsive genes is therefore essential for the development of climate-resilient crop varieties. However, conventional experimental approaches for gene discovery are labour-intensive, time-consuming and resource intensive. In recent years, advances in bioinformatics and machine learning (ML) have transformed the analysis of large-scale transcriptomic datasets, enabling rapid and accurate identification of candidate genes associated with stress tolerance. This review highlights recent progress in the application of ML techniques—including Random Forest, Support Vector Machines (SVM), Artificial Neural Networks (ANN), and deep learning models—for the prediction and classification of abiotic stress-responsive genes in plants. Publicly available transcriptomic resources, such as the NCBI Gene Expression Omnibus (GEO) and RNA-seq datasets, have facilitated integrative computational analyses that combine differential gene expression profiling, feature selection, and pathway enrichment strategies. Key regulatory gene families frequently identified through these approaches include DREB, NAC, MYB, and WRKY transcription factors, which play central roles in abscisic acid (ABA) signalling, osmoprotectant biosynthesis, and reactive oxygen species (ROS) detoxification pathways. By accelerating gene prioritisation and reducing reliance on extensive wet-lab screening, ML-based frameworks offer a scalable and cost-effective strategy for crop improvement. The integration of artificial intelligence with plant biotechnology thus represents a promising avenue for achieving sustainable agricultural development and enhancing global food security in the face of climate change

**KEYWORDS:** Machine Learning; Abiotic Stress; Transcriptomics; Stress-Responsive Genes; Sustainable Agriculture

**Isolation, Characterization and Antagonistic Activity of Potent Endophytes  
Against Stem Rot (*Sclerotium rolfsii*) Derived from Groundnut (*Arachis  
hypogaea* L.)**

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## ABSTRACT

Stem rot (*Sclerotium rolfsii*), is a most destructive soil-borne pathogen that significantly declines groundnut productivity in global level especially, developing countries like India. Endophytic microorganism represents a great promising and sustainable alternative to chemical fungicides for the suppression of phytopathogens. The present research investigation aimed to isolate, characterize, and screening of the antagonistic activity of potent endophytic bacteria against stem rot pathogen derived from groundnut (*Arachis hypogaea* L.) crops. Endophytes were isolated from stem, root, and leaf plant tissues through culture depended methods, and purified using standard microbiological four-way streaking techniques. Colony morphology was performed through microscopic examination like gram staining and biochemical characterization based on kit as well as manually, followed by screening included assessment of plant growth potential (PGP) traits such as indole-3-acetic acid, nitrogen, potassium solubilization, phosphorus and zinc solubilization, ACC deaminase activity, HCN, siderophores and ammonia production, and antagonistic potential endophytes against *Sclerotium rolfsii* was evaluated through *in vitro* dual culture method, antibiotic sensitive assay, extracellular enzymatic activity, and their interaction using advanced microscopy like scanning electron microscopy (SEM), volatile metabolite through gas chromatography mass spectrometry (GC-MS) and identified through matrix-assisted laser desorption/ionization time-of-flight (MALDITOF) techniques. Several isolates, predominantly affiliated with the genera *Aeromonas*, *Bacillus*, *Enterobacter*, *klebsiella*, *Pseudomonas*, etc., exhibited powerful antifungal activity, producing significant inhibition of fungal mycelial growth and sclerotia formation. Selected most potent endophytes demonstrated multifunctional PGP traits along with unbelievable biocontrol efficiency. These research findings suggest that groundnut-derived endophytic bacteria constitute a valuable insight microbial resource for the development of effective biofertilizer, and biocontrol candidates for sustainable disease control approaches against stem rot in groundnut crop improvement and production to support sustainable environment, economy, and agricultural biotechnology development and growth.

**Keywords:** SEM, MALDITOF, GC-MS, Stem rot, Groundnut, Bacterial endophytes, PGP traits, Antagonist activity.

## **Agricultural Biotechnology: Present Innovations and Future Prospects with the Integration of Artificial Intelligence**

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## **ABSTRACT**

In response to major global challenges such as climate change, rapid degradation of land and increasing food demand across the world, agricultural biotechnology play a vital role in improving crop productivity, yield, quality and resilience. It includes various methods like genomics, marker assisted breeding, genome editing, plant tissue culture and genetic engineering. These methods have improved crop yield, stress tolerance and biotic stress resistance. Conventional biotechnological approaches are sometimes labour intensive, time consuming and have several limitations when it comes to handle big and complicated biological datasets. Artificial intelligence (AI) has become a crucial tool for agricultural biotechnology in last few years. By AI, it is possible to carry out large-scale genomic and phenotypic data analysis, which supports high-throughput phenotyping and genomic prediction, improves gene discovery and speeds up accuracy of gene editing tools like CRISPR. In addition to this, it also reduces time it needed before and expenses for breeding by predicting crop performance under changing environmental conditions and also integrating multi-omics data. This review highlights current applications of agricultural biotechnology; study problems faced before AI integration and mark transformative role of AI in the modern crop improvement. Recent research and projects that are ongoing globally show that AI-assisted biotechnology is already being applied in practical breeding programs. Integration of biotechnology and AI makes a way toward a smarter and more sustainable future for agriculture.

**Keywords:** Agricultural biotechnology, Crop improvement, Genomics, CRISPR, Artificial intelligence

## **Toxicological, Physiological, and Biochemical Responses of Earthworms to Pesticides in India: A Comprehensive Review**

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## **ABSTRACT**

Agriculture is the most important part of the Indian economy, however since the Green Revolution, the use of chemicals has increased a lot, which has put a lot of stress on soil fauna that aren't the focus. This thorough review combines toxicological data from Indian studies to look at how pesticides, like organophosphates and synthetic pyrethroids, affect earthworm populations. It compares standard test organisms like *Eisenia fetida* with native species like *Metaphire posthuma* and *Lampito mauritii*. The investigation demonstrates that indiscriminate chemical application leads to high mortality, with acute toxicity exhibiting considerable variation across different soil substrates. Beyond lethal limits, exposure induces significant physiological and histological degradation, manifested by epidermal lesions, intestinal vacuolization, and muscle disintegration. Biochemical studies demonstrate that these xenobiotics systematically interfere with metabolic processes, chiefly by inhibiting acetylcholinesterase (AChE) and destabilizing oxidative stress markers such as superoxide dismutase (SOD) and catalase. These physiological insults include changes in metabolism, including protein loss and enzyme inhibition, which lead to decreases at the organism level, as seen by reproductive failure, lower biomass, and behavioral changes like avoidance and coiling. In the end, the widespread presence of pesticide residues in Indian farmlands puts the health of the soil ecosystem at risk. The results show that protecting soil biodiversity is very important for long-term fertility. This means that we need to quickly change the way we farm to make it more sustainable and lower the dangers of ecotoxicology to these important ecosystem engineers.

**Keywords:** Bioindicators, Agrochemicals, Acetylcholinesterase, Histopathology, Oxidative Stress

## **Environmental drivers of zooplankton community structure and bacterial load in Rajasthan's freshwater ecosystems: A global perspective**

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### **ABSTRACT**

Freshwater ecosystems face numerous environmental challenges, including climate change, eutrophication, and pollution, and these factors can significantly influence zooplankton community structure and bacterial loads. This review highlights the ecological factors influencing zooplankton community structure and bacterial loads in Rajasthan's freshwater ecosystems, offering a global perspective. Zooplanktons are

essential components of aquatic food chains and serve as effective bioindicators of environmental health, as they are sensitive to changes in physicochemical conditions and climatic variations. Eutrophic conditions often reflect species composition that indicates pollution levels and anthropogenic impacts. Various studies reported high levels of bacterial content during the rainy season, particularly coliforms, fecal coliforms, and *Escherichia coli*, a condition attributed to poor sanitation and surface runoff. Various researchers identified that *Salmonella*, *Shigella*, *Vibrio cholerae*, and *Pseudomonas aeruginosa* often coincided with water-borne diseases such as diarrhea and typhoid, while increased bacterial loads in water bodies during the monsoon season intensify public health risks. Our analysis reveals that environmental factors such as temperature, pH, nutrient levels, and land-use patterns can significantly impact zooplankton community composition and bacterial loads. We also explore global patterns and trends related to these communities and discuss the implications for freshwater management and conservation efforts. This review highlights the need for more comprehensive integrated management strategies that include zooplankton analysis alongside measurements of bacterial abundance, as such approaches are essential for developing effective protection measures and health policies.

**Keywords:** Bioindicators, Coliforms, Conservation, Eutrophication, Zooplankton

## **MORPHOLOGICAL CHANGES IN GROUND BEETLES AS BIOINDICATORS OF ZINC POLLUTION IN ECOSYSTEM: A COMPREHENSIVE REVIEW**

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### **ABSTRACT**

Beetles have emerged as effective bio indicators for environmental monitoring due to their sensitivity to ecological changes and pollutants. Bio indicators have been generating great interest in environmental pollution research. Insects and especially arthropod are useful to assess the effects of anthropogenic activities on the terrestrial ecosystem, because they are in close contact with toxic elements present in soil and in leaf litter. Beetles are extremely sensitive to several ecological parameters, react quickly to environmental modifications and can be easily and cost-effectively sampled by various methods. This

study examines the impact of zinc metal exposure on beetle morphology. Beetles are increasingly recognized as effective bio indicators for assessing zinc contamination in environmental studies. This research investigates the utility of beetles in monitoring zinc pollution by evaluating their morphological and behavioral responses.

**Keywords:** Beetles, pollution, ecosystem, zinc, morphology

## **“SUSTAINABLE AND ANALYTICAL PERFORMANCE EVALUATION OF MEMANTINE HYDROCHLORIDE’S QUANTIFICATION METHODS.”**

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### **ABSTRACT**

In the present study, comparative greenness, blueness, and redness assessment of reported methods for the determination of memantine hydrochloride in bulk, formulation and biological matrices was showcased. Analytical techniques such as spectrophotometric, chromatographic, and electroanalytical were evaluated based on their developmental parameters along with validation results. Simultaneously, the environmental impact of these methods is evaluated using established green analytical chemistry assessment tools like AGREE, BAGI and RAPI. The integrated evaluation identifies analytical methods that maintain high reliability while minimizing environmental impact, and it also underscores methodological limitations and areas requiring further research.

**Keywords:** Memantine Hydrochloride, RAPI, BAGI, AGREE, Analytical Methods

## **GIS-BASED CONSERVATION ASSESSMENT OF PTERIDOPHYTES IN BARDA WILDLIFE SANCTUARY, GUAJART WITH QUANTITATIVE PHYTOCHEMICAL ANALYSIS**

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## ABSTRACT

Pteridophytes constitute an important group of vascular cryptogams with significant ecological roles in ecosystem stability, soil binding, nutrient cycling, and maintenance of microhabitats. They occupy a wide range of habitats, including terrestrial, lithophytic, and aquatic environments. Despite their ecological importance, pteridophytes remain relatively underexplored in Barda Wildlife Sanctuary at species-level identification. The Barda Wildlife Sanctuary, characterized by varied topography, annual rainfall of 500–600 mm, and distinct temperature regimes, offers diverse ecological niches favorable for pteridophyte growth. The systematic studies on pteridophyte distribution, particularly using geospatial tools, are limited. To fill the gap, the research have conducted to documents a checklist of pteridophytes from the Barda Wildlife Sanctuary, along with their habitat preferences and GIS-based distribution. The present study records 10 Pteridophyte species belonging to 5 genera and 4 families from Study area. The quantitative analysis of selected pteridophytes were done namely *Marsilea minuta*, *Marsilea gigantia*, *Marsilea quadrifolia* and *Actinopteris radiata*. The phytochemical compounds Flavonoids and Phenols were tested using Methanol and Water solvent.

**Keywords:** Pteridophyte, GIS, Ecological indicators, Quantitative analysis, Barda Wildlife Sanctuary.

## **Integrated Phytochemical Profiling and GC-MS Metabolomics of *Strychnos potatorum* Fruits with Molecular Docking for Anticancer Potential**

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## ABSTRACT

*Strychnos potatorum*, commonly known as the clearing nut tree, is a medicinal plant valued in traditional systems for its role in treating gastrointestinal, renal, and inflammatory disorders. Despite its recognised therapeutic importance, the fruits remain comparatively underexplored, even though they possess a rich phytochemical potential. In this study, fruit extracts were analysed to establish their chemical profile and biological relevance. Quantitative assays revealed the presence of phenolics, flavonoids, tannins, saponins,

and proteins, indicating a diverse secondary metabolite composition. Gas chromatography–mass spectrometry provided a detailed metabolomic fingerprint, identifying major volatile and semi-volatile constituents with significant relative abundance. To connect chemistry with therapeutic potential, molecular docking was performed against validated cancer-related protein targets. Several metabolites demonstrated favourable binding affinities and interaction patterns, suggesting possible anticancer relevance. Complementary ADMET and drug-likeness screening further evaluated absorption, distribution, metabolism, excretion, and toxicity parameters, highlighting compounds with acceptable pharmacokinetic profiles and reduced toxicity risks. In addition to experimental data, phytochemical information was compiled from established databases to broaden the candidate pool and strengthen compound prioritisation. Together, these findings present a comprehensive framework that integrates phytochemical profiling, GC-MS metabolomics, and computational evaluation to identify promising metabolites of *S. potatorum* for anticancer applications.

**Keywords:** *Strychnos potatorum*, Secondary metabolites, Molecular docking, ADMET profiling

## **NARRATIVES OF NATURE: INTERSECTIONS OF BIOTECHNOLOGY AND ECOCRITICAL THOUGHT IN ENGLISH LITERATURE**

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### **ABSTRACT**

The growing entanglement of scientific innovation and environmental consciousness has significantly reshaped contemporary literary discourse. *Narratives of Nature: Intersections of Biotechnology and Ecocritical Thought in English Literature* examines how English literary texts respond to and critique the expanding influence of biotechnology on natural ecosystems and human life. Drawing upon the theoretical framework of ecocriticism, this study explores literary representations of genetically modified organisms, bioengineering, artificial life, and ecological manipulation as narrative sites where ethical, environmental, and cultural anxieties converge. The paper argues that literature functions as a critical space that interrogates the promises and perils of biotechnological advancement while foregrounding the fragile relationship between humanity and nature.

Through close readings of selected modern and contemporary English literary works, the study highlights how authors employ nature as both a metaphor and a material reality to question anthropocentric domination and technological hubris. These narratives reveal tensions between scientific progress and ecological sustainability, emphasizing themes such as environmental degradation, loss of biodiversity, and moral responsibility. By integrating ecocritical perspectives with biotechnological discourse, the paper demonstrates how literature not only reflects scientific developments but also actively shapes ecological awareness and ethical debate. Ultimately, this research underscores the relevance of interdisciplinary approaches in literary studies, positioning English literature as a vital medium for examining ecological crises in the age of biotechnology. The intersection of narrative imagination and scientific intervention offers profound insights into the future of nature, urging a re-evaluation of human practices and ecological ethics in an increasingly technologized world.

**Keywords:** Ecocriticism, Biotechnology, English Literature, Nature Narratives, Environmental Ethics, Science and Literature

## **SILENT THREAT: INSECTICIDE RESISTANCE AND ESCALATING DENGUE CASES IN INDIA**

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### **ABSTRACT**

The increasing incidence of dengue in India coincides with growing insecticide resistance in *Aedes* mosquito populations, undermining the efficacy of conventional vector control strategies. The introduction of DDT in the 1940s revolutionized mosquito control, forming the backbone of the global malaria eradication efforts, but widespread resistance and environmental concerns led to its reduced use. Subsequent adoption of organophosphates and carbamates provided effective alternatives by inhibiting acetylcholinesterase, though resistance again emerged across vector populations. The development of pyrethroids in the 1980s enabled low-dose, cost-effective vector control interventions like insecticide-treated nets and indoor residual spraying, significantly reducing the burden of vector born diseases.

However, rapid expansion of resistance at global scale compromised their long-term effectiveness. In response to these limitations, WHO promoted integrated vector management and facilitated the deployment of newer classes of insecticides such as neonicotinoids, microbial larvicides, and insect growth regulators to combat resistance and ensure sustainable control. This review provides a comprehensive analysis of the evolution of insecticide resistance. Specifically, it elucidates the mode of action of major classes of insecticide, the resistance mechanisms, and context-dependent deployment strategies crucial for preserving the effectiveness of vector control interventions against dengue, malaria, Zika, and other vector-borne diseases.

**Keyword:** *DDT, Pyrethroids, Organophosphates, Insecticide resistance, Integrated vector management, Aedes mosquitoes*

## **MOLECULAR MARKERS LINKED TO BACTERIAL WILT (*Ralstonia solanacearum*) RESISTANCE GENE LOCI IN EGGPLANT (*Solanum melongena* L.)**

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### **ABSTRACT**

Bacterial wilt (BW) (Caused by *Ralstonia solanacearum*) is the most devastating soil-borne disease in eggplant, causing sudden wilting of the plants before flowering, followed by yellowing of leaves and stunted growth. The molecular marker linked to BW resistance loci will help in the selection and development of elite eggplant resistant cultivars. Bulked segregant analysis (BSA) was performed in segregating F<sub>2</sub> populations with BW resistance and susceptible plants. These populations were derived from the cross between susceptible cultivar GPBRJ 234 and resistant cultivar Anand Raj (GPBRJ 234 × Anand Raj). The present inheritance studies indicated that the eggplant BW resistance is governed by single dominant gene. A total of 380 random amplified polymorphic DNA (RAPD) markers were used in the survey of parental polymorphism, and 144 RAPD were found to be polymorphic. The polymorphic marker OPK 15, showed two different bands of amplicon size 187 bp and 154 bp in GPBRJ 234 and Anand Raj, respectively. The polymorphic RAPD marker OPK 15 can be further utilized for easy

differentiation between resistant and susceptible plants for bacterial wilt. The marker can also be used for development of SCAR marker.

**Keywords:** Eggplant, Bacterial wilt, Resistance, RAPD markers

**SYNTHESIS, BIOLOGICAL SCREENING, MOLECULAR MODELING,  
AND PHARMACOKINETIC PREDICTION OF 2-  
METHYLBENZO[B]THIOPHENE CHALCONE ANALOGUES WITH  
ANTIMICROBIAL POTENTIAL**

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**ABSTRACT**

The rapid spread of multidrug-resistant microorganisms has intensified the search for new therapeutic agents with enhanced potency and improved safety profiles. In this work, a novel set of (E)-1-(substituted)-3-(2-methylbenzo[b]thiophen-3-yl)prop-2-en-1-one derivatives was designed and synthesized. Structural confirmation of the prepared chalcone derivatives was achieved through spectroscopic analyses including FT-IR, <sup>1</sup>H NMR, <sup>13</sup>C NMR, and mass spectrometry. The compounds were evaluated for their antimicrobial efficacy against representative Gram-positive and Gram-negative bacteria, as well as selected fungal strains. Several derivatives demonstrated noteworthy antimicrobial activity, showing effects comparable to reference standard drugs. To further understand their mechanism of action, molecular docking studies were conducted against key bacterial and fungal protein targets, revealing strong binding affinities and favorable interactions within the active sites. In addition, in silico ADMET assessment suggested desirable drug-like characteristics, satisfactory pharmacokinetic behavior, and low predicted toxicity. Overall, the integrated synthetic, biological, and computational investigations indicate that these benzo[b]thiophene-based chalcone derivatives represent promising candidates for future antimicrobial drug development.

**Keywords:-** Benzo[b]thiophene derivatives; Chalcone analogues; Antimicrobial activity; Molecular docking; ADMET profiling; Drug discovery

## **SUSTAINABLE MICROWAVE-ASSISTED SYNTHESIS OF PYRIMIDINE DERIVATIVES: A GREEN CHEMISTRY PERSPECTIVE**

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### **ABSTRACT**

Pyrimidine derivatives constitute an important class of heterocyclic compounds due to their wide range of biological and pharmaceutical applications. In the present study, an efficient and environmentally benign microwave-assisted synthetic protocol has been developed for the synthesis of substituted pyrimidine derivatives. The proposed methodology emphasizes the principles of green chemistry by employing mild reaction conditions, reduced reaction times, minimal solvent usage, and improved product yields. Compared to conventional thermal methods, microwave irradiation significantly enhances reaction efficiency, leading to cleaner reactions and simplified work-up procedures. The synthesized compounds were obtained in excellent yields and were characterized using standard spectroscopic techniques. This sustainable approach offers a practical, energy-efficient, and eco-friendly alternative for the synthesis of pyrimidine derivatives and holds promise for future applications in medicinal and synthetic organic chemistry.

**Keywords:** N-(2,4-bis(trifluoromethyl)phenyl)-3-oxobutanamide; HCl, urea only refluxed.

## **TARGET OF RAPAMYCIN (TOR) SIGNALLING: A MAJOR REGULATOR FOR STRACH METABOLISM IN RED MICROALGA**

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### **ABSTRACT**

The target of rapamycin (TOR) signalling pathway is a key regulator of cellular metabolism in eukaryotes, yet its role in starch metabolism remains poorly understood. Here, we investigated the molecular mechanisms by which TOR controls starch accumulation and degradation in the unicellular red alga *Cyanidioschyzon merolae*. Inhibition of TOR activity by rapamycin increased cellular starch content approximately 10-fold without affecting the expression of genes involved in carbohydrate metabolism, indicating post-transcriptional regulation. Phosphoproteomic analysis identified 52 potential TOR substrates, including CmGLG1, a glycogenin-like priming protein required for starch synthesis initiation. Rapamycin treatment reduced phosphorylation of CmGLG1 at Ser613. Overexpression of CmGLG1 significantly enhanced starch accumulation, whereas a phosphomimic mutant (Ser613Asp) showed markedly reduced starch levels, demonstrating that TOR modulates starch synthesis through CmGLG1 phosphorylation. We further examined CmGWD, an  $\alpha$ -glucan water dikinase homolog implicated in starch degradation. CmGWD knockout increased starch accumulation and decreased starch phosphorylation. Phosphomimic (Ser264Asp) and dephosphomimic (Ser264Ala) variants revealed that phosphorylation at Ser264 promotes starch degradation. Rapamycin-induced starch accumulation was abolished in the phosphomimic strain, indicating that TOR regulates starch degradation by controlling CmGWD phosphorylation. Together, these findings establish dual roles for TOR in coordinating starch synthesis and degradation.

**Keywords:-** rapamycin, eukaryotes, *Cyanidioschyzon merolae*, phosphomimic mutant, dephosphomimic

## **"SYNTHESIS OF ANTI-BIOFOULING METABOLITES UTILIZING STREPTOMYCES SP. FOR THE MITIGATION OF BACTERIAL BIOFILMS**

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### **ABSTRACT**

This study focuses on the screening and inhibition of biofilm-producing bacteria indigenous to the Alang-Sosiya Ship Breaking Yard, Bhavnagar. Four marine *Actinobacteria* were evaluated for their anti-biofouling potential, with *Streptomyces* sp. strain RD4 emerging as the most potent producer of bioactive metabolites. Biofilm formation and inhibition were quantified using phenotypic characterization, the Congo Red Agar (CRA) method, and the Microtiter Plate (MTP) assay.

At a concentration of 2.5 mg/mL, the RD4 extract demonstrated significant anti-biofilm activity, achieving inhibition rates of 91.07% against *Bacillus sonorensis*, 89.54% against *B. licheniformis*, 64.91% against *B. subtilis*, and 79.17% against *Staphylococcus epidermis*. Total inhibition (100%) across all tested bio-fouling strains was achieved at a concentration of 5 mg/mL. The efficacy of the metabolites was further validated through Live/Dead cell assays, while Fourier Transform Infrared Spectroscopy (FT-IR) was employed to characterize the functional groups of the anti-biofoulant compounds. These findings suggest that *Streptomyces* sp. strain RD4 is a promising source of natural compounds for mitigating marine biofouling

**Keywords:** Anti-biofouling; Biofilm; Congo red agar; *Streptomyces* sp. RD4

## **EFFICACY OF A POLYHERBAL FORMULATION IN MANAGING COLIBACILLOSIS IN BROILER CHICKENS**

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### **ABSTRACT**

In response to the growing threat of antibiotic resistance in poultry production, this study investigated the protective effects of a polyherbal formulation (fermented and non-fermented aqueous extracts) in broiler

chickens challenged with *Escherichia coli*. A total of 150 one day old Vencobb 400 broiler chicks were divided into five groups: Environmental control (G1), infection control (G2), non-fermented extract treated (G3), fermented extract treated (G4) and a safety group (G5), receiving only fermented extract. Over a 42-day experimental period, the birds were monitored for growth performance, hematobiochemical, immunological, oxidative stress, gut microbiome status and histopathological parameters. Both extracts demonstrated *in vitro* inhibitory activity against *E. coli*. Polyherbal treated groups (G3, G4) exhibited improved weight gain, feed intake and feed conversion ratio (FCR). Mortality was significantly reduced in the polyherbal extract treated groups compared to the infection control group. Treatment normalized hematobiochemical parameters, signifying hepatoprotective and nephroprotective effects of polyherbal formulation. Antioxidant status improved, and significant reductions in CRP and TNF- $\alpha$  levels were observed, particularly with fermented extract. Microbiome profiling demonstrated that treatment with fermented polyherbal extract led to notable shifts in gut microbial diversity and composition. The Shannon diversity index, a measure of microbiome richness and evenness, was highest in G4, indicating a well balanced and diverse microbial ecosystem compared to the infection control and non treated groups. Histopathological analysis confirmed that the extracts preserved tissue integrity in the liver and intestine. In a nut shell, the polyherbal formulation particularly its fermented form demonstrated protective, antimicrobial, antiinflammatory, antioxidant and immunomodulatory effects in *E. coli* infected broiler chickens.

**Keywords:-** immunomodulatory, resistance, oxidative stress

## SCREENING OF SOIL FUNGI FOR EFFICIENT XYLANASE PRODUCTION

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### ABSTRACT

Xylanase is an industrially important enzyme widely utilized in the pulp and paper sector for the degradation of xylan, a key structural component of hemicellulose. Beyond paper processing, xylanases are extensively applied in biofuel production and in food and beverage industries to facilitate the release of fermentable sugars such as xylose. Importantly, the enzymatic pretreatment using xylanase offers an

environmentally safe approach by minimizing the use of chlorine-based bleaching agents. In the present investigation, soil fungi were evaluated for their ability to produce xylanase under laboratory-controlled conditions. Fungal isolates, namely *Aspergillus niger* and *Penicilium notatum*, were obtained from garden soil samples collected at the Department of Life Sciences, Bhavnagar. The isolates were collected using wheat bran as a substrate and grown on Potato Dextrose agar (PDA) and Yeast Extract Agar (YEA) media. Enzyme activity was examined by optimizing cultural parameters such as pH, temperature, and incubation period. Among the two fungal isolates tested, *Aspergillus niger* demonstrated prominent xylanase activity, evidenced by a distinct zone of hydrolysis observed within 48 hours of incubation, with maximum activity recorded on Yeast Extract Agar. In contrast, *Penicilium notatum* failed to exhibit any detectable hydrolytic zone under identical experimental conditions. The comparative analysis confirms the superior xylanase-producing capability of *Aspergillus niger*. Overall, the study emphasizes the potential of soil-derived fungi, particularly *Aspergillus niger*, as efficient and sustainable sources of xylanase, supporting their application in eco-friendly industrial processes aimed at reducing chlorine dependency.

**KEYWORDS:** Xylanase, *Aspergillus niger*, *Penicilium notatum*, Wheat bran, Chlorine reduction, Hydrolysis

## **SUSTAINABLE BIOCOLORANT FROM DRAGON FRUIT PEEL : DYEING AND ANTIBACTERIAL APPLICATIONS**

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### **ABSTRACT**

Dragon fruit (*Hylocereus* spp.) is an emerging exotic fruit crop in India and the area of production as well as its popularity is increasing nowadays not only because of its attractive colour and economic value, but for its high nutritional value and antioxidant potential. Dragon fruit is a high-value tropical crop primarily harvested for its flesh, leaving significant quantities of nutrient-rich peels as agricultural waste. This study explores the valorization of dragon fruit peel waste as a sustainable source of natural betacyanin pigments with functional antibacterial properties. Total phenolic content (TPC) were determined via UV-Vis spectrophotometry. The antibacterial efficacy of the peel extracts was evaluated against pathogenic bacteria using the agar diffusion method, with potency quantified by measuring zones of inhibition (mm).

Phytochemical profiling indicated that dragon fruit peels are rich in bioactive polyphenols, specifically flavonoids and betacyanins. The extracted red-purple pigment exhibited dual functionality as both a stable colorant and a potent antibacterial agent. Utilizing dragon fruit peel waste offers an eco-friendly alternative to synthetic dyes in the food industry. This integrated waste management approach not only reduces environmental pollution but also enhances the circular economy by providing a secondary income stream for tropical fruit farmers

**Keywords:-** nutritional value, antioxidant potential, spectrophotometry, polyphenols

## **Electric and Magnetic Fields in Biotechnology**

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### **ABSTRACT**

Electric and magnetic fields are invisible physical forces that play an important role in modern biotechnology by influencing biological systems at cellular and molecular levels. In agricultural biotechnology, electric fields are widely applied in techniques such as electroporation, which enables the transfer of genetic material into plant cells by temporarily increasing membrane permeability. Bioelectric signals within plant tissues are also involved in growth regulation, stress response, and nutrient transport.

Magnetic fields provide eco-friendly approaches to enhance seed germination, metabolic activity, and overall plant growth. Applications such as magnetic seed treatment and magnetic nanoparticle-based systems allow targeted gene delivery, biomolecule separation, and controlled release of agro-inputs. These technologies are based on fundamental physical principles including electric potential, ion movement, and magnetic force interactions. The integration of electric and magnetic fields in biotechnology improves efficiency, sustainability, and precision in agricultural practices, demonstrating the vital role of physics in advancing agricultural biotechnology.

**Keywords:-** Electric field, Magnetic field, Electroporation, Agricultural biotechnology, Seed treatment, Physics in life sciences

## **THE CATALYSIS OF MOOD: MONOAMINE OXIDASE (MAO) KINETICS AND THEIR IMPLICATIONS IN MAJOR DEPRESSIVE DISORDER**

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## **ABSTRACT**

Major Depressive Disorder (MDD) is traditionally categorized within the domain of clinical psychology, yet its etiology is deeply rooted in biochemical kinetics. This paper explores the catalytic function of Monoamine Oxidase (MAO), specifically the MAO-A isoform, in the regulation of human mood and affect. By analyzing the oxidative deamination of key neurotransmitters—serotonin (5-HT), norepinephrine (NE), and dopamine (DA)—we establish a direct correlation between enzymatic turnover rates and depressive phenotypes. The paper reviews the "Monoamine Hypothesis" through an enzymatic lens, discussing how overexpression or hyperactivity of MAO-A leads to synaptic deprivation of monoamines, precipitating depressive symptoms. Furthermore, we examine the evolution of MAO Inhibitors (MAOIs) from irreversible non-selective agents to modern Reversible Inhibitors of MAO-A (RIMAs). We conclude that bridging the gap between enzyme kinetics and psychological assessment is essential for the advancement of precision psychiatry.

**Keywords:** Monoamine Oxidase (MAO), Enzyme Kinetics, Major Depressive Disorder, Psychopharmacology, Serotonin, Biopsychology.

## **MEDICINAL SIGNIFICANCE OF CHALCONE DERIVATIVES**

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## **ABSTRACT**

Chalcone derivatives are an important class of naturally occurring and synthetic compounds belonging to the flavonoid family. Structurally characterized by an  $\alpha$ ,  $\beta$ -unsaturated carbonyl system linking two aromatic rings, chalcones serve as key intermediates in the biosynthesis of flavonoids and isoflavonoids in plants. Due to their simple structure and ease of chemical modification, chalcones have attracted

considerable attention in medicinal chemistry for the development of novel therapeutic agents. Extensive pharmacological studies have demonstrated that chalcone derivatives exhibit a wide range of biological activities, including antimicrobial, anti-inflammatory, antioxidant, anticancer, antimalarial, antiviral, antitubercular, and antidiabetic properties. Their anticancer activity is particularly significant, as many chalcone compounds induce apoptosis, inhibit cell proliferation, and interfere with tumour growth pathways. Additionally, chalcones show promising potential in combating drug-resistant microbial strains due to their ability to disrupt microbial enzymes and cell membranes.

Overall, chalcone derivatives represent a versatile and promising scaffold in drug discovery and development. Their broad spectrum of biological activities, combined with low toxicity and synthetic flexibility, makes them attractive lead compounds for the design of new therapeutic agents.

**Keywords:** Chalcone derivatives, Medicinal chemistry, antimicrobial activity, Drug discovery.

## **“SIR Model: A Mathematical Approach to Disease Spread”**

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### **ABSTRACT**

The simplest epidemiological model, known as the SIR (Susceptible–Infected–Recovered) model, consists of mutually exclusive compartments and is widely used to describe real-world phenomena. Beyond public health applications, it serves as a foundational framework in fields such as marketing, computer science, and sociology to analyze and better understand complex dynamic systems. In this study, a two-parameter epidemiological SIR model describing the propagation of coronavirus is considered. The first integrals of the resulting system of nonlinear differential equations are derived. The Painlevé test indicates that the system is not integrable in the general case. Nevertheless, the general solution can be expressed in quadrature form as an inverse time function. By utilizing the first integrals of the system, analytical relationships are established for the number of infected individuals,  $I(t)$ , and recovered individuals,  $R(t)$ , in terms of the susceptible population,  $S(t)$ . Particular attention is given to the interrelationship between  $I(t)$

and  $R(t)$ , both of which depend on the ratio  $\alpha/\beta$ , where  $\alpha$  represents the contact (transmission) rate within the community and  $\beta$  denotes the recovery or mortality rate of infected individuals.

**Keywords:-** SIR model, Epidemiological Modeling, Coronavirus Propagation, Nonlinear Differential Equations, Two-Parameter Model, Disease Transmission Dynamics, Infection Rate ( $\alpha$ ), Recovery Rate ( $\beta$ )

## **ANTICANCER POTENTIAL OF ALPHA-TERPINEOL: A NETWORK PHARMACOLOGY AND MOLECULAR DOCKING STUDY ON APOPTOTIC GENES.**

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### **ABSTRACT**

Cervical cancer remains a significant global health challenge, necessitating the exploration of novel and safer therapeutic agents. Alpha-terpineol, a naturally occurring monoterpene alcohol, has shown promising anticancer potential. This study investigated the effects of alpha-terpineol on cervical cancer using an integrated network pharmacology and molecular docking approach. Drug-likeness and ADME properties of alpha-terpineol were evaluated using QikProp. Cervical cancer-associated targets were identified from GeneCards and OMIM databases and intersected with predicted protein targets obtained from ChEMBL, PharmMapper, SwissTargetPrediction, and PASS. Protein-protein interaction network analysis identified 272 candidate genes, while KEGG pathway enrichment analysis revealed significant involvement in cancer-related pathways, particularly apoptosis. Molecular docking performed using Schrödinger Maestro 13.5 demonstrated strong binding affinity of alpha-terpineol with key apoptotic proteins, including AKT1, BCL2, CASP3, MAPK3, and PARP1. Overall, the findings suggest that alpha-terpineol may exert anticancer effects by modulating apoptotic pathways, supporting its potential as a therapeutic candidate for cervical cancer.

**Keywords:** Alpha-Terpineol, Apoptotic Genes, Network Pharmacology, Molecular Docking, KEGG Enrichment Analysis.

## **CELL CYCLE REGULATION AND DISORDERS**

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### **ABSTRACT**

The cell cycle is a fundamental biological process that ensures accurate cell growth, DNA replication, and division. Its regulation is controlled by a complex network of cyclins, cyclin-dependent kinases (CDKs), and checkpoint pathways that maintain genomic integrity. Recent advances have highlighted the critical role of CDK-cyclin oscillations, tumor suppressors such as p53 and Rb, and DNA damage response mechanisms in safeguarding cell cycle progression. Aberrations in these regulatory pathways lead to uncontrolled proliferation and are strongly associated with cancer and various genetic disorders.

This study reviews key molecular events governing the G1, S, G2, and M phases, emphasizing checkpoint control, mitotic spindle assembly, and replication fidelity. Emerging research on epigenetic regulation, cell-cycle-dependent signaling, and therapeutic targeting of CDKs is also discussed. Understanding these mechanisms is essential for developing innovative diagnostic tools and targeted therapies. The insights presented contribute to strengthening the application of cell cycle research in biotechnology, medicine, and cancer biology.

**Keywords:-** cyclins, , emphasizing checkpoint control, CDK-cyclin oscillations

## **INNOVATIVE STRATEGIES FOR ENHANCING CONCRETE DURABILITY: BACILLUS SPECIES ENCAPSULATION WITH SYNTHESIZED POLYUREA**

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### **ABSTRACT**

Concrete structures often face durability challenges due to environmental factors such as moisture ingress, chemical attacks, and microbial deterioration, leading to reduced lifespan and increased maintenance costs. This study investigates an innovative bio-based strategy to enhance concrete durability by encapsulating *Bacillus megaterium* and *Bacillus subtilis* spores within synthesized polyurea microcapsules. These bacterial species are known for their ability to precipitate calcium carbonate, promoting self-healing in cracked concrete. Polyurea encapsulation protects bacterial spores, maintains their viability, and ensures controlled release upon concrete cracking. The encapsulated microcapsules were characterized using FT-IR, FE-SEM, EDX, and XRD techniques to confirm successful encapsulation and structural integrity. Results demonstrated significant bacterial viability and calcium carbonate productivity post-encapsulation. Crack healing efficiency was confirmed through microscopy, and compressive strength tests revealed substantial improvements (up to 67% for *B. subtilis* treated cubes after 28 days). Overall, this encapsulation strategy presents a promising, sustainable approach for developing self-healing, durable concrete infrastructures by integrating microbiological processes with advanced polymer encapsulation technologies.

**Keywords:** Bacterial concrete; Self-healing concrete; Bacterial encapsulation; Polyurea; Self-healing mechanism.

## **A Selective Recovery of Zinc and Copper Extraction from Brass Foundry Waste Using Sustainable Hydrometallurgical Approach**

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### **ABSTRACT**

Selective recovery of zinc and copper from brass foundry waste presents a sustainable pathway for resource conservation and circular economy advancement. This study investigates an eco-friendly hydrometallurgical approach involving controlled acidic leaching, selective precipitation, and solvent extraction to efficiently separate and recover valuable metals from secondary waste streams. Process parameters such as pH, temperature, leachant concentration, and contact time were optimized to enhance

metal dissolution and selectivity. The proposed method minimizes secondary pollution, reduces energy consumption compared to pyrometallurgical routes, and enables high metal recovery efficiency. The results demonstrate the technical feasibility and environmental compatibility of sustainable zinc and copper recovery from brass industry residues.

**Keywords:** Brass foundry waste; Zinc recovery; Copper extraction; Hydrometallurgy; Selective leaching; Sustainable metallurgy; Circular economy.

## **AN INTEGRATED REVIEW OF POLLUTION SOURCES IN THE BHADAR RIVER AND THEIR IMPACTS ON LIVESTOCK HEALTH**

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### **ABSTRACT**

The Bhadar River constitutes a vital freshwater system in the Saurashtra region of Gujarat, supporting regional biodiversity, agricultural activities, and human settlements. In recent decade, rapid industrialization, urban expansion, and intensified agricultural practices within the Bhadar River basin have led to progressive deterioration of water quality. This review scientific literature, environmental monitoring reports, and government database to evaluate the sources, physiological characteristics, and ecological consequences of pollution in the Bhadar River. Major pollution input includes untreated and partially treated industrial effluents predominantly from textile, dyeing, and agro – processing units – municipal sewage discharges, and non – point agricultural runoff, pesticides and fertilizers. Available studies report elevated concentrations of heavy metals along with persistent organic pollutants, synthetic dyes and significantly increased biochemical oxygen demand (BOD) and chemical oxygen demand (COD), indicating severe organic and toxic contamination. These pollutants have induced substantial alterations in aquatic ecosystem structure, including declines in species diversity, disruption in planktonic and benthic community composition, impaired physiological and reproductive functions in fish, and pronounced bioaccumulation and biomagnification of contaminants across tropical levels. Additionally, degradation of

Bhadar River water quality poses chronic ecotoxicological and public health risks through direct exposure and food chain transfer. The study emphasizes the necessity of integrated basin – scale management.

**Keywords:-** biomagnifications, emphasizes, biodiversity, biomagnifications, chronic ecotoxicological

## **MICROBIAL SYSTEMS IN GREEN MANUFACTURING: FROM ENZYMES TO BIO-BASED MATERIALS**

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### **ABSTRACT**

Green manufacturing aims to reduce the environmental impact of industrial processes by adopting sustainable and biologically driven alternatives. Microbial systems play an important role in this transition by utilizing microorganisms and their metabolic activities for the production of industrially valuable products. This review focuses on the role of microbial systems in green manufacturing, with particular emphasis on microbial enzymes and bio-based materials. Microorganisms such as bacteria, fungi, and yeast are widely used as biological platforms for the production of industrial enzymes through controlled fermentation processes. These enzymes act as efficient biocatalysts and are applied in various industries including detergents, textiles, food processing, and biofuel production. Compared to conventional chemical catalysts, microbial enzymes operate under mild conditions, show high specificity, and reduce the generation of harmful byproducts. In addition to enzyme production, microbial systems are also involved in the synthesis of bio-based materials such as bioplastics, organic acids, and biofuels. Certain microorganisms can convert renewable substrates into biodegradable polymers and other valuable biomolecules, contributing to the development of sustainable industrial materials. The use of microbial fermentation and bioprocess technologies enables efficient resource utilization and supports environmentally responsible manufacturing practices. This review highlights the scientific basis of microbial systems in green manufacturing, discusses their major applications, and addresses key challenges such as process optimization and scale-up. Overall, microbial biotechnology offers promising approaches for developing sustainable and efficient manufacturing processes.

**Keywords:-** biomolecules, byproducts, biofuel, Microorganisms

## **FORMATION OF NITROGEN CONTAINING ADDUCT FROM PYRROLIDINE AND REACTION OF GLUCOSE**

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### **ABSTRACT**

This study investigates the chemical condensation between D-glucose, a representative hexose, and pyrrolidine, a cyclic secondary amine, to form a nitrogen-containing adduct. The reaction typically proceeds via the nucleophilic attack of the pyrrolidine lone pair on the electrophilic carbonyl carbon of the glucose open-chain form. This results in the formation of an unstable hemiaminal intermediate, which subsequently undergoes dehydration to yield a glycosyl amine (specifically, an N-substituted glucosylpyrrolidine).

Under specific conditions (such as slight acidity or heat), this adduct may further undergo Amadori rearrangement to produce 1-amino-1-deoxy-2-ketoses. The structural integrity and yield of the resulting adduct are influenced by solvent polarity, temperature, and the molar ratio of the reactants. This formation is a fundamental model for understanding the initial stages of the Maillard reaction and the development of nitrogen-heterocycle-sugar conjugates in medicinal chemistry.

**Keywords** - Glucose (D-Glucopyranose) ,Pyrrolidine, Amadori Rearrangement Maillard Reaction, N-Glycosylation

## **ISOLATION, CHARACTERIZATION, AND EVALUATION OF PLANT GROWTH-PROMOTING RHIZOBACTERIA (PGPR) ASSOCIATED WITH THE RHIZOSPHERE OF TRITICUM AESTIVUM**

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#### **ABSTRACT**

### **ISOLATION, CHARACTERIZATION AND EVOLUTION OF PLANT PROMOTING RHIZOBACTERIA FROM WHEAT RHIZOSPHERE**

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#### **ABSTRACT**

The increasing contamination of water bodies with synthetic dyes poses serious environmental and public health concerns, while conventional physicochemical treatment methods are often costly and environmentally unfriendly. This study investigates the potential of plant growth-promoting rhizobacteria (PGPR) isolated from wheat ( *Triticum aestivum* ) for simultaneous plant growth promotion and bioremediation of dye-contaminated water. PGPR isolates were obtained from wheat rhizosphere soils across different agro-ecological zones and characterized using morphological and biochemical assays. Fourteen out of fifteen isolates showed positive indole-3-acetic acid production, and selected strains demonstrated sugar utilization ability. Plant bioassays revealed improved root and shoot growth, germination percentage, and vigour index. Five isolates exhibited effective decolorization of azo dyes, likely mediated by enzymatic activities such as azoreductase and laccase. Toxicity assays confirmed significant detoxification of treated effluents. The results demonstrate that wheat-associated PGPR possess dual functionality in enhancing plant growth and remediating dye pollutants, highlighting their promise as sustainable agents for industrial wastewater treatment and eco-friendly agriculture.

**Keywords:** Biofertilizer, PGPR, Dye Degradation, Bioremediation, Seed Germination

### **Microbial Bioplastic (Polyhydroxyalkanoate) Production from Marine Seaweed Biomass Using *Halomonas* spp.**

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### **ABSTRACT**

The increasing environmental impact of synthetic plastics has intensified efforts to develop sustainable and biodegradable alternatives. Polyhydroxyalkanoates (PHAs) are microbial biopolymers with wide applications in packaging, agriculture, and healthcare; however, their large-scale production is limited by the high cost of conventional carbon sources. This study explores seaweed as a low-cost, renewable feedstock for PHA production using *Halomonas* spp. Seaweed biomass was processed to release fermentable sugars, which were utilized by the bacteria for PHA biosynthesis. The results demonstrate that seaweed-derived substrates effectively support microbial growth and PHA accumulation. Owing to its abundance, rapid growth, and minimal resource requirements, seaweed represents an environmentally sustainable raw material for bioplastic production. This work highlights the potential of seaweed-based bioprocessing as a promising strategy for reducing PHA production costs and advancing eco-friendly plastic manufacturing.

**Keywords:-** Polyhydroxyalkanoates, seaweed-based bioprocessing, PHA biosynthesis

### **ISOLATION, SCREENING, CHARACTERIZATION AND OPTIMIZATION OF B-GALACTOSIDASE PRODUCING BACTERIA AND PARTIAL PURIFICATION OF B- GALACTOSIDASE**

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### **ABSTRACT**

**Background:** B-galactosidase (EC 3.2.1.23) is a high-value industrial enzyme essential for the hydrolysis of lactose into glucose and galactose, addressing lactose intolerance and enabling the synthesis of prebiotic galacto-oligosaccharides.

**Methodology:** In this study, potential bacterial strains were isolated from lactose-rich environments, such as dairy effluent and fermented milk products. Primary screening was conducted using X-gal chromogenic assays, followed by quantitative secondary screening via ONPG (o-nitrophenyl-beta-D-galactopyranoside) hydrolysis. The most potent isolate was identified through morphological, biochemical, and 16S rRNA sequencing techniques.

**Optimization and Purification:** To maximize enzyme yield, fermentation parameters including carbon sources, nitrogen sources, pH, and temperature were optimized. The intracellular enzyme was extracted via sonication and subjected to partial purification using Ammonium Sulfate precipitation followed by dialysis.

**Keywords:** B-galactosidase, Lactose intolerance, ONPG assay, 16S rRNA sequencing, Protein purification, Optimization.

## **BIOPESTICIDE/BIOFERTILIZER**

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## **ABSTRACT**

Biopesticides offer sustainable alternatives to synthetic pesticides, derived from natural materials like bacteria (e.g., *Bacillus thuringiensis*), fungi, viruses, pheromones, and plant extracts. Classified into microbial, biochemical, and plant-incorporated types, they target pests specifically, decompose rapidly, and reduce resistance risks. Key advantages include lower toxicity to non-target organisms and enhanced integrated pest management (IPM).

**Keywords:-** Biopesticides, *Bacillus thuringiensis*, synthetic pesticides

## **EFFECT OF THE USE OF PESTICIDES IN AGRICULTURE ON BUTTERFLY FAUNA**

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### **ABSTRACT**

The extensive use of pesticides in agriculture has significantly increased crop production. However, these chemicals have severe negative impacts on non-target organisms, especially butterflies. Butterflies play an essential role in ecosystems as pollinators, bio-indicators, and as part of the food chain. This study analyzes the effects of agricultural pesticides on butterfly diversity, population size, reproduction, and behaviour.

**Keywords:-** pesticides, diversity, reproduction, behaviour

## **Plant Microbiome Engineering: The Future of Sustainable Agriculture**

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### **ABSTRACT**

The increasing demand for food production, coupled with climate change and declining soil fertility, necessitates innovative and sustainable agricultural strategies. Plant microbiome engineering has emerged as a promising approach to enhance crop productivity while reducing dependence on chemical fertilizers and pesticides. The plant microbiome, comprising diverse microbial communities inhabiting the rhizosphere, phyllosphere, and endosphere, plays a critical role in nutrient acquisition, stress tolerance, and disease resistance.

Recent advances in metagenomics, synthetic biology, and microbial consortia design have enabled targeted manipulation of beneficial microbial communities associated with plants. Engineering plant-associated microbiomes can improve nitrogen fixation, phosphorus solubilization, and phytohormone production, thereby promoting plant growth and resilience under abiotic and biotic stress conditions. Additionally, microbiome-based bioinoculants offer environmentally friendly alternatives to agrochemicals, contributing to soil health restoration and long-term agricultural sustainability.

Despite its potential, challenges such as microbial stability in field conditions, host–microbe specificity, and regulatory considerations must be addressed for large-scale implementation. Future research integrating multi-omics approaches and precision agriculture technologies will be crucial in optimizing microbiome interventions for different crops and agroecosystems.

Plant microbiome engineering represents a transformative paradigm in sustainable agriculture, offering eco-friendly solutions to enhance productivity, ensure food security, and mitigate environmental impact.

**Keywords:**- soil fertility, plant-associated microbiomes, agroecosystems

## **CRISPR-CAS9 APPLICATIONS, GENOMIC PRIVACY, AND ADVANCEMENTS IN MEDICAL/AGRICULTURAL BIOTECHNOLOGY**

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### **ABSTRACT**

CRISPR-Cas9 has emerged as a revolutionary tool that enables precise and efficient modifications of the genetic material. This review provides a comprehensive overview of CRISPR-Cas9 technology and its applications in genome editing. We begin by describing the fundamental principles of CRISPR-Cas9 technology, explaining how the system utilizes a single guide RNA (sgRNA) to direct the Cas9 nuclease to specific DNA sequences in the genome, resulting in targeted double-stranded breaks. In this review, we provide in-depth explorations of CRISPR-Cas9 technology and its applications in agriculture, medicine, environmental sciences, fisheries, nanotechnology, bioinformatics, and biotechnology. We also highlight its potential, ongoing research, and the ethical considerations and controversies surrounding its use. This review might contribute to the understanding of CRISPR-Cas9 technology and its implications in various fields, paving the way for future developments and responsible applications of this transformativetechonology.

**Keywords:** CRISPR-Cas9, genome editing, medicine, molecular biology, molecular genetics

## IMPACT OF POLLUTION ON AQUATIC ECOSYSTEMS

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### ABSTRACT

The Increasing Concentration Of Carbon Dioxide (Co<sub>2</sub>) In The Atmosphere Is A Major Contributor To Global Climate Change. This Project Focuses On The Decomposition Of Co<sub>2</sub> Using Microwave Plasma Technology As An Efficient And Sustainable Approach For Carbon Utilization. Microwave Plasma Generates High-Energy Electrons That Break The Strong C=O Bonds In Co<sub>2</sub> Molecules Without Requiring Extremely High Bulk Temperatures.

Through This Process, Co<sub>2</sub> Is Converted Into Valuable Products Such As Carbon Monoxide (Co) And Oxygen (O<sub>2</sub>), Which Can Further Be Used For Syngas Production And Other Industrial Applications. Compared To Conventional Thermal Methods, Microwave Plasma Offers Advantages Such As Faster Reaction Rates, Energy Efficiency, And Reduced Environmental Impact.

This Study Highlights The Potential Of Plasma-Based Co<sub>2</sub> Conversion As A Promising Technology For Greenhouse Gas Reduction And Clean Energy Generation, Contributing Toward Sustainable And Carbon-Neutral Energy Systems.

**Keywords:-** Microwave Plasma, Co<sub>2</sub> Decomposition, Carbon Dioxide, Conversion Plasma Technology, Greenhouse Gas Reduction

## IMPACT OF POLLUTION ON AQUATIC ECOSYSTEMS

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### ABSTRACT

Aquatic Ecosystems Are Essential For Maintaining Ecological Balance, Supporting Biodiversity, And Providing Resources For Human Survival. However, Increasing Levels Of Water Pollution Due To Industrial Discharge, Agricultural Runoff, Oil Spills, And Plastic Waste Have Severely Affected These Ecosystems.

Pollutants Such As Heavy Metals, Pesticides, Petroleum Products, And Persistent Organic Pollutants Contaminate Water Bodies, Leading To Reduced Water Quality, Loss Of Aquatic Species, And Disruption Of Food Chains. Excess Nutrients From Fertilizers Cause Eutrophication, Resulting In Oxygen Depletion And Mass Mortality Of Aquatic Organisms. Additionally, Pollution Poses Serious Risks To Human Health Through Contaminated Drinking Water And Seafood Consumption. Effective Management Strategies, Including Waste Treatment, Pollution Control Regulations, Sustainable Agricultural Practices, And Public Awareness, Are Essential To Protect And Restore Aquatic Environments.

Addressing Water Pollution Is Crucial For Ensuring Environmental Sustainability And Safeguarding Future Generations.

**Keywords:-** Aquatic Ecosystem, Water Pollution, Industrial Waste, Agricultural Runoff, Oil Spill, Plastic Pollution, Heavy Metals, Eutrophication, Biodiversity Loss, Environmental Sustainability

## **FOXP3-DRIVEN IMMUNE TOLERANCE :A THERAPEUTIC TARGET IN AUTOIMMUNITY**

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### **ABSTRACT**

Regulatory T cells (Tregs) are essential for maintaining immune homeostasis by suppressing excessive immune responses and preserving self-tolerance. The transcription factor FOXP3 is the key regulator of Treg development, stability, and immunosuppressive function. Dysregulation of FOXP3 expression or activity—through altered signaling pathways such as IL-2, transcriptional changes, or post-translational modifications—can lead to Treg dysfunction and contribute to autoimmune diseases like systemic lupus erythematosus and rheumatoid arthritis. Current research focuses on understanding the multilayered regulation of FOXP3 and exploring therapeutic strategies, including Treg-based cell therapy and pharmacological modulation, to treat autoimmunity and improve immune-related conditions.

**Keywords:-** Regulatory T cells, homeostasis, Dysregulation

## **MICROBIAL BIOFERTILIZERS: ADVANCING SOIL HEALTH, CROP PRODUCTIVITY AND ENVIRONMENTAL PROTECTION**

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### **ABSTRACT**

The excessive application of chemical fertilizers has contributed to soil degradation, nutrient imbalance, environmental pollution and loss of native microbial diversity. These impacts threaten long-term soil fertility and demand a shift toward biologically sustainable nutrient management for sustainable agriculture. Biofertilizers, consisting of beneficial microorganisms such as nitrogen-fixing bacteria, phosphate-solubilizing microbes, potassium mobilizers, and plant growth-promoting Rhizobacteria, enhance nutrient availability and improve soil health through natural biological processes, further stimulate plant development through phytohormone production, improved root architecture, and enhanced stress tolerance. Recent advances in biofertilizer technology include microbial consortia, smart delivery systems, and precision agriculture-based applications, which improve root colonization, nutrient-use efficiency, and field performance. These innovations support reduced chemical inputs while promoting soil biodiversity and crop productivity. The integration of advanced biofertilizers with site-specific nutrient management offers a promising strategy for regenerative agriculture and climate-resilient food systems. Overall, microbial biofertilizers represent a strategic shift toward regenerative agriculture, promoting soil health, environmental sustainability, and economically viable agricultural production.

**Keywords:** Biofertilizers, Soil Health, PGPR, Sustainable Agriculture, Nano-encapsulation

## **Comparative In-Vitro Antifungal Efficacy of Traditional Bio-resources and Anti-Dandruff Shampoos against Clinical Isolates of *Malassezia* species**

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## ABSTRACT

Dandruff is a chronic dermatological concern characterized by excessive scalp flaking and pruritus, primarily mediated by lipophilic yeasts of the genus *Malassezia*. While synthetic anti-dandruff shampoos are the standard treatment, high recurrence rates and potential side effects have intensified the search for sustainable, natural alternatives. The present research emphasizes the transition from empirical usage to scientific validation of the antifungal potential of traditional remedies.

This study aimed to isolate and characterize *Malassezia* spp. from clinical samples and evaluate the comparative antifungal efficacy of commercial shampoos against traditional bio-resources specifically Onion (*Allium cepa*), Methi (*Trigonella foenum-graecum*), Lemon juice (*Citrus limon*) and Probiotic Curd. Scalp scales were collected aseptically from symptomatic individuals. Fungal isolation was performed on specialized Dixon Agar to satisfy the lipophilic requirements of the isolates. Primary identification was achieved via direct microscopic examination using Lactophenol Cotton Blue (LPCB) staining. The antifungal susceptibility of three commercial shampoos and various concentrations of herbal extracts was determined using the Agar Well Diffusion method, with efficacy quantified by measuring the Zones of Inhibition (ZOI).

Commercial shampoos showed the largest ZOI, the selected bioresources demonstrated significant inhibitory effects. Notably, the mixture of curd and concentrated onion extract exhibited enhanced antifungal activity compared to individual herbal treatments, suggesting a synergistic effect.

Traditional bio-resources, particularly in combination, offer a potent, cost-effective adjunct for long-term dandruff management. This study highlights the potential of using probiotic-botanical mixtures as effective alternatives to purely synthetic formulations.

**Keywords:** *Malassezia* spp., Synergism, Dixon Agar, Antifungal Susceptibility, Bio-resources.

## **SOIL-SPECIFIC OPTIMAL SOWING DEPTH FOR CORIANDER : EFFECTS ON SEED GERMINATION AND EARLY GROWTH.**

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## **ABSTRACT**

Coriander (*Coriandrum sativum L.*) is a commercially and nutritionally important seed spice crop, with India accounting for over 67% of global production and holding a leading position in export markets. Despite its prominence, suboptimal agronomic practices, particularly inappropriate sowing depth and soil selection, limit successful stand establishment and early seedling vigor. This study investigated the combined effects of sowing depth (0, 1, 2, and 3 cm) and soil type (red, black, sandy, and alluvial) on seed germination and early growth performance of coriander under controlled pot conditions. A total of 160 seeds were evaluated across 32 treatment units using a completely randomized design. Germination parameters, including germination percentage (GP), mean germination time (MGT), germination index (GI), and coefficient of velocity of germination (CVG), along with seedling height, leaf number, and stem diameter, were recorded over a six-week period. The results indicated that a 1 cm sowing depth in black soil produced the highest germination efficiency (GI = 6.17, CVG = 61.54%, MGT = 1.63 days) and superior early seedling vigor. In contrast, germination declined markedly at a 3 cm depth, particularly in sandy and alluvial soils. Logistic modeling ( $R^2 > 0.90$ ) indicated black soil's superior performance across all depths, while sandy soil supported enhanced vegetative traits at deeper sowing levels. Correlation analyses underscored a strong inverse relationship between MGT and GI ( $r = -0.89$ ) and suggested a trade-off where rapidly germinating seeds might limit later vegetative development. These findings suggest that a sowing depth of 1–2 cm, particularly in black or well-drained sandy soils, optimizes both germination kinetics and seedling establishment.

**Key words:** *Coriandrum sativum*, sowing depth, soil type, germination index, seedling vigor, stand establishment, edaphic response.

## **The Bi-Directional Loop in Human-Dog Partnership: From Coevolution to Conflict**

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### **ABSTRACT**

Dogs (*Canis lupus familiaris*), members of the family Canidae, evolved from gray wolves (*Canis lupus*) through cooperation rather than aggression, as supported by archaeological and genetic evidence showing benefits for both early humans and proto-dogs in protection and resource sharing (Hare & Tomasello, 2005; Larson et al., 2012). In India, historical records from the Mughal period, particularly during Emperor Akbar's reign, describe social tolerance toward animals, with texts such as the *Ain-i-Akbari* by Abul Fazl documenting free-roaming dogs within forts and settlements as part of a broader ethic of coexistence. Based on field observations, rapid urbanisation, habitat loss, and reduced daily interaction have weakened this bond. Scientific evidence shows that modern lifestyles, including excessive screen exposure and poor nutrition, elevate chronic stress and anger-related hormones in humans (McEwen, 2007; Jacka et al., 2017). Dogs, as social mammals, can perceive human facial expressions and emotional cues (Kis et al., 2017); increased human fear and aggression may therefore provoke defensive biting incidents. Recent Supreme Court observations on human–dog conflict reveal a broader erosion of empathy and coexistence in society, underscoring safety–welfare tensions in stray dog management and indicating that shelters alone are insufficient and not a solution, while sustainable coexistence requires strengthening dog–human partnerships grounded in trust, understanding, and mutual respect. This research contributes by reframing human–dog conflict as a disruption of an evolved cooperative partnership and demonstrates that restoring trust-based human–dog relationships can promote public safety, animal welfare, and the positive psychological and social benefits of sustainable human–dog coexistence.

**Keywords:** Human–Stray Dog Coexistence Ethics, Behavioural Ecology of Dogs, Urbanisation and Habitat Loss, Human–Dog Conflict, Supreme Court of India

## **APPLICATIONS OF GREEN CHEMISTRY AND ENVIRONMENTAL MICROBIOLOGY IN SUSTAINABLE POLLUTION CONTROL**

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### **ABSTRACT**

Rapid industrialization and excessive use of hazardous chemicals have led to severe environmental pollution, posing serious risks to ecosystems and human health. Green chemistry, combined with environmental microbiology, provides a sustainable solution by promoting eco-friendly chemical processes and biologically mediated remediation techniques. This interdisciplinary approach focuses on minimizing toxic waste generation and enhancing natural degradation pathways. The principles of green chemistry emphasize the use of non-toxic reagents, renewable resources, biodegradable materials, and energy-efficient processes to reduce environmental impact. Environmental microbiology further contributes through the application of microorganisms capable of biodegradation, biotransformation, and bioremediation of pollutants such as heavy metals, pesticides, and industrial effluents. Microbial enzymes play a crucial role in converting toxic compounds into less harmful or environmentally benign products. Advancements in green synthesis, microbial catalysis, and bio-based materials have significantly improved pollution control strategies. The integration of microbial processes with green chemical technologies supports sustainable waste management, water treatment, and soil restoration. Overall, the synergy between green chemistry and environmental microbiology represents a promising approach toward achieving environmental sustainability, reducing ecological damage, and promoting sustainable development.

**Keywords-** Green Chemistry, Environmental Microbiology, Bioremediation, Sustainable Development, Pollution Control.

## **AIR POLLUTION CONTROL USING GREEN CHEMICAL METHODS- SUSTAINABLE STRATEGIES FOR A CLEANER ENVIRONMENT**

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### **ABSTRACT**

Air pollution has emerged as one of the most critical environmental challenges due to rapid industrialization, urbanization, and increased vehicular emissions. Conventional air pollution control techniques often rely on chemical processes that may generate secondary pollutants or consume significant energy. In recent years, green chemical methods have gained considerable attention as sustainable and environmentally benign alternatives for air pollution control. This paper focuses on the application of green chemistry principles in mitigating air pollution through the use of eco-friendly materials, renewable resources, and energy-efficient processes. Green chemical approaches such as bio-based adsorbents, photocatalysts, plant-derived chemicals, and non-toxic solvents are discussed for the removal and degradation of major air pollutants including particulate matter, nitrogen oxides, sulfur oxides, and volatile organic compounds. These methods aim to minimize hazardous by-products while maximizing efficiency and environmental compatibility. The study highlights recent advancements in green catalytic systems, natural absorbents, and sustainable reaction pathways that contribute to cleaner air and reduced environmental impact. Emphasis is also placed on the potential for large-scale implementation, economic feasibility, and compliance with environmental regulations. By integrating green chemistry with air pollution control technologies, it is possible to achieve effective pollution reduction while promoting sustainable development. The findings suggest that green chemical methods offer promising solutions for long-term air quality management and play a vital role in protecting human health and the environment.

### **Keywords**

Air pollution control, green chemistry, Sustainable methods, Eco-friendly catalysts, Environmental protection.

## **BIOSYNTHESIS OF VITAMINS- SUSTAINABLE AND BIOLOGICAL APPROACHES FOR NUTRITIONAL ENHANCEMENT**

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### **ABSTRACT**

Vitamins are essential micronutrients required for normal growth, metabolism, and overall human health. Traditionally, vitamins have been produced through chemical synthesis; however, these methods often involve harsh reaction conditions, non-renewable resources, and environmentally harmful by-products. In

recent years, biosynthesis of vitamins using biological systems has emerged as a sustainable and eco-friendly alternative. This paper focuses on the biosynthesis of vitamins using microorganisms such as bacteria, yeast, and fungi, as well as plant-based systems. Biosynthetic pathways for important vitamins including vitamin B-complex, vitamin C, and vitamin K are discussed, highlighting the role of enzymes, metabolic engineering, and fermentation technology. Advances in genetic modification and bioprocess optimization have significantly improved yield, purity, and cost-effectiveness of biologically produced vitamins. The study emphasizes the advantages of biosynthetic methods, including reduced environmental impact, lower energy consumption, and improved biocompatibility compared to conventional chemical synthesis. Applications of biosynthesized vitamins in food fortification, pharmaceuticals, and nutraceutical industries are also explored. Overall, vitamin biosynthesis represents a promising approach that aligns with green chemistry and sustainable biotechnology principles. Continued research and technological development in this field can contribute to enhanced nutritional security and environmentally responsible vitamin production.

**Keywords**

Vitamin biosynthesis, Microbial production, green biotechnology, Metabolic pathways, Nutritional supplements.

**HORMONAL REGULATION AND METABOLISM- INTEGRATIVE  
MECHANISMS IN HEALTH AND DISEASE**

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**ABSTRACT**

Hormones play a central role in regulating metabolic processes essential for maintaining physiological homeostasis in the human body. The endocrine system coordinates the synthesis, secretion, and action of hormones that control carbohydrate, lipid, and protein metabolism, thereby influencing growth, energy balance, and overall health. Disruptions in hormonal regulation can lead to metabolic disorders such as diabetes mellitus, obesity, thyroid dysfunction, and metabolic syndrome. This paper provides an overview of the mechanisms involved in hormonal regulation of metabolism, focusing on key hormones including insulin, glucagon, thyroid hormones, cortisol, and growth hormone. The interactions between these hormones and their target tissues are discussed, emphasizing their role in regulating energy production,

storage, and utilization at the cellular and systemic levels. Recent insights into hormone signaling pathways and feedback mechanisms are highlighted to explain how metabolic balance is achieved under normal physiological conditions. The study also addresses the impact of lifestyle factors, stress, and environmental influences on hormonal balance and metabolic health. Understanding the complex relationship between hormonal regulation and metabolism is essential for developing effective strategies for the prevention and management of metabolic diseases. This review underscores the importance of integrative research in endocrinology and metabolism for improving human health and therapeutic outcomes.

**Keywords**

Hormonal regulation, Metabolism, Endocrine system, Homeostasis, Metabolic disorders.

**ASTEWATER TREATMENT AND MINERAL EXTRACTION-  
SUSTAINABLE APPROACHES FOR RESOURCE RECOVERY**

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**ABSTRACT**

Wastewater generated from industrial, agricultural, and domestic activities contains significant amounts of dissolved minerals and valuable inorganic components. Conventional wastewater treatment processes primarily focus on pollutant removal and safe discharge, often overlooking the potential for resource recovery. In recent years, the integration of mineral extraction techniques with wastewater treatment has gained attention as a sustainable and economically beneficial approach. This paper discusses advanced wastewater treatment methods that enable the recovery of minerals such as phosphates, nitrates, calcium, magnesium, and trace metals. Techniques including chemical precipitation, adsorption, ion exchange, membrane filtration, and electrochemical processes are highlighted for their effectiveness in both contaminant removal and mineral recovery. These methods contribute to reducing environmental pollution while simultaneously generating value-added products.

The study emphasizes the role of sustainable treatment technologies in minimizing waste, conserving natural mineral resources, and supporting circular economy principles. Challenges related to process efficiency, cost, and large-scale implementation are also addressed. The integration of mineral extraction with wastewater treatment presents a promising solution for achieving environmental protection, resource conservation, and sustainable water management. Overall, this approach represents a significant

advancement toward eco-friendly wastewater treatment systems that transform waste streams into valuable resources.

**Keywords**

Wastewater treatment, Mineral extraction, Resource recovery, Sustainable technology, Environmental management.

**HEAVY METAL TOXICITY AND DETOXIFICATION- MECHANISMS,  
IMPACTS, AND REMEDIAL STRATEGIES**

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**ABSTRACT**

Heavy metal contamination has become a major environmental and public health concern due to rapid industrialization, mining activities, agricultural practices, and improper waste disposal. Metals such as lead, mercury, cadmium, arsenic, and chromium are highly toxic, persistent, and capable of bioaccumulation in living organisms. Exposure to these metals can result in severe health effects, including neurological disorders, organ damage, metabolic disturbances, and increased risk of chronic diseases. This paper focuses on the sources and mechanisms of heavy metal toxicity, emphasizing their interaction with biological systems and their role in inducing oxidative stress, enzyme inhibition, and cellular damage. The study also reviews various detoxification and remediation strategies employed to reduce heavy metal toxicity. Biological approaches such as phytoremediation, microbial detoxification, and chelation therapy are discussed alongside physicochemical methods including adsorption, ion exchange, membrane technologies, and chemical precipitation. The advantages and limitations of these detoxification methods are evaluated in terms of efficiency, environmental impact, and sustainability. Emphasis is placed on eco-friendly and green technologies that minimize secondary pollution while effectively reducing metal toxicity. Understanding the mechanisms of heavy metal toxicity and advancing detoxification strategies are essential for protecting environmental health and ensuring human safety. This study highlights the need for integrated and sustainable approaches to manage heavy metal pollution effectively.

**Keywords**

Heavy metal toxicity, Detoxification, Environmental pollution, Oxidative stress, Remediation methods.

## **BIOCATALYSIS AND ENZYME REACTIONS- SUSTAINABLE TOOLS FOR MODERN CHEMICAL AND BIOLOGICAL PROCESSES**

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### **ABSTRACT**

Biocatalysis, the use of enzymes and whole cells to catalyze chemical reactions, has emerged as a powerful and sustainable approach in modern chemistry and biotechnology. Enzymes offer high specificity, efficiency, and selectivity under mild reaction conditions, making them superior alternatives to conventional chemical catalysts. Enzyme-catalyzed reactions play a vital role in biological systems and are increasingly applied in industrial processes. This paper discusses the fundamental principles of biocatalysis and the mechanisms of enzyme reactions, emphasizing enzyme–substrate interactions, catalytic efficiency, and reaction kinetics. Recent advances in enzyme engineering, immobilization techniques, and bioprocess optimization are highlighted for enhancing enzyme stability and performance. Applications of biocatalysis in pharmaceuticals, food processing, biofuels, and environmental remediation are also reviewed. The study emphasizes the contribution of biocatalytic processes to green chemistry by reducing energy consumption, minimizing toxic by-products, and utilizing renewable resources. Challenges associated with large-scale implementation, such as enzyme cost and operational stability, are briefly addressed. Overall, biocatalysis represents a key technology for sustainable development, bridging biological systems with industrial and environmental applications.

**Keywords:-** Biocatalysis, Enzyme reactions, Green chemistry, Metabolic pathways, Industrial biotechnology.

## **“ADVANCING SUSTAINABLE INNOVATION- MAJOR PRINCIPLES OF GREEN CHEMISTRY FOR A GREENER FUTURE”**

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### **ABSTRACT**

The growing environmental concerns associated with conventional organic solvents have accelerated the demand for sustainable alternatives in chemical research and industrial processes. Green solvents, characterized by low toxicity, biodegradability, renewability, and minimal environmental impact, play a vital role in advancing green chemistry principles. The proposed National Conference on Green Solvents for Sustainable Chemistry aims to provide a comprehensive platform for researchers, academicians, industry professionals, and policymakers to discuss recent innovations, practical applications, and future challenges in the field of green solvent technology. The conference will focus on emerging green solvents such as ionic liquids, deep eutectic solvents (DES), supercritical fluids, bio-based solvents, and water as a reaction medium. It will also highlight their applications in organic synthesis, pharmaceutical manufacturing, nanotechnology, extraction processes, catalysis, and environmental remediation. Special emphasis will be given to solvent selection strategies, toxicity assessment, life cycle analysis, and industrial scale-up challenges. By promoting interdisciplinary collaboration, this conference seeks to encourage sustainable practices in chemical industries and research laboratories. The event will contribute to reducing hazardous waste, improving energy efficiency, and supporting national goals toward environmental protection and sustainable development.

**Keywords**

Prevention, reduction of toxicity, alternative energy sources, real time analysis, safer chemistry.

**“GREEN SOLVENTS FOR SUSTAINABLE CHEMISTRY- INNOVATIONS,  
APPLICATIONS, AND FUTURE PERSPECTIVES”**

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**ABSTRACT**

The growing environmental concerns associated with conventional organic solvents have accelerated the demand for sustainable alternatives in chemical research and industrial processes. Green solvents, characterized by low toxicity, biodegradability, renewability, and minimal environmental impact, play a vital role in advancing green chemistry principles. The proposed National Conference on Green Solvents for Sustainable Chemistry aims to provide a

comprehensive platform for researchers, academicians, industry professionals, and policymakers to discuss recent innovations, practical applications, and future challenges in the field of green solvent technology. The conference will focus on emerging green solvents such as ionic liquids, deep eutectic solvents (DES), supercritical fluids, bio-based solvents, and water as a reaction medium. It will also highlight their applications in organic synthesis, pharmaceutical manufacturing, nanotechnology, extraction processes, catalysis, and environmental remediation. Special emphasis will be given to solvent selection strategies, toxicity assessment, life cycle analysis, and industrial scale-up challenges. By promoting interdisciplinary collaboration, this conference seeks to encourage sustainable practices in chemical industries and research laboratories. The event will contribute to reducing hazardous waste, improving energy efficiency, and supporting national goals toward environmental protection and sustainable development.

**Keywords**

Green solvents, DES, Life Cycle Analysis, Toxicity Assessments, Waste Reduction.

**“EPIGENETIC MODIFICATIONS IN CANCER- ROLE OF DNA METHYLATION AS A DIAGNOSTIC BIOMARKER”**

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**ABSTRACT**

Cancer development involves not only genetic mutations but also epigenetic alterations that regulate gene expression without changing DNA sequence. Among these, DNA methylation plays a critical role in tumor initiation and progression by silencing tumor suppressor genes. This study evaluates the pattern of promoter hypermethylation in selected tumor suppressor genes and its association with clinicopathological features in patients with solid tumors. Peripheral blood and tissue samples were analyzed using methylation-specific PCR. Aberrant hypermethylation was significantly higher in cases compared to controls ( $p < 0.05$ ) and correlated with advanced disease stage. These findings suggest that DNA methylation patterns can serve as minimally invasive, early diagnostic and prognostic biomarkers. Understanding epigenetic mechanisms may open avenues for targeted therapies and precision medicine in oncology.

**Keywords-** Epigenetics, DNA methylation, cancer biomarkers, tumor suppressor genes, methylation-specific PCR.

## **PLASTIC DEGRADATION USING MICROORGANISMS AND ENZYMES: A BIOTECHNOLOGICAL APPROACH FOR ENVIRONMENTAL SUSTAINABILITY**

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### **ABSTRACT**

Plastic pollution has intensified into a global environmental crisis, as millions of tons of synthetic polymers continue to accumulate within ecosystems, posing SETious threats to biodiversity as well as human health. Conventional plastic waste management strategies, including mechanical and chemical recycling, show notable limitations in sustainability, especially for polymers such as polyethylene (PE) and polystyrene (PS), which exhibit a strong resistance to degradation. Contemporary attention has increasingly emphasized the need for alternatives such as biodegradable plastics and surrogate disposal strategies, particularly highlighting the potential of microbes to degrade synthetic plastics without any inimical effects. This process involves microbial colonization, enzymatic degradation, and conversion of plastics into non-toxic end products. Biotechnological tools help enhance degradation efficiency through microbial and enzyme optimization. This approach has promising applications in plastic waste management and environmental sustainability, making it a valuable solution for reducing plastic pollution.

**Keywords:** Plastic pollution, Microbial degradation, Enzymatic degradation, Environmental sustainability.

## **MICROBIAL BIOTECHNOLOGY FOR SUSTAINABLE INDUSTRIAL PRODUCTION**

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## ABSTRACT

Microbial biotechnology involves the use of microorganisms such as bacteria, fungi, and yeast for industrial production. For thousands of years, microorganisms have been utilized to produce products such as enzymes, biofuels, organic acids, vitamins, antibiotics, and bioplastics. These microbial processes consume less energy and utilize renewable raw materials. Compared to chemical methods, microbial processes generate minimal waste and significantly reduce environmental pollution. Microbial biotechnology also helps in waste management and bioremediation of industrial effluents. Recent advances in fermentation technology have greatly improved production efficiency. Genetic engineering further enhances microbial productivity. Overall, microbial biotechnology supports green industrial practices and contributes significantly to sustainable development and environmental protection.

**Keywords:** Microbial biotechnology, Bioremediation, Fermentation technology, Sustainable development

## RECOMBINANT ENZYMES IN CANCER THERAPY: MECHANISM OF L-ASPARAGINASE

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## ABSTRACT

Biopharmaceuticals produced using biotechnology have transformed modern medicine by enabling the safe and efficient production of therapeutic proteins and enzymes. Among them, recombinant enzymes play a significant role due to their involvement in specific chemical reactions within the body. Recombinant enzymes, such as L-Asparaginase (L-ASNase), play a crucial role due to their specific biochemical actions. L-ASNase catalyzes the hydrolysis of asparagine into aspartic acid and ammonia, thereby reducing asparagine availability required for the survival of rapidly proliferating cancer cells. It is a key drug in the treatment of acute lymphoblastic leukemia (ALL), as leukemic cells lack asparagine synthetase and depend on extracellular asparagine. Using recombinant DNA technology, the gene encoding L-asparaginase is

isolated and expressed in *Escherichia coli* to obtain the enzyme in large quantities. This biotechnological approach highlights the strong connection between chemistry and life sciences in therapeutic applications.

**Keywords:** Recombinant Enzymes, Asparaginase, Asparagine, Acute lymphoblastic leukemia

## **BIOTECHNOLOGICAL APPROACHES TO IMPROVE BIOACTIVE METABOLITE PRODUCTION IN MEDICINAL AND AROMATIC PLANTS**

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### **ABSTRACT**

Since prehistoric times, medicinal and aromatic plants (MAPs) have been utilized for a wide range of therapeutic applications owing to their diverse pharmaceutically important bioactive compounds, namely secondary metabolites. However, direct isolation of these metabolites from MAPs often results in low yields and restricted production limited to specific tissues or developmental stages. Furthermore, many MAP species, particularly those of pharmaceutical importance, are threatened with extinction as their natural populations face severe pressure from overexploitation driven by the increasing demand for plant-based herbal medicines. Biotechnology provides effective tools to enhance and regulate the natural biosynthetic potential of these plants. Techniques such as plant tissue culture and cell culture allow controlled growth of plant cells and stimulation of metabolite-producing pathways, leading to improved yield and quality. This biotechnological approach supports sustainable production while conserving medicinal and aromatic plant resources for industrial and therapeutic applications.

**Keywords:** Medicinal and aromatic plants, Secondary metabolites, Plant biotechnology, Tissue culture.

## **BIOTECHNOLOGICAL ROLE OF VERMICOMPOSTING IN BIOPESTICIDE PRODUCTION FOR SUSTAINABLE AGRICULTURE**

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## **ABSTRACT**

Sustainable agriculture aims to enhance crop productivity while maintaining environmental balance and long-term soil health. Organic farming is a holistic system that improves soil fertility rather than simply replacing chemical inputs. The generation of large quantities of solid waste worldwide poses a SETious ecological and technical challenge. Vermicomposting offers an effective and environmentally friendly solution for solid waste management. An integrated system combining composting and vermicomposting yields improved outcomes. Additionally, co-digestion of organic wastes enhances process efficiency by creating favorable conditions for microorganisms and earthworms to effectively convert the organic fraction of solid waste under controlled environments. Moreover, the end product of vermicomposting, the nutrient-rich compost, could be used for biogas production. Thus, solid waste management and energy production can be achieved simultaneously without additional costs. This approach provides an environmentally safe and cost-effective strategy for sustainable agricultural practices.

**Keywords:** Vermicomposting, Organic farming, Earthworm, Biogas production.

## **AN INTEGRATED MARINE MICROALGAE RAS SOLUTION FOR URBAN CARBON CAPTURE AND PM 2.5 MITIGATION**

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## **ABSTRACT**

Delhi's persistent air quality crisis, frequently peaking at an AQI of 400+, demands more than traditional mechanical filtration. This study proposes "The Delhi Shield," an urban infrastructure project deploying marine bio-filters to simultaneously target PM2.5 mitigation and carbon sequestration. Unlike standard land-based plants, marine microalgae exhibit significantly higher photosynthetic efficiency and CO<sub>2</sub>

fixation rates. By integrating these organisms into a Recirculating Aquaculture System (RAS), we can maintain optimal growth conditions in harsh urban environments, ensuring a continuous “biological sponge” effect. Our research examines the efficacy of algae-based films in capturing fine particulate matter through electrostatic attraction and moisture-based trapping. Preliminary data suggests that these living filters can reduce localized PM<sub>2.5</sub> concentrations while producing high-purity oxygen as a byproduct. This “blue-to-green” engineering approach moves beyond passive greenery, offering a scalable, point-source solution for high-traffic corridors. By leveraging the natural metabolic power of marine biotechnology, the Delhi Shield provides a sustainable blueprint for reclaiming urban air quality in the world’s most polluted metropolitan environment.

**Keywords:** Bioremediation, Microalgae, Carbon Sequestration, Mitigation

## **PHAGE THERAPY: A TARGETED BIOTECHNOLOGICAL APPROACH TO COMBAT BACTERIAL INFECTIONS**

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### **ABSTRACT**

Phage therapy is an effective alternative for treating infections caused by both antibiotic-sensitive and antibiotic-resistant bacteria, with minimal or no toxicity to patients. It uses bacteriophages; viruses that specifically infect bacteria to treat bacterial infections. With the rise of antibiotic resistance, phage therapy has gained renewed attention in biotechnology and life sciences. Bacteriophages attach to specific bacterial cells, inject their genetic material, replicate inside the host, and finally cause bacterial cell lysis. This high specificity allows phages to target harmful bacteria without affecting beneficial microflora. Phages are naturally eliminated from the body within about seven days after infection clearance and specifically target bacterial strains without significantly disturbing the human microbiota. Phage therapy is being explored in human medicine, aquaculture, and agriculture to control pathogenic bacteria. Biotechnological advances have enabled phage isolation, characterization, genetic modification, and large-scale production. Overall,

phage therapy represents a promising, eco-friendly, and targeted strategy for managing bacterial infections in the post-antibiotic era.

**Keywords:** Phage therapy, Bacteriophage, Antibiotic resistance, Bacterial infections.

## **INDUSTRIAL BIOTECHNOLOGY: ENZYMES AND THEIR APPLICATIONS IN DAILY LIFE**

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### **ABSTRACT**

Industrial biotechnology focuses on the use of biological systems, particularly enzymes, to develop efficient and environmentally friendly industrial processes. Enzymes act as highly specific and efficient biocatalysts that accelerate chemical reactions under mild conditions, reducing the need for extreme temperatures, pressures, and hazardous chemicals, while enhancing sustainability and operational efficiency compared to conventional chemical processes. This review highlights the successful scale-up and commercial application of enzyme-based catalysis in industries such as pharmaceuticals and food and beverages. It also critically examines the current limitations related to enzyme stability and functional performance that restrict their wider application in emerging sectors, including biofuel production and natural gas conversion. Overall, this study emphasizes the role of enzyme engineering and biotechnological strategies in expanding industrial enzyme applications and underscores industrial biotechnology as a key driver of sustainable and green industrial development.

**Keywords:** Enzyme, Biocatalysts, Enzyme application, Green industrial development

## **GREEN CHEMISTRY IN INDUSTRIAL EFFLUENT TREATMENT USING MICROBES**

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## **ABSTRACT**

Green chemistry emphasizes the use of environmentally benign and sustainable approaches to minimize pollution and reduce the use of hazardous chemicals. In industrial effluent treatment, microorganisms offer an eco-friendly and efficient alternative to conventional physicochemical methods. Microbes are environmentally, economically, and socially important, and have been exploited for centuries for the production of valuable products such as enzymes, probiotics, and biofuels. At present, their role has expanded to large-scale industrial applications, particularly in the treatment of toxic wastes. Microorganisms and their enzymes are primarily responsible for the degradation of organic pollutants in wastewater, acting as natural catalysts in biochemical transformations. They function as key biological engineers that regulate ecological processes and facilitate the conversion of harmful contaminants into less toxic or harmless products. Microbial-based bioremediation aligns with green chemistry principles by reducing chemical inputs, energy consumption, and secondary pollution. Overall, this approach highlights the potential of microorganisms as powerful tools in achieving sustainable wastewater management while promoting environmental safety and long-term ecological balance.

**Keywords:** Green chemistry, Industrial effluent treatment, Microorganisms, Microbial enzymes

## **MATHEMATICAL MODELLING OF PCR AMPLIFICATION: EXPONENTIAL GROWTH AND EFFICIENCY**

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## **ABSTRACT**

Polymerase Chain Reaction (PCR) is a widely used molecular biology technique for the amplification of specific DNA sequences and is commonly described as an exponential process in which the target DNA ideally doubles with each cycle. Mathematical modelling of PCR amplification provides a deeper understanding of the kinetics of DNA replication, amplification efficiency, and factors affecting product yield. These models use exponential growth equations that incorporate key parameters such as initial template concentration, number of amplification cycles, and reaction efficiency. Although PCR is often assumed to proceed with constant efficiency during the exponential phase, experimental observations indicate that efficiency can vary with cycle number due to limitations in reagents, enzyme activity, and reaction dynamics. To explain this behavior, mathematical models focusing on the annealing and extension phases of PCR have been developed. Such models allow simulation of the PCR process over successive cycles, improving interpretation of amplification behavior and aiding optimization of PCR conditions in molecular biology and biotechnology applications.

**Keywords:** Polymerase Chain Reaction (PCR), Mathematical modelling, Exponential amplification, Amplification efficiency, DNA replication kinetics.

## **BIOPESTICIDES: AN ECO-FRIENDLY APPROACH FOR SUSTAINABLE AGRICULTURE**

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### **ABSTRACT**

Biopesticides are natural pest control agents derived from microorganisms, plants, and other natural sources, and have proven to be effective in controlling agricultural diseases and insect pests. Because they originate from the environment, biopesticides are generally safe for non-target organisms, including humans, and show reduced persistence in the environment. This makes them suitable for organic farming and sustainable agriculture. Compared to synthetic pesticides, biopesticides are biodegradable, target specific pests, and help reduce pesticide residues and the development of pest resistance. They also offer economic and regulatory advantages, as they require less time and lower cost for development and approval. Important examples include *Bacillus thuringiensis*, pyrethrins, and brassinolide, which are being

developed as alternatives to chemical pesticides in countries. Although biopesticides may act more slowly and have limited shelf life, their environmental safety and role in integrated pest management make them a promising and eco-friendly solution for modern agriculture.

**Keyword:** Biopesticides, Sustainable agriculture, Organic farming, Eco-friendly pesticides.

## **NANO-FERTILIZERS AND NANO-BIOFERTILIZERS: A SUSTAINABLE APPROACH TO AGRICULTURE**

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### **ABSTRACT**

Nano-fertilizers (NFs) and nano-biofertilizers (NBFs) have emerged as innovative tools for improving crop productivity while reducing the environmental impact of conventional chemical fertilizers. These fertilizers utilize nanoparticles in the size range of 1–100 nm to enhance nutrient delivery, uptake efficiency, and utilization by plants. Nano-fertilizers supply essential macro- and micronutrients and can enter plants through roots, leaves, and stomata, resulting in improved growth and yield. Green-synthesized nanoparticles such as zinc oxide, iron oxide, copper, and calcium-based nanomaterials have shown positive effects on various crops including cereals, vegetables, and oilseeds. Nano-biofertilizers combine nanoparticles with beneficial microorganisms or natural polymers like polysaccharides, which promote plant growth, improve stress tolerance, and support sustainable farming practices. Although their large-scale application is still under development, nano-fertilizers and nano-biofertilizers offer great potential for eco-friendly agriculture, smart farming, and global food security. Proper regulation of dosage and application methods is essential for their safe and effective use.

**Keyword:** Nano-fertilizers, Green synthesis, Nutrient delivery, Sustainable agriculture.

## **IMMUNOTHERAPY IN CANCER TREATMENT**

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#### **ABSTRACT**

Immunotherapy is an advanced and promising approach in cancer treatment that works by enhancing the body's own immune system to recognize and destroy cancer cells. Unlike conventional treatments such as chemotherapy and radiation therapy, immunotherapy targets cancer more specifically, resulting in fewer side effects and improved patient outcomes. Several types of immunotherapies are used in cancer treatment, including monoclonal antibodies, cancer vaccines, and adoptive cell therapies. These therapies help the immune system overcome cancer's ability to evade immune detection and promote long-lasting immune responses against tumours. Immunotherapy has shown significant success in treating cancers such as melanoma, lung cancer and lymphoma. However, challenges such as high cost, immune-related side effects, and variable patient response still exist. Despite these limitations, immunotherapy represents a major breakthrough in oncology and offers new hope for effective and personalized cancer treatment. This poster highlights the types, mechanisms, advantages, and future potential of immunotherapy in cancer management.

**Keyword:** Cancer, Immunotherapy, Targeted therapy.

### **MEDICINAL AND AROMATIC PLANT: SHATAVARI (ASPARAGUS RACEMOSUS)**

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#### **ABSTRACT**

Shatavari (*Asparagus racemosus*) is a well-known medicinal and aromatic plant widely used in traditional Ayurvedic medicine. It is valued for its tuberous roots, which possess adaptogenic, immunomodulatory,

and rejuvenating properties. Shatavari is especially recognized for supporting female reproductive health, promoting lactation, and balancing hormonal functions. The plant contains important bioactive compounds such as saponins (shatavarins), flavonoids, alkaloids, and antioxidants, which contribute to its anti-inflammatory, antimicrobial, and digestive benefits. Due to its wide range of therapeutic uses and minimal side effects, Shatavari holds significant importance in herbal medicine and pharmaceutical applications.

**Keyword:** Shatavari, Medicinal and aromatic plant, Ayurveda, Therapeutic uses, Herbal medicine.

## **PLANT HYBRIDIZATION: AN EFFECTIVE TOOL FOR CROP IMPROVEMENT**

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### **ABSTRACT**

Plant hybridization is an important breeding technique that involves the crossing of two genetically different plant varieties or species to produce offspring with desirable traits. This method is widely used to improve crop yield, quality, disease resistance, and adaptability to environmental conditions. Hybrid plants often exhibit hybrid vigor, showing better growth, higher productivity, and increased resistance compared to their parent plants. Plant hybridization can occur naturally or be carried out artificially through controlled pollination. It plays a significant role in the development of improved crop varieties in vegetables, fruits, and ornamental plants. Advances in plant breeding techniques, including molecular markers and biotechnology, have further enhanced the efficiency of hybridization programs. Overall, plant hybridization is a valuable tool for sustainable agriculture and food security by helping meet the increasing demand for high-yielding and stress-tolerant crops.

**Keyword:** Plant hybridization, Cross-breeding, Crop improvement, Uses.

## **ANTIMICROBIAL EFFECT OF NATURAL HONEY**

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## **ABSTRACT**

Natural honey exhibits significant antimicrobial activity against a broad range of pathogenic microorganisms. This effect is attributed to multiple factors, including high sugar concentration, low pH, hydrogen peroxide production, and the presence of bioactive compounds such as phenolicS and flavonoids. These components act synergistically to inhibit bacterial growth and disrupt microbial metabolism. Studies have shown that natural honey is effective against both Gram-positive and Gram-negative bacteria, as well as some fungi, highlighting its potential as a natural antimicrobial agent for therapeutic and food-preSETvation applications. Thus, identification and characterization of the active principle(s) may provide valuable information on the quality and possible therapeutic potential of honeys (against several health disorders of humans), and hence we discussed the medicinal property of honeys with emphasis on their antibacterial activities

**KEYWORDS:** Honey, Antibacterial activity, wound healing property, Glucose oxidase, Non-peroxide effect, Antimicrobial agents, Antimicrobial property, Immunomodulatory property

## **“GUT MICROBES: THE HIDDEN LINK BETWEEN STOMACH AND BRAIN”**

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## **ABSTRACT**

Our stomach and intestines are home to trillions of tiny living organisms called **gut microbes**. These include bacteria that normally help digest food and protect us from harmful germs. However, scientists have discovered that these gut microbes do much more than just help with digestion — they also play a role in how our brain works. the connection between the gut and brain is known as the **gut-brain axis**. This

is a communication network that links the nervous system of the gut with the brain. Signals travel back and forth through nerves, hormones, and immune molecules. Gut microbes can produce substances like **neurotransmitters**, which are chemicals that affect mood, thinking, and behaviour. For example, some gut bacteria help make **SETotonin**, a chemical important for feeling happy and calm.

When the balance of gut microbes gets disrupted — a condition called **dysbiosis** — it can affect this communication system and the brain. This imbalance has been linked with problems like stress, anxiety, depression, and even memory issues. Some stomach bacteria, such as *Helicobacter pylori*, have also been studied for possible effects on the nervous system. Understanding how gut microbes influence the brain could help researchers find new ways to prevent or treat brain-related conditions — not by changing the brain directly, but by improving the balance of microbes in the stomach and gut.

**KEYWORDS:** - Gut Microbes, Gut-Brain Axis, Neurotransmitters.

## **DYNAMIC ADAPTATION IN ANIMALS COLOUR CHANGE, MIMICRY AND BIOLOGICAL TRANSFORMATION**

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### **ABSTRACT**

Animals have developed remarkable strategies to survive in their environments, often by changing their appearance or behavior. These strategies, collectively known as dynamic adaptations, allow animals to respond to threats, environmental changes, or the need to attract mates. One key adaptation is colour change, where animals such as chameleons, cuttlefish, and some fish can alter their skin color to camouflage with their surroundings, warn predators, or communicate with other animals. Another fascinating strategy is mimicry, where harmless animals imitate the appearance, sounds, or behavior of dangerous or unpalatable species to avoid predation. For example, the harmless viceroy butterfly mimics the toxic monarch butterfly. Biological transformation is another form of adaptation, where animals

undergo physical or behavioral changes during their life cycle to survive. Examples include metamorphosis in insects like butterflies and frogs, which transition from larval to adult forms with completely different structures and lifestyles.

**KEYWORDS:-** Dynamic Adaptation, Colour Change, Survival Strategies, Evolutionary Adaptation, Mimicry, Predator Avoidance

## **A REVIEW ON: BIOCHEMISTRY BEHIND STRSS – PLANT FUNCTION**

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### **ABSTRACT**

Plant Functional Biochemistry explores how the chemical processes within plants influence their growth, development, and adaptation. It examines the roles of enzymes, metabolites, and signaling molecules in key physiological activities like photosynthesis, respiration, nutrient assimilation, and stress responses. By linking molecular mechanisms to whole-plant function, this field helps explain how plants adjust to environmental challenges, such as drought, pathogens, or temperature extremes. Understanding these biochemical pathways also informs crop improvement, sustainable agriculture, and biotechnology. Essentially, it bridges plant biochemistry with practical functions, revealing how molecular interactions drive survival, productivity, and ecological success.

**KEYWORDS:-** Plant biochemistry, Enzymes, Metabolites, Photosynthesis, Respiration, Stress physiology, Signal transduction, Plant adaptation, Crop improvement, Functional biology

## **CHALLENGES OF ANTIBIOTICS**

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### **ABSTRACT**

Antibiotic resistance has emerged as a major global health challenge due to the overuse and misuse of antibiotics. The slow development of new drugs, high research costs, and environmental contamination further reduce treatment effectiveness. Addressing this issue requires responsible antibiotic use, improved awareness, and innovation in antimicrobial research.

**KEYWORDS:-** Antibiotic resistance, overuse and misuse, drug development, environmental contamination, global health, antimicrobial stewardship.

## **BIO-FERTILIZER NITROGEN FIXATION**

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### **ABSTRACT**

Nitrogen fixation is the process of converting atmospheric nitrogen ( $N_2$ ) into ammonia ( $NH_3$ ), making nitrogen available for plant growth. This process is mainly carried out by nitrogen-fixing microorganisms such as Rhizobium, Azotobacter, and cyanobacteria. Symbiotic nitrogen fixation in legumes through root nodules is highly important for improving soil fertility. The enzyme nitrogenase plays a key role in this energy-dependent process. Biological nitrogen fixation reduces the need for chemical fertilizers, supports sustainable agriculture, and helps maintain soil health.

**KEYWORDS:-** Atmospheric Nitrogen ( $N_2$ ), Ammonia ( $NH_3$ ), Biological Nitrogen Fixation, Nitrogen-Fixing Microorganisms, Symbiotic Nitrogen Fixation, Health Plant, Growth and Nutrition

## **PHEROMON BASED BIOTECHNOLOGICAL APPARATUS IN AGRICULTURE AND AQUACULTURE**

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## ABSTRACT

Pheromones are chemical signals that help organisms communicate, affecting behavior and body functions. Biotechnology uses these natural signals to solve real-world problems like pest control and fish breeding. In the cotton bollworm (*Helicoverpa armigera*), female moths release sex pheromones to attract males. Synthetic pheromones confuse the males, preventing mating and reducing crop damage. In Nile tilapia (*Oreochromis niloticus*), reproductive pheromones trigger hormonal changes in males and females, leading to synchronized spawning and better aquaculture production. Using biotechnology, pheromones can be produced on a large scale with chemicals or microbes. Understanding how each organism detects and responds to pheromones helps design eco-friendly, targeted solutions for agriculture and aquaculture.

**KEYWORDS:-** Pheromones, Chemical Communication, Behavioral Regulation, Physiological Responses, Cotton Bollworm, Mating Disruption, Eco-friendly Biotechnology, Aquaculture Enhancement, Reproductive Pheromones, Crop Protection

## TETRA FISH ASA MODEL FOR BIOTECHNOLOGY AND GENETIC ENGINEERING

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## ABSTRACT

Tetra fish (family Characidae), especially species like the yellowtail tetra (*Astyanax altiparanae*), are emerging as promising model organisms in biotechnology and genetic engineering research. While traditional fish models like zebrafish have dominated laboratory studies, tetra fish offer distinct advantages for regional and applied biotechnological studies due to their small size, ease of breeding, and suitability for controlled laboratory conditions. Research efforts have focused on establishing tetra fish as a laboratory model for advanced biotechnological techniques such as **germ cell transplantation, chromosome SET manipulation, and micromanipulation**, which are critical tools in genetic engineering and aquaculture development. These studies demonstrate that tetra fish can be used not only for fundamental genetic

research but also for applied objectives like conservation of genetic resources and aquaculture improvement. Their potential to bridge ecological relevance with modern molecular tools positions tetra fish as valuable alternatives or complements to existing vertebrate models in biotechnological innovation.

**KEYWORDS:-** Tetra fish model organism, genetic engineering, **germ cell transplantation**, Chromosome manipulation, Neotropical fish research, Genetic tools in aquaculture, Micromanipulation

## **CLIMATE RESILIENCE: INTEGRATING NATURE-BASED SOLUTIONS AND SMART TECHNOLOGY FOR DISASTER MITIGATION**

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### **ABSTRACT**

"In the current era, Climate Change has emerged as a global crisis, leading to an increased intensity of severe disasters in India such as floods □, heatwaves , and cyclones. These escalating calamities pose a significant challenge not only to human life and the economy but also to our secure existence in the future." "To mitigate these risks, this research proposes integrating Nature-Based Solutions with Smart Technology. We introduce innovative methods like 'Sponge Cities' for flood control and 'Cool Roofs' for heat reduction. This hybrid approach ensures sustainable protection using advanced sensors and natural ecosystems." "The methodology focuses on 'Hybrid Resilience', combining Mangrove Restoration □ for coastal defense with AI-driven IoT sensors for early flood detection. By integrating satellite data with living ecosystems, we developed a robust model for proactive disaster mitigation. In conclusion, this hybrid model provides long-term and cost-effective protection against climate extremes. It not only mitigates disaster risks but also enhances environmental sustainability, which is essential for building a secure and resilient future.

**KEYWORDS:-** Climate Change, Nature-Based Solutions, Smart Technology, Hybrid Resilience, AI-driven IoT sensors, environmental sustainability, Mangrove Restoration

## **EFFECT OF RADION IN HUMAN BODY**

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## **ABSTRACT**

Radiation refers to energy emitted as particles or waves that can interact with living tissues. When the human body is exposed to ionizing radiation, such as X-rays, gamma rays, and particles from radioactive sources, it can cause biological damage by ionizing atoms in cells and disrupting molecular structures like DNA. High doses of radiation can lead to **acute radiation syndrome (ARS)**, characterized by nausea, fatigue, and in severe cases, organ failure. At the cellular level, radiation can break DNA strands directly or indirectly through free radical formation, leading to mutations, cell death, or uncontrolled cell growth (cancer). Long-term effects of exposure include increased risk of cancer, genetic mutations passed to future generations, and damage to rapidly dividing tissues such as bone marrow and reproductive organs. The health impact depends on the dose, duration of exposure, and type of radiation. Understanding these effects is crucial for risk assessment, medical uses, and radiation protection measures.

**KEYWORDS:** - Radiation, X-rays, gamma rays, Tissue damage, Radio sensitivity, Acute radiation syndrome, radiation protection

## **Gene Therapy: Rewriting the Code of Life**

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## **ABSTRACT**

Gene therapy represents a groundbreaking paradigm in medicine, aiming to treat diseases at their genetic roots by rewriting the code of life. This presentation explores what gene therapy entails, tracing its evolution from early trials to modern breakthroughs. It delves into the two fundamental approaches—gene addition and gene editing—and key methods of gene delivery, such as viral vectors and nanoparticles. A step-by-step explanation reveals how gene therapy works, from targeting defective genes to cellular integration and protein expression.

The transformative impact spans diseases like genetic disorders (e.g., SMA), cancers, and inherited blindness, revolutionizing treatment paradigms. At the forefront stands CRISPR-Cas9: the gene-editing revolution, enabling precise DNA modifications with unprecedented accuracy. Yet, challenges persist, including off-target effects, immune responses, and ethical concerns, requiring a balanced view of benefits against challenges.

Looking forward, the future of gene therapy promises personalized cures, ex vivo therapies, and global accessibility, heralding an era of precision

**Keywords:** - Gene therapy, medicine, genetic roots, evolution, disorders, immune responses, enabling precise

### **DIFFERENCE BETWEEN ANTIBIOTICS AND ANTIVIRALS**

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#### **ABSTRACT**

Antibiotics and antivirals are medicines used to treat infectious diseases, but they work against different types of microorganisms. Antibiotics are used to treat bacterial infections by killing bacteria or stopping their growth, and they are ineffective against viruses. Antivirals, on the other hand, are used to treat viral infections by preventing viruses from multiplying inside the host cells. Unlike antibiotics, antivirals do not destroy viruses completely but help control the infection. Understanding the difference between antibiotics and antivirals is important to ensure proper treatment and to prevent drug resistance

**Keywords:-** Antibiotics, Antivirals, Infectious diseases, Bacterial infections, Viral infections, Kill bacteria, Inhibit bacterial growth, Ineffective against viruses, Prevent viral multiplication, Host cells, Control infection, Drug resistance, Proper treatment

### **THE ROLE OF GUT BACTERIA IN IMMUNE SYSTEM**

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#### **ABSTRACT**

gut bacteria, collectively known as the gut microbiota, comprise a diverse community of microorganisms residing in the human gastrointestinal tract. these microbes play a crucial role in host metabolism by aiding in the digestion of complex carbohydrates, synthesizing essential vitamins, and regulating energy balance. gut bacteria also contribute significantly to immune system development and protection against pathogenic microorganisms. disruption of the gut microbiota, known as dysbiosis, has been linked to various disorders, including inflammatory bowel disease, obesity, diabetes, and mental health conditions. therefore, maintaining a balanced gut microbiota is essential for overall physiological health.

**Keywords:-** gut microbiota, microorganisms, disruption, obesity, diabetes

## **AI IN MEDICINE**

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## **ABSTRACT**

As we enter 2026, the fusion of Artificial Intelligence and Microbiology is transforming global healthcare and research. This presentation explores five breakthrough areas that define this era:

1. AI-Powered Diagnostics: Using machine learning to identify pathogens from digital images in seconds, replacing hours of manual microscopy with 95% accuracy.
2. Fighting Superbugs & AMR: Utilizing genomic AI to predict antibiotic resistance, ensuring that patients receive the most effective treatment immediately without trial and error.
3. AI in Drug Discovery: Showcasing how generative models design new antibiotic molecules in weeks rather than years, staying ahead of evolving bacterial threats.
4. Gut Microbiome & Personalized Health: Analyzing trillions of microbial data points to provide personalized health maps that connect gut bacteria to immunity and mental well-being.
5. Smart Labs & Robotics: Implementing fully autonomous laboratory systems that conduct 24/7 experiments, accelerating the pace of scientific discovery with zero human error.

By replacing slow, manual processes with digital precision, AI is not just improving laboratory science—it is saving lives at an unprecedented speed and creating a future of accessible, high-quality healthcare for all.

**Keywords:** - Artificial Intelligence, Antimicrobial Resistance (AMR), Genomic AI, Gut Microbiome, Smart Lab Automation, Precision Medicine, Pathogen Diagnostics.

## **MEDICIONAL PLANT TULSI**

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### **ABSTRACT**

Tulsi (*Ocimum sanctum*), widely known as the Queen of Medicinal Plants, is a highly valued herb in traditional Indian systems of medicine, particularly Ayurveda. It has been used for centuries for its preventive and curative properties. Tulsi exhibits a broad spectrum of pharmacological activities, including antioxidant, anti-inflammatory, antimicrobial, antidiabetic, and immunomodulatory effects. These medicinal properties are attributed to the presence of bioactive compounds such as eugenol, ursolic acid, carvacrol, and flavonoids. Tulsi is effective in the management of respiratory disorders, stress-related illnesses, infections, and metabolic disorders. In addition to its therapeutic applications, Tulsi contributes to environmental health through air purification and ecological balance. Recent scientific studies support many of its traditional uses, highlighting its potential role in modern medicine. This paper emphasizes the medicinal significance of Tulsi and explores its role as a natural, cost-effective, and sustainable resource for promoting human health, thereby justifying its recognition as the Queen of Medicinal Plants

**Keywords:-** Tulsi (*Ocimum sanctum*), immunomodulatory effects, carvacrol, metabolic disorders

## **DEVELOPMENT OF STANDARDIZED MICROPROPAGATION PROTOCOL FOR BRAHMI (*BACOPA MONNIERI*) : A TOOL FOR THE AUTGENTICATION FOR ENGANGERED SPECIES**

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## ABSTRACT

Brahmi (*Bacopa monnieri*) is a valuable medicinal plant known for its neuropharmacological properties, but its natural populations are rapidly declining due to overexploitation and habitat destruction. The present study aims to develop a standardized micropropagation protocol as an effective tool for the authentication and conservation of this endangered species. Authenticated, healthy explants were collected and surface sterilized to establish aseptic cultures. The explants were cultured on Murashige and Skoog (MS) medium supplemented with optimized plant growth regulators for efficient shoot induction and multiplication. Successful rooting was achieved on half-strength MS medium containing suitable auxins. The regenerated plantlets were hardened through gradual acclimatization and transferred to field conditions with high survival rates. This protocol enables rapid multiplication of true-to-type, disease-free plants and reduces dependence on wild populations. The study demonstrates the potential of micropropagation in conserving and authenticating endangered medicinal plants like *Bacopa monnieri*.

**Keywords:** Brahmi (*Bacopa monnieri*), medicinal plant, (MS) medium

## VACCINES AND RECOMBINANT TECHNOLOGY

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## ABSTRACT

Vaccines are a cornerstone of preventive medicine, providing immunity against infectious diseases by stimulating the body's immune system to recognize and neutralize pathogens. Traditional vaccines, such as live-attenuated and inactivated types, have been instrumental in controlling diseases like polio, measles and influenza. Recombinant technology has emerged as a transformative tool in modern vaccinology. This approach involves the insertion of genes encoding specific antigens from pathogens into suitable host organisms—such as bacteria, yeast, or insect cells—which then produce the antigens safely and efficiently.

These recombinant antigens are purified and formulated into vaccines, eliciting a robust immune response without the risk of causing disease. Prominent examples include the Hepatitis B vaccine, produced in yeast cells expressing the surface antigen (HBsAg), and the Human Papillomavirus (HPV) vaccine, which uses virus-like particles generated through recombinant DNA technology.

**Keywords-** Hepatitis vaccine, Human papillomavirus, Diseases

## THE AMAZING KINGDOM OF FUNGI

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### ABSTRACT

The Fungal Kingdom is vast, spanning two to five million, or even more, fungal species. Only a relatively small fraction has been isolated and named, and an even smaller number have been subjected to genetic, molecular and genomic studies. Fungi shape many facets of life on Earth by occupying important ecological, medicinal, and industrial niches. This example emphasizes how fungus can be the source of both significant global problems and game-changing remedies. On the one hand, fungi are linked to the increase of human pathogenic species, plant disease outbreaks, wildlife threats and antifungal resistance—pressures that are exacerbated by environmental disruption and climate change. Fungi are a diverse and ubiquitous group of organisms that play important roles in nature, industry and medicine. They exist mainly as hyphae forming a mycelium, though some, like yeasts, occur as unicellular forms. Many fungi are opportunistic pathogens causing infections, especially in immunocompromised individuals. Fungi reproduce both asexually and sexually through processes such as budding, fragmentation and spore formation. They obtain nutrients by extracellular digestion and absorption of organic matter. Fungi are beneficial to humans through their role in decomposition, fermentation, and antibiotic production, particularly penicillin.

**Keywords-**Fungal species, Global problems, Organic matter

## INDUSTRIAL BIOTECHNOLOGY

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### ABSTRACT

In terms of sustainability, resource efficiency and environmental protection, industrial biotechnology has emerged as one of the major transformative forces of the twenty-first century. Modern biological processes and industrial uses for bio-based chemicals, materials and energy are combined in this sector. These developments pave the way for long-term solutions that will lessen reliance on fossil fuels, cut greenhouse gas emissions, and offer sustainable substitutes for traditional manufacturing methods. The effects of industrial biotechnology on the manufacturing, healthcare, energy and agricultural sectors are thoroughly examined in this abstract. The evolution of synthetic biology, the creation of biofuels and bioplastics and the function of microbes and enzymes in environmentally friendly production processes are all covered. In order to maximize the potential benefits of industrial biotechnology and limit its drawbacks, this abstract urges more study and integrative approaches.

**Keywords**-Healthcare, Enzymes, Sustainability

### A NEW HOPE: USING CRISPR GENE EDITING TO TREAT SICKLE CELL DISEASE

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### ABSTRACT

Sickle cell disease (SCD) is a painful blood disorder caused by a small mistake in a person's DNA. This mistake makes red blood cells turn into a "sickle" or crescent shape, which can block blood flow and cause severe pain and organ damage. While treatments exist to manage symptoms, the NIH (National Institutes of Health) is supporting new research to find a permanent cure. This research focuses on a breakthrough called CRISPR-Cas9. Scientists take a patient's own blood-building cells and use CRISPR like "molecular scissors" to edit them in a lab. They specifically turn off a gene that normally stops the body from making fetal hemoglobin—a healthy type of blood we all have before birth. In a landmark study published in the New England Journal of Medicine, patients who received these edited cells began making high levels of healthy fetal hemoglobin. In clinical trials, **93% of** patients were completely free from severe pain crises for at least one year. Many no longer needed regular blood transfusions and reported feeling much more energy.

**Keywords-** Sickle cell disease (SCD), CRISPR-Cas9, Fetal hemoglobin

## **BIOPROCESS AND BIOENGINEERING FOR SUSTAINABLE BIOPRODUCTION**

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### **ABSTRACT**

Bioprocess and bioengineering are central to advancing sustainable bioproduction, offering innovative pathways to replace fossil-based systems with renewable, eco-friendly alternatives. Modern bioprocessing integrates microbial cell factories, enzymatic catalysis and metabolic engineering to convert biomass and waste streams into fuels, chemicals, pharmaceuticals, and materials. By optimizing fermentation strategies, downstream processing, and bioreactor design, bioengineering enables higher yields, reduced energy consumption and minimized environmental impact. Synthetic biology further enhances this field by tailoring genetic circuits and metabolic pathways to improve efficiency and resilience of production strains. Coupled with advances in computational modeling, machine learning and process automation,

bioprocesses can be scaled sustainably to meet industrial demands. Importantly, circular bioeconomy principles—such as valorization of agricultural residues, CO<sub>2</sub> utilization and wastewater recycling—are increasingly integrated into bioproduction systems, ensuring resource efficiency and reduced carbon footprints. Challenges remain in cost competitiveness, feedstock variability and regulatory frameworks, but interdisciplinary approaches combining biology, engineering, and environmental sciences are driving solutions. Sustainable bioproduction through bioprocess and bioengineering not only supports climate goals but also fosters innovation in healthcare, food security and green manufacturing. This convergence of science and technology positions bioprocess engineering as a cornerstone of the global transition toward a sustainable, bio-based economy.

**Keywords-** Bioprocess, Bioengineering, Environmental Sciences

## **LIGHTING THE FUTURE : IMPACT OF LED SPECTRA ON PHYTOHORMON MODULATION FOR SUSTAINABLE INDOOR DEVELOPMENT**

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### **ABSTRACT**

Sustainable indoor farming relies heavily on LED technology, yet the spectral influence on internal signaling remains a complex bottleneck for crop optimization. This study examines how specific LED wavelengths—specifically the interplay between blue (450 nm) and far-red (730 nm) radiation—directly modulate phytohormone profiles to drive plant development. We focused on the shifts in auxin and abscisic acid (ABA) levels across three leafy green varieties grown under four distinct spectral “recipes.” Our data show that while blue-heavy spectra improve leaf thickness and antioxidant density, they simultaneously trigger stress-related hormonal spikes that can stunt overall biomass if not balanced with far-red supplementation. By measuring hormonal concentrations through mass spectrometry, we identified

a specific spectral threshold that maximizes growth without the traditional “stretch” associated with shade-avoidance responses. These simple growth observations, providing a mechanistic look at how light-hormone crosstalk can be manipulated to “program” plant morphology. For vertical farm operators, these findings offer a blueprint for spectral tuning that balances nutritional quality with energy-efficient biomass production.

**Keywords**-LED, Auxin, Abscisic acid (ABA)

## **AI- REVIEWED BY ENZYME TECHNOLOGY**

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### **ABSTRACT**

AI- powered enzyme engineering combines artificial intelligence with biotechnology to improve enzyme design and optimization. Traditional enzyme engineering methods are slow and costly, while AI techniques such as machine learning and deep learning enable rapid prediction of enzyme structure, function and stability. These tools help identify beneficial mutations and design efficient enzymes with enhanced catalytic performance. AI- based approaches reduce experimental time and cost and support sustainable industrial process. AI-powered enzyme engineering has wide applications in pharmaceuticals, food and dairy industries, biofuels and environmental biotechnology, making it a promising technology for next-generation biocatalyst development.

**Keywords**- Enzyme, Mutations , AI techniques

## **A REVIEW ON ROLE OF BIOTECHNOLOGY IN MEDICINE**

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## **ABSTRACT**

The biotechnology can be used for medicinal purpose. Biotechnology used for tailor- made medicines. Using pharmacogenomics, pharmaceutical companies can create drugs based on the proteins, enzyme and RNA molecules that are associated with specific genes and diseases. This tailor-made drugs promise not only to maximize therapeutic effects but also to decrease damage to nearby health cells. More accurate methods of determining appropriate drug dosages. Knowing a patient's genetics will enable doctors to determine how well the patient's body can process and metabolize a medicine. This will maximize the value of the medicine and decrease the likelihood of overdose. Improvements in the drug discovery and approval process. The discovery of potential therapies will be made easier using genome targets. Genes have been associated with numerous diseases and disorders. With modern biotechnology, these genes can be used as targets for the development of effective new therapies, which could significantly shorten the drug discovery process.

Key wordd- Tailor-made drugs, Enzyme, Proteins

## **INNOVATIONS IN PLANT BREEDING: LEADING THE WAY IN SUSTAINABLE AGRICULTURE**

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## **ABSTRACT**

In order to ensure food security, boost agricultural output, and lessen the effects of climate change, plant breeding is essential. The substantial developments in plant breeding methods and approaches targeted at utilizing genetic variety for long-term crop enhancement. Technological developments have enhanced traditional plant breeding techniques, giving breeders access to and use of the tremendous genetic diversity

found in crop species. Plant breeding has been transformed by the development of high-throughput DNA sequencing, which makes it easier to identify and characterize the genes causing desired features. Two effective methods that speed up the breeding process are genomic selection and marker-assisted breeding. These methods shorten the time needed for traditional breeding programs by enabling breeders to find and choose plants with desirable features early in development. Molecular markers associated with certain genes or traits are used in marker-assisted breeding to enable their effective transfer across a range of genetic backgrounds.

**Keywords-** Plant breeding, Genetic diversity, DNA sequencing

## **MICROBIAL AND INDUSTRIAL BIOTECHNOLOGY**

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### **ABSTRACT**

Microbial and industrial biotechnology represent a rapidly advancing field that harnesses the metabolic potential of microorganisms and biological systems for the sustainable production of valuable goods and services. By integrating microbiology, molecular biology, genetic engineering and process engineering, this discipline enables the large scale manufacture of pharmaceutical, enzymes, biofuels, organic acid, food products and environmentally friendly material. Microbial biotechnology focuses on the utilisation and genetic improvement of microorganisms to enhance productivity and specificity, while industrial biotechnology translate these biological processes into economically viable and scalable industrial operation through optimised fermentation and downstream processing technology. Advances in recombinant DNA technology metabolic engineering and bioprocess optimization have significantly expanded the scope and efficiency of biotechnology application. moreover, microbial and biotechnology plays a crucial role in promoting sustainable development by reducing reliance on fossil resources , minimising environmental impact and supporting green manufacturing practices. this field continue to drive innovation across healthcare, agriculture, energy and environmental management, positioning it as a cornerstone of modern bio-based industries.

**Keywords-** Pharmaceutical, Fermentation, genetic engineering

## **SATAVARI (*ASPARAGUS RACEMOSUS*): THE QUEEN OF HERBS**

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### **ABSTRACT**

Satavari, also known as *Asparagus racemosus*, is a revered Ayurvedic herb celebrated for its profound benefits in promoting women's health, vitality, and overall wellness. This poster presentation explores the multifaceted advantages of Satavari, its traditional uses and modern applications. Renowned for its adaptogenic properties, Satavari supports hormonal balance, reproductive health and immune function. It alleviates menstrual discomfort, boosts fertility, and mitigates menopause symptoms, making it a cherished herb for women's health. Additionally, its antioxidant-rich profile strengthens immunity, combats stress, and promotes digestive health. Traditionally, Satavari has been used to treat various ailments, including infertility and lactation issues. Its preparations, such as powders, capsules, and teas, are widely used in Ayurvedic medicine. Satavari roots also use in medicine and root powder is available in market Modern research underscores Satavari's potential in supporting women's health, enhancing vitality, and reducing stress. Its bioactive compounds, including shatavarin I-IV, alkaloids and flavonoids, contribute to its therapeutic effects.

**Keywords-** *Asparagus racemosus*, Health, Antioxidant-rich

## **A REVIEW ON: THE HEALING POWER OF SOUND**

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## ABSTRACT

Sound and frequency represent important biophysical tools in modern medicine, operating through measurable mechanical vibrations that interact with human tissues, cells and microorganisms. Scientifically, sound waves—particularly ultrasound—are applied in diagnosis and therapy due to their ability to induce mechano transduction, alter cell membrane permeability, modulate ion channels and influence cellular signaling pathways without invasive intervention. These effects have proven applications in medical imaging, physiotherapy, antimicrobial enhancement, tissue regeneration, and neurological modulation, supported by reproducible, peer-reviewed research. In contrast, so-called spiritual or therapeutic sound frequencies, such as mantra chanting or specific tonal frequencies, lack direct biophysical validation and are not quantifiable in medical terms; their observed benefits are primarily mediated through psychological and neurophysiological mechanisms, including stress reduction, parasympathetic activation and improved emotional regulation. Distinguishing evidence-based acoustic medicine from belief-based sound practices is essential to maintain scientific integrity. When clearly separated, sound-based medical technologies and complementary auditory practices together highlight the growing role of non-chemical, non-invasive approaches in integrative healthcare, while reinforcing the necessity of rigorous validation in clinical applications.

**Keywords-** Sound, Healthcare, Microorganisms

## ARTIFICIAL SEED: A PRACTICAL INNOVATION

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## ABSTRACT

An artificial seeds (also called a synthetic seeds or synseeds, seed analog or manufactured seed) includes a range of plant structures, including somatic embryos, buds, shoots or other meristematic tissues inside a coating that can be sown in the same way as a conventional seed to produce a new plant. An improved

artificial seed production technique is considered a valuable alternate technology of propagation in many commercially important crops and a significant method for mass propagation of elite plant genotypes. Artificial seeds have a variety of applications in plant biotechnology such as large scale clonal propagation, germplasm conservation, breeding of plants in which propagation through normal seeds is not possible, genetic uniformity, easy storage and transportation etc. For some plants such as ornamental plants, propagation through somatic embryogenesis and artificial seeds is the only way out.

**Keywords-**Somatic embryos, Propagation, Ornamental plants

## **EVIDENCE OF RADIATION-INDUCED DYSBIOSIS IN THE HUMAN MICROBIOME: CLINICAL AND EXPERIMENTAL RESEARCH**

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### **ABSTRACT**

The human body harbors complex microbial communities that play essential roles in immunity, metabolism, and tissue homeostasis. Exposure to ionizing radiation, including X-rays and gamma radiation used in medical and environmental settings, generates DNA damage and oxidative stress that may disrupt these microbial ecosystems. This study evaluates current clinical and experimental evidence describing the effects of radiation on microorganisms associated with the human body, with primary emphasis on the gut microbiota. A structured literature review of peer-reviewed studies involving microbiome sequencing, culture-based assays and animal and human radiation models was performed. Across multiple reports, radiation exposure consistently resulted in reduced microbial diversity, altered community composition and increased abundance of opportunistic or pathogenic taxa, while beneficial commensals such as *Lactobacillus* and *Bifidobacterium* were frequently diminished. In vitro investigations further demonstrate taxa-dependent differences in survivability and stress tolerance. Mechanistically, radiation induces DNA strand breaks, reactive oxygen species generation, and metabolic disturbances that collectively reshape microbial competition and ecological balance. These findings indicate that ionizing radiation does not merely exert bactericidal effects but promotes measurable dysbiosis within human-associated microbial

communities. Consideration of microbiome alterations may therefore be important in understanding radiation-associated health outcomes and improving therapeutic strategies.

**Keywords**-X-rays, DNA damage, Homeostasis

## **METAGENOMICS: EXPLORING MICROBIAL DIVERSITY THROUGH CULTURE INDEPENDENT GENOMIC ANALYSIS**

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### **ABSTRACT**

Metagenomics is defining as the study of genetic materials extracted directly from environmental samples rather than cultured in a lab. By bypassing traditional cultivation, this field provides a comprehensive overview of microbial community structure and functional potential. with the advent of Next-Generation sequencing and (NGS) Third-Generation sequencing (TGS), researchers can now deeply profile complex habitat from the human gut to extreme soil environments - uncovering unculturable taxa Land rare species. These study employed shotgun metagenomics sequencing to analyze from sample like soil or water. Metagenomics is a powerful molecular approach that enables the direct analysis of genetic material recovered from environmental samples without the need for prior culturing of microorganisms. This technique has revolutionized microbiology by allowing researchers to explore microbial diversity, functional potential, and ecological roles across diverse habitats such as soil, water, and the human microbiome. By employing high-throughput sequencing technologies and bioinformatics tools, metagenomics provides insights into community structure, metabolic pathways, and interactions among microorganisms. Metagenomic studies have significant applications in environmental monitoring, human health, agriculture, and biotechnology. In clinical research, metagenomics helps in pathogen detection, antimicrobial resistance surveillance, and microbiome-associated disease studies. In environmental sciences, it supports biodiversity assessment and bioremediation strategies. Furthermore, metagenomics plays a vital role in discovering novel genes, enzymes, and bioactive compounds with industrial and pharmaceutical potential. Despite its advantages, challenges remain in data analysis, standardization, and interpretation due to the complexity and large volume of sequencing data. Continuous advancements in

sequencing platforms, computational tools, and analytical pipelines are enhancing the accuracy and applicability of metagenomics. Overall, metagenomics represents a transformative approach for understanding microbial communities and their functional contributions, offering promising opportunities for scientific innovation and sustainable solutions.

Key words : Metagenomics , Traditional cultivation

## **INVASIVE WHITEFLY PESTS OF COCONUT IN INDIA AND THEIR MANAGEMENT**

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### **ABSTRACT**

Invasive whiteflies have emerged as a major threat to coconut cultivation in India, particularly the rugose spiralling whitefly *Aleurodicus rugioperculatus* along with other invasive species such as *A. dispersus*, *P. bondari*, *P. minei* and *A. atratus*. These pests are highly polyphagous and spread rapidly through infested planting material and human movement. They feed on leaf sap, causing nutrient depletion, premature leaf drying and severe yield reduction, while excretion of honeydew leads to black sooty mould formation that reduces photosynthesis and marketability of coconut produce. Whiteflies are one of the important pest group that occurs in almost all kind of crops they inflict direct damage by sucking of plant sap by both nymphal and adult stages and also by acting as vector for many viral diseases. They also indirectly inflict damage by secreting honeydew that attracts sooty mould fungus and thereby affecting the photosynthetic process of the plant. In a past few years four major whitefly species have entered India and has created menace in coconut plantations all over the country and also some other fruit crops. The pest raised some biosecurity concerns and (PCRI, Kasargod and NBAIR , Bengaluru has declared pest alert against these whiteflies. In order to understand more about the biology. Variation among the species, damaging symptoms and their management this review article has been written.

KEY WORDS : Invasive pests , whitefly , coconut , Rugose spiralling whitefly , Nesting whitefly,  
Palm Infesting whitefly , Bondar's Nesting whitefly.

## MYCOREMEDIATION OF HEAVY METALS USING SPECIFIC FUNGAL SPECIES

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### ABSTRACT

Heavy metal pollution is a major environmental issue caused by industrial discharge, mining, agricultural chemicals, and urban waste, leading to contamination of soil and water ecosystems. Metals such as lead (Pb), cadmium (Cd), chromium (Cr), mercury (Hg), and arsenic (As) are toxic, non-biodegradable, and tend to accumulate in living organisms. Bioremediation using specific fungal species has emerged as an effective, eco-friendly, and economical method for the removal and detoxification of heavy metals. Several fungi have demonstrated significant potential in heavy metal remediation due to their high tolerance and metal-binding capacity. *Aspergillus niger* and *Aspergillus fumigatus* are widely reported for their ability to remove lead, cadmium, and chromium through biosorption and intracellular accumulation. *Penicillium chrysogenum* and *Penicillium simplicissimum* play an important role in cadmium and copper removal from contaminated soils and wastewater. *Trichoderma harzianum* has shown efficiency in chromium and nickel detoxification, while *Rhizopus arrhizus* is effective in biosorption of uranium, lead, and zinc. White-rot fungi such as *Phanerochaete chrysosporium* are known for enzymatic transformation and immobilization of metals due to their ligninolytic enzyme systems. The mechanisms involved include biosorption by cell wall components (chitin, chitosan, and glucans), bioaccumulation, precipitation, and enzymatic reduction of toxic metal ions. Factors such as pH, temperature, fungal biomass, and metal concentration significantly influence remediation efficiency. Recent advancements in fungal biotechnology and immobilized fungal systems have further enhanced metal removal potential and environmental application.

**keywords-** nonbiodegradable, , contaminated soil , nickel detoxification , biosorption ,

## **ECO-FRIENDLY APPROACHES FOR WASTEWATER MANAGEMENT**

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### **ABSTRACT**

Wastewater treatment is essential for protecting public health and maintaining environmental sustainability. Conventional treatment systems are often energy-intensive and costly, especially in developing regions. Constructed wetlands have emerged as a sustainable, low-cost, and eco-friendly alternative for wastewater purification. This study focuses on the role of constructed wetlands in removing physical, chemical, and biological contaminants from domestic wastewater through natural processes involving plants, microorganisms, and soil media. The system effectively reduces biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), nutrients, and pathogens. Additionally, constructed wetlands promote biodiversity and require minimal maintenance and energy input. The findings highlight their potential as an efficient and sustainable wastewater management strategy for rural and urban areas.

**Keywords** : Conventional treatment , sustainable , Contaminants , BOD ,wetlands .

## **BIODIVERSITY : A FRAMEWORK FOR RESILIENT AGRICULTURE**

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### **ABSTRACT**

Modern agriculture faces the dual challenge of increasing yields while minimizing environmental degradation. This poster explores the critical role of biodiversity—from soil microbiota to pollinator networks—in fostering sustainable farming systems. By transitioning from monocultures to diversified agroecosystems (such as polycropping and agroforestry), we can reduce reliance on synthetic fertilizers and pesticides. Our analysis highlights how increased species richness enhances ecosystem services, improves soil carbon sequestration, and stabilizes yields against climate-driven stressors. The findings suggest that integrating biodiversity is not merely an environmental choice, but a socio-economic necessity for long-term food security.

**Keywords** : pollinator, polycropping, , synthetic fertilizers , carbon sequestration pollinator

## **MICROBIAL FERMENTATION IN CHEESE PRODUCTION AND ITS IMPACT ON NUTRITIONAL AND FUNCTIONAL PROPERTIES**

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### **ABSTRACT**

Fermented milk products are among the most widely consumed functional foods due to their nutritional value, probiotic properties, and health-promoting potential. The fermentation of milk using beneficial microorganisms such as Lactobacillus, Bifidobacterium, and Streptococcus thermophilus enhances digestibility, improves bioavailability of nutrients, and contributes to gut microbiota balance. This study focuses on the role of probiotic fermented milk products—such as yogurt, kefir, and cultured buttermilk—in improving human health and preventing lifestyle-related disorders. During fermentation, lactic acid bacteria convert lactose into lactic acid, resulting in improved texture, flavor, and extended shelf life of milk products. In addition, fermentation produces bioactive compounds including peptides, vitamins, and antimicrobial substances that exhibit antioxidant, anti-inflammatory, and immunomodulatory effects. Regular consumption of fermented milk products has been associated with improved digestion, enhanced immune response, cholesterol reduction, and prevention of gastrointestinal infections. The poster highlights microbial fermentation processes, nutritional enhancement, functional properties, and therapeutic potential of fermented milk products. Understanding the science behind milk fermentation can support the

development of innovative functional dairy foods and promote their role in sustainable nutrition and public health.

**Keywords:** Fermented milk, probiotics, lactic acid bacteria, yogurt, functional food, health benefits.

## **ENZYMATIC HYDROLYSIS AND HYDROLYSATE ENZYMES**

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### **ABSTRACT**

Hydrolysate enzymes play a crucial role in biochemical and industrial processes by catalyzing the breakdown of complex macromolecules into simpler, bioavailable forms. These enzymes act through hydrolysis reactions, targeting substrates such as proteins, carbohydrates, and lipids to produce hydrolysates rich in peptides, amino acids, sugars, and fatty acids. Enzymatic hydrolysis is preferred over chemical methods due to its specificity, efficiency, and environmentally friendly nature. This poster discusses the classification of hydrolysate enzymes, their mechanism of action, and their wide-ranging applications in food processing, pharmaceuticals, biotechnology, and agriculture. Understanding hydrolysate enzymes contributes to improved product quality, enhanced nutritional value, and sustainable industrial practices.

**Keywords :** macromolecules , hydrolysates, pharmaceuticals.

## **ANTIMICROBIAL RESISTANCE: A GROWING GLOBAL THREAT TO PUBLIC HEALTH**

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## **ABSTRACT**

Antimicrobial resistance (AMR) has emerged as one of the most serious global health challenges of the 21st century, threatening the effective prevention and treatment of infectious diseases. The misuse and overuse of antibiotics in human medicine, veterinary practices, and agriculture have accelerated the development of resistant microorganisms. Bacteria such as *Staphylococcus aureus*, *Escherichia coli*, and *Klebsiella pneumoniae* have developed resistance mechanisms including enzymatic drug degradation, target site modification, and efflux pump activity, reducing the effectiveness of commonly used antimicrobial agents. AMR leads to prolonged illness, increased healthcare costs, treatment failure, and higher mortality rates worldwide. Environmental factors, poor infection control practices, and lack of awareness further contribute to the spread of resistant pathogens. Surveillance, antimicrobial stewardship, infection prevention strategies, and the development of novel therapeutics are essential to combat this growing crisis. This poster highlights the causes, mechanisms, global impact, and preventive strategies of antimicrobial resistance. Understanding AMR and promoting responsible antibiotic use are crucial steps toward safeguarding public health and ensuring the continued effectiveness of antimicrobial therapies.

**Keywords:** Antimicrobial resistance, antibiotics, public health, drug resistance, stewardship, infection control.

## **Ligninolytic Enzymes from White-Rot Fungi: A Sustainable Solution for Textile Dye and Xenobiotic Degradation.**

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## **ABSTRACT**

Dyes released from textile industries pose a serious threat to environmental quality, creating an urgent need for eco-efficient treatment solutions. The textile sector is the largest consumer of synthetic dyes, and

its colored effluents are often resistant to conventional remediation methods. White-rot basidiomycetous fungi represent a promising biological alternative, as they are the only group of organisms known to completely degrade lignin. These fungi produce a complex ligninolytic enzyme system composed of various extracellular oxidases, including laccase, manganese peroxidase (MnP), and lignin peroxidase (LiP). In their natural lignocellulosic substrates, these enzymes are responsible for lignin degradation, but they are also capable of oxidizing a wide range of structurally diverse compounds. As a result, ligninolytic enzymes play a direct role in the degradation of textile dyes and other xenobiotic substances. Beyond dye decolorization, the broad substrate specificity of the ligninolytic system enables the transformation and removal of numerous environmental pollutants, highlighting its value in bioremediation processes. Consequently, ligninolytic enzymes from white-rot fungi have attracted considerable interest for industrial and biotechnological applications across multiple sectors, including chemical, fuel, food, agricultural, paper, textile, and cosmetic industries. This review focuses on the role of ligninolytic enzymes produced by white-rot basidiomycetes in the degradation of textile dyes and xenobiotic compounds, emphasizing their potential for environmental, industrial, and biotechnological applications.

**Key Word:-White-rot fungi, ligninolytic enzymes, laccase, peroxidases, textile dye and xenobiotic biodegradation, bioremediation.**

## **Green Strategies for Textile Dye Wastewater Management**

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### **ABSTRACT**

Dyes are among the most widely used chemical compounds in daily life and across various industrial sectors, particularly in textile manufacturing. Increasingly stringent environmental regulations governing dye-containing wastewater have created significant challenges for dye manufacturers and uSETs. Many industries continue to rely on outdated technologies, leading to inefficiencies during dyeing processes and substantial losses of dyestuffs into industrial effluents. Synthetic dyes are highly stable and recalcitrant, and their release into the environment poses SETious ecotoxicological risks, including bioaccumulation

and adverse effects on aquatic and terrestrial ecosystems. Furthermore, the extensive water consumption associated with dyeing operations generates large volumes of highly contaminated wastewater. Conventional wastewater treatment methods show limited effectiveness in color removal. Although physico-chemical techniques are commonly applied, they are often constrained by high costs, poor scalability, and the generation of toxic secondary by-products that create additional disposal problems. In contrast, biological approaches using microorganisms, plants, or their products—particularly enzymes—have emerged as promising, eco-friendly, and cost-effective alternatives for dye decolorization and degradation. However, despite more than two decades of research, large-scale implementation remains limited due to incomplete mineralization and the formation of toxic intermediates. This review emphasizes the importance of biodecolorization and biodegradation of synthetic dyes, highlighting recent advances in immobilization strategies, in silico modeling approaches, and future prospects for sustainable dye wastewater treatment.

**Keywords:** Dyes, Xenobiotic, Enzymes, Biodecolorization, Biodegradation, Textile wastewater.

## **BIOFUEL FROM ALGAE: A SUSTAINABLE ALTERNATIVE ENERGY SOURCE**

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### **ABSTRACT**

The increasing need for sustainable and renewable energy sources has accelerated interest in biofuels as alternatives to fossil fuels. Algae have emerged as a promising biofuel feedstock due to their high growth rates, efficient photosynthetic activity, and ability to accumulate lipids and carbohydrates suitable for biofuel production. Algal cultivation requires minimal resources, including water, simple salts, minerals, and sunlight, and can be integrated with wastewater treatment systems, offering additional benefits such as nutrient removal and carbon dioxide sequestration. Despite these environmental advantages, the commercial feasibility of algae-based biofuels remains uncertain because of high cultivation, harvesting, and processing costs. However, the adoption of circular economy concepts and carbon-neutral strategies in algal biomass production presents significant opportunities to enhance sustainability and economic

viability. This review highlights recent advancements in algae-based biofuel production, focusing on cultivation and harvesting techniques, factors affecting algal growth, biofuel conversion technologies, and economic challenges. Continued research on strain improvement, process optimization, and large-scale cultivation systems is essential to reduce production costs and improve the competitiveness of algae-based biofuels in the global energy market.

**Keywords:** Algae, biofuels, sustainable energy, lipid accumulation, cultivation techniques, wastewater treatment, carbon sequestration, biofuel conversion, circular economy.

## **BIOLUMINESCENT SYSTEMS: FROM MOLECULAR MECHANISMS TO BIOTECHNOLOGICAL APPLICATIONS**

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### **ABSTRACT**

Bioluminescence is a natural phenomenon in which living organisms emit visible light through the oxidation of a substrate, luciferin, catalyzed by the enzyme luciferase. A unique feature of this reaction is that most of the released energy is emitted as light rather than heat. Biochemical and taxonomic evidence suggests that bioluminescence has evolved independently multiple times, resulting in a wide diversity of luciferin–luciferase systems. Among marine organisms, however, an unusual convergence exists: many species across at least seven phyla utilize the same luciferin, coelenterazine. First identified in jellyfish, coelenterazine is derived from three amino acids—two tyrosines and one phenylalanine. Nevertheless, many marine organisms employ different luciferins. In some species, such as jellyfish, the luciferin–luciferase system occurs as a stable photoprotein that emits light upon calcium activation. Several natural bioluminescent systems have been identified, including D-luciferin-dependent systems, coelenterazine-dependent systems, Cypridina luciferin-based systems, tetrapyrrole-based luciferins, bacterial systems, and fungal bioluminescence. These systems produce light at distinct wavelengths, enabling diverse applications in drug discovery, protein–protein interaction analysis, in vivo imaging, and optogenetics. Due to efficient luciferase expression and luciferin permeability, bioluminescence assays are widely used across cell and

tissue types. Emerging research also explores bioluminescent plants and sustainable lighting technologies. This review highlights the mechanisms, evolution, and expanding applications of bioluminescence systems.

**Keywords:** Bioluminescence, luciferin, luciferase, coelenterazine, photoproteins, marine organisms, imaging, optogenetics, biotechnology, sustainable lighting.

## **Microbial degradation of microplastics**

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### **ABSTRACT**

Microplastics (MPs) have become a major global pollutant due to their persistence, widespread distribution, and potential toxicity to ecosystems and human health. Generated either intentionally as primary MPs or through the fragmentation of larger plastic materials, these particles accumulate in soil, freshwater, marine environments, and even the food chain. Conventional physical and chemical remediation strategies for MP removal are often inefficient, costly, and environmentally intrusive, prompting the search for sustainable alternatives. Microbial biodegradation has emerged as a promising eco-friendly strategy for mitigating MP pollution. Various microorganisms, including bacteria, fungi, and algae, have demonstrated the ability to colonize plastic surfaces and initiate degradation through enzymatic and oxidative mechanisms. Enzymes such as esterases, hydrolases, laccases, and oxygenases play a key role in polymer chain cleavage, leading to structural deterioration of MPs. This review critically evaluates recent advances in microbial degradation of commonly used plastics, including polyethylene, polypropylene, polystyrene, and polyvinyl chloride, emphasizing degradation pathways, influencing environmental factors, and current limitations. Despite encouraging laboratory-scale results, the degradation efficiency of MPs under natural conditions remains limited. Emerging approaches such as microbial consortia, enzyme engineering, metagenomics, and biofilm-based systems show potential to

significantly enhance degradation rates. This review highlights future research directions necessary for translating microbial MP Biodegradation into effective large-scale environmental applications.

**Keywords:** Microplastics; Plastic pollution; Microbial biodegradation; Bioremediation; Polymer degradation; Enzymatic degradation; Bacteria; Fungi; Algae; Environmental sustainability

## MICROBIAL REMEDIATION OF HEAVY METALS

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### ABSTRACT

Heavy metals are persistent environmental pollutants that pose significant threats to living organisms due to their toxicity, non-biodegradable nature, and tendency to accumulate in ecosystems. The rapid expansion of industrial activities, urban development, and improper agricultural practices has led to a continuous increase in heavy metal contamination of soil and water resources. Although several physical and chemical remediation techniques have been developed, their application is often limited by high costs, low efficiency, and the generation of secondary pollutants. Microbial bioremediation has gained considerable attention as an effective, economical, and environmentally sustainable alternative for heavy metal removal. Microorganisms interact with metals through various mechanisms, including biosorption, bioaccumulation, bioleaching, biomineralization, and biotransformation, enabling the conversion of toxic metals into less harmful forms. Long-term exposure to heavy metals allows microbes to develop resistance via adaptive strategies such as metal efflux systems, intracellular sequestration, enzymatic reduction, and permeability barriers. These resistance mechanisms are governed by metal resistance genes located on chromosomes and plasmids. A thorough understanding of metal–microbe interactions and microbial resistance mechanisms is essential for developing efficient and sustainable bioremediation strategies for heavy metal–contaminated environments.

**Keywords:** Heavy metals, microbial bioremediation, biosorption, bioaccumulation, bioleaching, biomineralization, metal resistance, environmental pollution, metal–microbe interactions.

## **BIODEGRADATION OF PLASTIC BY MICROORGANISMS**

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### **ABSTRACT**

Plastic disposal is one of the most serious environmental challenges today, as large quantities of synthetic plastics are non-biodegradable and persist in the environment for long periods. Although certain microorganisms are capable of degrading different types of plastics under suitable conditions, the high molecular weight, hardness, and water insolubility of these polymers make biological degradation extremely slow. As a sustainable alternative, natural plastics derived from plant and animal sources or produced by microorganisms have gained increasing attention. Several bacterial strains are able to synthesize and accumulate bioplastics using carbon sources under appropriate fermentation conditions. These biopolymers, known as polyhydroxyalkanoates (PHAs) or biological polyesters, are environmentally friendly, non-toxic, and readily biodegradable by microorganisms, making them promising substitutes for conventional synthetic plastics.

**Keywords:** Plastics, bioplastics, polyhydroxyalkanoates (PHAs), microbial synthesis, biodegradation, sustainable polymers, environmental pollution, carbon sources.

## **IMPACT OF PHARMACEUTICAL WASTE ON AQUATIC ECOSYSTEMS**

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## ABSTRACT

Pharmaceutical waste has emerged as a significant environmental contaminant, particularly in aquatic ecosystems. Residues of antibiotics, analgesics, hormones, antidepressants, and other therapeutic compounds enter water bodies through wastewater treatment plant effluents, improper disposal of medicines, hospital waste, and agricultural runoff. Conventional wastewater treatment processes are often ineffective in completely removing these biologically active compounds, leading to their persistence in surface water, groundwater, and sediments. Even at low concentrations, pharmaceutical contaminants can disrupt aquatic ecosystems by inducing endocrine disruption, altering reproductive behavior, promoting antibiotic resistance, and causing toxic effects in fish, invertebrates, and algae. Long-term exposure may result in bioaccumulation and trophic transfer, posing risks to ecosystem stability and human health. This abstract highlights the sources, environmental fate, and ecological impacts of pharmaceutical waste in aquatic environments and emphasizes the need for improved wastewater treatment technologies, regulatory frameworks, and sustainable pharmaceutical disposal practices to mitigate their environmental consequences

**Keywords:** Pharmaceutical waste, aquatic pollution, antibiotics, endocrine disruption, bioaccumulation, wastewater treatment, ecological impact, antibiotic resistance.

## MICROBIAL MERCURY DEGRADATION BY PSEUDOMONAS

### STUTZERI

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## ABSTRACT

Mercury contamination is a serious environmental concern due to its high toxicity, persistence, and ability to bioaccumulate in aquatic and terrestrial ecosystems. Industrial activities such as mining, chlor-alkali processes, fossil fuel combustion, and improper waste disposal contribute significantly to mercury pollution. Conventional physicochemical methods for mercury removal are often expensive, energy-

intensive, and generate secondary toxic wastes. Consequently, biological approaches have gained increasing attention as sustainable alternatives for mercury remediation. Among mercury-resistant microorganisms, *Pseudomonas stutzeri* has emerged as an efficient bacterial species capable of detoxifying mercury through enzymatic reduction mechanisms. This bacterium possesses the mercury resistance (*mer*) operon, which encodes key enzymes such as mercuric reductase (MerA) that convert highly toxic ionic mercury ( $\text{Hg}^{2+}$ ) into less toxic, volatile elemental mercury ( $\text{Hg}^0$ ). In some strains, organomercurial lyase (MerB) further enables the degradation of organic mercury compounds. The metabolic versatility, environmental adaptability, and genetic stability of *P. stutzeri* enhance its potential application in bioremediation systems. This ABSTRACT highlights the role of *Pseudomonas stutzeri* in mercury degradation, emphasizing its enzymatic pathways, resistance mechanisms, and applicability in bioremediation strategies. The integration of such mercury-resistant bacteria into engineered or natural treatment systems offers a promising, eco-friendly approach for mitigating mercury pollution and protecting environmental and public health.

**Keywords:** Mercury contamination, *Pseudomonas stutzeri*, bioremediation, *mer* operon, mercuric reductase, organomercurial lyase, enzymatic detoxification, heavy metal pollution.

## **GREEN CHEMISTRY IN THE PHARMACEUTICAL INDUSTRY- SUSTAINABLE APPROACHES FOR DRUG DEVELOPMENT**

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### **ABSTRACT**

The pharmaceutical industry plays a vital role in improving human health; however, traditional drug synthesis and manufacturing processes often involve hazardous chemicals, excessive solvent use, high energy consumption, and the generation of toxic waste. Green chemistry offers an innovative and sustainable framework to address these challenges by designing safer chemicals and environmentally benign processes without compromising product quality or efficiency. This paper focuses on the application of green chemistry principles in the pharmaceutical industry, emphasizing sustainable synthetic routes, alternative solvents, catalysis, and waste minimization strategies. The use of biocatalysts, microwave-assisted synthesis, solvent-free reactions, and renewable raw materials are discussed as effective methods to reduce environmental impact. Recent advancements in process optimization and

atom-economical reactions have significantly improved the sustainability of pharmaceutical production. The study highlights the environmental, economic, and regulatory benefits of adopting green chemistry practices, including reduced production costs, improved safety, and compliance with environmental standards. Challenges related to large-scale implementation and technological adaptation are also addressed. Overall, green chemistry represents a crucial pathway toward sustainable pharmaceutical manufacturing, promoting environmental protection while meeting the growing demand for safe and effective medicines.

**Keywords**

Green chemistry, pharmaceutical industry, Sustainable synthesis, Eco-friendly processes, Drug manufacturing.

**COSMETICS AND SKIN- FRIENDS OR FOE**

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**ABSTRACT**

Human skin is the largest organ composing a complex ecosystem harbouring different types of microorganism such as bacteria virus, fungi and mites that are together known as the 'Skin microbiome' The human skin is inhabited by a huge amount of microorganisms that constantly take part in the processes taking place on its surface. These organisms play an important role in communicating and instructing the cutaneous arm of the immune system to keep the skin healthy. Hygiene products, make up, perfume, skin cream, nail polish, deodorant, etc. also implicated in modifying the Skin microbiome. The number and impact of microflora is influenced by such factors as : humidity, pH, sebum content, diet use of antibiotic, vitamins, and other supplements. The use of appropriate cosmetics leads to blocking the imbalance between species of skin microflora.. Consumers today are moving towards a simpler, cleaner and nature based products which are known as Biocosmetics. Microbiome balancing skincare natural products can respond to the rising concerns of environment pollution, skin sensitivity and premature ageing.

**Keywords:** Skin Microbiome, Sebum Content, Hygiene, Biocosmetics.

**A STUDY OF MICROBIAL CONTAMINATION ON INDIAN CURRENCY  
NOTES FROM DIFFERENT OCCUPATIONAL SOURCES**

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**ABSTRACT**

Currency notes are widely exchanged for commerce and SETvices and act as potential fomites for the transmission of pathogenic microorganisms, posing a significant public health hazard. This disSETtation investigated the prevalence and diversity of microbial contamination on Indian currency notes collected from diverse occupational sources to assess the associated health risks. A total of 100 currency notes were collected from different occupational groups, including Street vendors (vegetable vendor, street food shop, restaurant), general professionals (Bank tellers), Healthcare SETting (healthcare workers, hospital visitor), Public transport worker (Bus conductors, Auto/Taxi driver), Beggars.

Samples were processed using standard microbiological techniques, including swab collection, culture on Agar media, gram staining, and biochemical characterization to isolate and identify the microbial flora. The results indicated that a vast majority of the currency notes analyzed were contaminated with a range of bacteria with significant variations obSETved across different occupational groups.

Key finding revealed higher contamination levels on notes from beggars, public transport workers and Street vendors compare to those from general professional and healthcare workers suggesting a direct correlation between the nature of occupation, personal hygiene practices, and the degree of contamination. Common isolated includes potential pathogens such as staphylococcus aureus, Escherichia coli, klebsilla spp., bacillus spp., and pseudomonas spp.. A notable percentage of these isolates demonstrated resistance to commonly used antibiotics, including methicillin -resistant staphylococcus aureus (MRSA) stains, highlighting a potential source for the spread of drug-resistant pathogens. In conclusion, Indian currency notes SETve as a significant environmental vehicle for the transmission of diverse microbial contaminants, with occupational handling practices playing a crucial role in contamination levels. The study emphasizes the urgent need for public awareness campaigns regarding proper hand hygiene after handling cash, especially for those in the food and healthcare sectors, and advocates for the adoptions of better money handling practices or alternative payment methods to mitigate public health risks.

**Keywords:-** staphylococcus aureus, drug-resistant pathogen, Microbial Contamination - Hand Hygiene - Occupational sources

**MICROBIOLOGY AND INDUSTRIAL BIOTECHNOLOGY**

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## **ABSTRACT**

Industrial microbiology and biotechnology involve utilizing microorganisms—bacteria, fungi, and yeasts—to produce valuable, large-scale products such as antibiotics, enzymes, biofuels, and fermented foods. This field harnesses microbial metabolism to develop sustainable, eco-friendly alternatives

**Keywords** :- microbial optimization , process , sustainability

## **Pollution and presentation of waste**

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## **ABSTRACT**

As global industrialization accelerates, the dual challenges of environmental pollution and waste preservation have become central to ecological stability. Pollution—the introduction of harmful materials into the environment—degrades air, water, and soil quality, often leading to irreversible ecosystem damage. A critical component of modern environmental strategy is the "preservation" or sequestration of waste. This involves the systematic containment of hazardous materials and the optimization of landfills to prevent leachate from contaminating groundwater.

**Keywords:-** accelerates, pollution, waste preservation, preservation

## **EFFECT OF THE USE OF PESTICIDES IN AGRICULTURE ON BUTTERFLY FAUNA**

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### **ABSTRACT**

Butterflies are widely recognized as sensitive bioindicators of environmental health due to their close association with host plants and rapid response to habitat disturbances. The increasing reliance on pesticides in modern agriculture, while enhancing crop productivity, poses significant threats to non-target organisms, particularly butterfly fauna. This study examines the effect of agricultural pesticide use on butterfly diversity, abundance, and species composition in cultivated landscapes. Field surveys were conducted in agricultural fields subjected to regular pesticide application and in adjacent non-treated or organically managed areas. Butterfly populations were recorded using standardized transect methods, and species richness and diversity indices were compared between sites. The results revealed a marked decline in butterfly abundance and diversity in pesticidetreated fields. Sensitive species, especially habitat specialists and larval host plant-dependent species, showed significant reductions, while a few tolerant generalist species persisted. Pesticide exposure affects butterflies directly through toxicity and indirectly by reducing nectar sources and larval host plants, thereby disrupting their life cycles. The study highlights that indiscriminate pesticide use leads to habitat simplification, reduced floral diversity, and contamination of soil and water, cumulatively contributing to the decline of butterfly populations. These findings emphasize the urgent need for sustainable pest management practices such as integrated pest management (IPM), reduced chemical inputs, and the promotion of ecofriendly alternatives. Conservation of butterfly fauna within agricultural ecosystems is essential not only for maintaining biodiversity but also for ensuring ecological services such as pollination and food web stability. The present investigation underscores the importance of balancing agricultural productivity with biodiversity conservation through environmentally responsible farming practices.

**Keywords:** Butterfly, Bioindicator, soil and water contamination, Integrated pest management

**IN SILICO DFT, ADMET AND MOLECULAR DOCKING STUDIES OF  
NOVEL COUMARIN-LINKED PYRAZOLE AND QUINOLINE  
DERIVATIVES AS ANTIMICROBIAL AND ANTIOXIDANT AGENTS**

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**ABSTRACT**

Ten novel coumarin-based hybrid molecules, including coumarin-pyrazole (**7a-e**) and coumarin-quinoline (**11a-e**) derivatives, were successfully synthesized through multistep reactions and characterized spectroscopically. Reaction optimization revealed that a DMF: Ethanol (1:1) mixture with H<sub>2</sub>SO<sub>4</sub> catalyst gave optimal results, yielding 88% product in 2-3 hours. Antimicrobial testing against four bacterial strains (*B. subtilis*, *S. aureus*, *E. coli*, *A. baumannii*) and one fungal strain (*A. niger*) identified compound **7a** as the most effective agent (MIC: 25 µg/mL), outperforming standard reference drugs. Antioxidant evaluation showed that **7a** exhibited strong activity (IC<sub>50</sub>: 20.23 ± 0.29 mg/mL), matching ascorbic acid performance. Molecular docking studies against three protein targets (4WMZ, 5FNR, 4LOL) revealed strong binding interactions, with compound **7b** achieving the highest docking score (-9.71186 kcal/mol) against 4WMZ. DFT calculations using B3LYP/6-311++G(d,p) basis set provided insights into electronic properties, including HOMO-LUMO energy gap (3.8640 eV), Mulliken charges, RDG, ELF, LOL, thermodynamic parameters, and reactivity descriptors. ADMET analysis confirmed favorable pharmacokinetic profiles. This comprehensive study establishes coumarin-pyrazole and coumarin-quinoline hybrids as promising multifunctional therapeutic candidates with significant antimicrobial and antioxidant potential.

**Keywords:** Antimicrobial, Coumarin, DFT, Molecular docking, Pyrazole

**“SYNTHESIS, SPECTROSCOPIC CHARACTERIZATION AND DFT-  
ASSISTED IN-SILICO EVALUATION OF NOVEL 1,3,4-OXADIAZOLE  
DERIVATIVES WITH ANTIMICROBIAL AND ANTICANCER  
ACTIVITY”**

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### **ABSTRACT**

In the current work, a new 1,3,4 oxadiazole derivative was synthesized through a multistep synthetic route using readily available starting materials under mild reaction conditions. The molecular framework integrates a 1,3,4-oxadiazole core with a sulphur-linked acetamide moiety and substituted aromatic rings, providing structural diversity and stability. The structure of the synthesized compound was established using spectroscopic techniques, including FT-IR, Mass, <sup>1</sup>H NMR and <sup>13</sup>C NMR analyses. The spectral data supported the formation of the oxadiazole ring, ether linkages, and amide functionalities. The incorporation of a 3-chloro 4-fluoro phenyl substituent may influence the electronic characteristics of the molecule. Overall, this study demonstrates a reliable synthetic approach to functionalized oxadiazole derivatives and provides a suitable platform for additional chemical modification and investigation.

**Keywords:** Antimicrobial, Anticancer, DFT, Molecular docking, 1,3,4 Oxadiazole.

## **ISOLATION OF PIGMENT-PRODUCING *ACTINOBACTERIA* WITH COMPARATIVE ANALYSIS OF ENZYME PRODUCTION AND ITS CHARACTERIZATION**

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### **ABSTRACT**

*Actinobacteria* constitute a diverse group of Gram-positive, filamentous microorganisms exhibiting a characteristic mycelial growth pattern and remarkable biosynthetic potential. The present investigation was undertaken to isolate, physiologically characterize, and evaluate pigment-producing *Actinobacteria* from wetland ecosystems, with an emphasis on their enzymatic and industrial relevance. Soil and sediment samples were collected from multiple locations of the Kumbharwada wetland, Bhavnagar, and processed using selective isolation techniques. The recovered isolates were examined for morphological traits and

subjected to a range of biochemical assays, including sugar fermentation and gas production analysis using Triple Sugar Iron (TSI) test. Pigment producing strains were screened and comparatively assessed based on pigment yield and visual characteristics. In view of the growing demand for environmentally safe alternatives to synthetic dyes, microbial pigments derived from *Actinobacteria* represent a sustainable resource for industrial applications. Furthermore, the isolates were evaluated for the production of industrially important extracellular enzymes such as amylase, gelatinase, and pectinase, which play a vital role in food processing, fermentation, textile, and paper industries. The findings highlight wetland-derived *Actinobacteria* as a valuable reservoir of bioactive pigments and enzymes underscoring their significance in biotechnological and commercial applications.

**Keywords:** *Actinobacteria*, microbial pigments, extracellular enzymes, biochemical characterization.

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### **Physicochemical evaluation of *Prosopis cineraria* growing in the arid ecosystem of Sirohi District, Rajasthan**

#### **Abstract**

*Prosopis cineraria* (L.) Druce, commonly known as Khejri, is a keystone desert tree species of arid and semi-arid regions of Rajasthan, valued for its ecological resilience and ethnobotanical significance. The present study investigates the physicochemical characteristics of *Prosopis cineraria* collected from different locations of the Sirohi district, Rajasthan, with the objective of assessing its chemical composition and quality attributes in relation to environmental conditions. Plant materials were subjected to standard physicochemical analyses including moisture content, ash value, acid-insoluble ash, water- and alcohol-soluble extractive values, pH, electrical conductivity, and elemental composition. Additionally, spectroscopic techniques such as FT-IR and UV-Visible spectroscopy were employed to identify functional groups and major phytochemical constituents. The results revealed significant variations in physicochemical parameters, reflecting the influence of soil type, climatic stress, and local edaphic factors prevalent in the Sirohi region. The presence of functional groups corresponding to phenolics, polysaccharides, and nitrogenous compounds indicates the plant's potential for medicinal, nutritional, and agro-industrial applications. This study provides baseline physicochemical data for *Prosopis cineraria* of the Sirohi district and highlights its importance as a sustainable natural resource for arid-zone ecosystems, phytopharmaceutical exploration, and value-added product development.

**Keywords:** *Prosopis cineraria*, Physicochemical analysis, Sirohi district, Arid plants, Spectroscopic studies.

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### **Mainstreaming Biodiversity: Ensuring wildlife conservation is a core outcome of Development planning.**

#### **Abstract**

Development planning has historically treated biodiversity conservation as a secondary concern, often leading to habitat fragmentation, species loss, and ecosystem degradation. This paper argues for the imperative of mainstreaming biodiversity—the systematic integration of wildlife conservation objectives and safeguards into the policies, plans, and practices of all economic and development sectors. Moving beyond isolated protected areas, mainstreaming positions healthy ecosystems and wildlife as foundational assets for sustainable development, essential for climate resilience, water security, livelihoods, and long-term economic stability.

The paper outlines a framework for ensuring wildlife conservation becomes a core outcome of development planning. This requires: (1) Policy and Regulatory Alignment to embed biodiversity-positive measures in national and sub-national strategies; (2) Proactive and Strategic Spatial Planning, utilizing tools like Strategic Environmental Assessment (SEA) to avoid critical habitats and direct development to less sensitive areas; (3) Cross-Sectoral Integration in key drivers such as agriculture, infrastructure, energy, and urban expansion, promoting nature-based solutions and mitigation hierarchies; and (4) Inclusive Governance and Finance that recognizes local and Indigenous knowledge, secures dedicated resources, and aligns public and private investments with conservation goals.

The paper concludes that effective mainstreaming is not a constraint on development but a recalibration towards true sustainability. It reduces long-term risks, unlocks green economies, and ensures that development pathways contribute to, rather than erode, the ecological infrastructure upon which all societies depend. Achieving this paradigm shift demands strong political commitment, institutional coordination, and robust monitoring to hold development accountable for delivering tangible, positive outcomes for wildlife and the ecosystems they inhabit.

**Keywords:** Biodiversity, Ecosystem, Wildlife, Conservation, Planning, Development.

**Dr. G.V. Mishra**

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Department of Zoology,  
Govt. College Sirohi



## **Mainstreaming Biodiversity: Ensuring wildlife conservation is a core outcome of Development planning.**

### **Abstract**

Development planning has historically treated biodiversity conservation as a secondary concern, often leading to habitat fragmentation, species loss, and ecosystem degradation. This paper argues for the imperative of mainstreaming biodiversity—the systematic integration of wildlife conservation objectives and safeguards into the policies, plans, and practices of all economic and development sectors. Moving beyond isolated protected areas, mainstreaming positions healthy ecosystems and wildlife as foundational assets for sustainable development, essential for climate resilience, water security, livelihoods, and long-term economic stability.

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## Dr. Suresh Kumar Gadhveer

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### Prospective use of Earthworm for medicinal purposes

#### Abstract

Earthworms (phylum Annelida, class Oligochaeta) have been integral to ecosystems for millions of years and are now gaining attention as potential biomedical resources. Traditionally used in Chinese, Ayurvedic, and Islamic medicine, earthworms have been shown to be effective in treating fever, hypertension, inflammation, and wounds. Modern pharmacological studies confirm that earthworm extracts contain diverse bioactive compounds, including enzymes, peptides, and polysaccharides with promising therapeutic properties such as wound healing, antimicrobial, anticancer, antioxidant, and fibrinolytic effects. This review consolidates the current evidence on the medicinal applications of earthworms, emphasizing the biochemical basis of their pharmacological activities, methodological approaches to extract characterization, and potential for clinical translation. Using a systematic literature review and qualitative content synthesis, this paper discusses how earthworms may serve as a renewable source of novel bioactive compounds for future drug development.

**Keywords:** Earthworms, *Eisenia fetida*, lumbrokinase, wound healing, antimicrobial peptides, fibrinolytic enzymes, traditional medicine, pharmacology

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### **Biochemical Modification of *Butea monosperma* Polysaccharides via Polymer Blending for Biomedical and Drug-Delivery Applications**

#### **Abstract**

Natural polysaccharides have gained considerable attention in biomedical and pharmaceutical research due to their biocompatibility, biodegradability, and structural versatility. *Butea monosperma*, a medicinally important plant widely used in traditional Indian systems, is a rich source of bioactive polysaccharides containing functional groups amenable to biochemical modification. The present work explores the biochemical modification of *Butea monosperma* polysaccharides through polymer blending techniques to develop advanced biomaterials for biomedical and drug-delivery applications. Polysaccharides extracted from *Butea monosperma* were blended with selected biodegradable polymers using green and solvent-minimized processing approaches to enhance mechanical stability, swelling behaviour, and controlled-release characteristics. The resulting biopolymer blends were systematically characterized using FT-IR, NMR, thermal analysis, and morphological studies to elucidate intermolecular interactions, structural compatibility, and polymer network formation. The modified systems exhibited improved physicochemical properties, including enhanced stability and tunable diffusion behaviour, compared to native polysaccharides, while retaining biodegradability and biocompatibility. In vitro evaluations indicated their suitability for biomedical applications such as wound-healing matrices, tissue engineering scaffolds, and sustained drug-delivery platforms. The polymer-blended polysaccharide matrices demonstrated potential for controlled and targeted release of therapeutic agents, highlighting their relevance in pharmaceutical formulations. This study establishes biochemical modification via polymer blending as an effective and sustainable strategy to transform *Butea monosperma* polysaccharides into functional biomaterials, contributing to eco-friendly healthcare technologies and sustainable drug-delivery systems.

**Keywords:** *Butea monosperma*, polysaccharides, biomedical polymers, drug delivery, polymer blending, sustainable biomaterials

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### **Biochemical Modification of *Anogeissus latifolia* Polysaccharides via Polymer Blending for Sustainable Biomaterial Applications**

#### **Abstract**

Plant-derived polysaccharides are increasingly explored in biochemistry for their renewability, biodegradability, and biocompatibility. *Anogeissus latifolia*, a traditionally valued tree species, yields polysaccharides with promising functional characteristics; however, native forms often exhibit limited mechanical strength and functional adaptability. This study focuses on the biochemical modification of *Anogeissus latifolia* polysaccharides through polymer blending as an eco-friendly approach to enhance their physicochemical properties.

Polysaccharides extracted from *A. latifolia* were blended with natural polymers such as starch, alginate, and chitosan under aqueous conditions. The blending process promotes intermolecular interactions including hydrogen bonding, electrostatic attractions, and polymer chain entanglement, resulting in the formation of interpenetrating polymer networks. The modified blends were evaluated for solubility, viscosity, swelling behaviour, and stability. Compared to native polysaccharides, blended systems demonstrated improved gel-forming ability, enhanced viscosity, greater structural stability, and tunable hydrophilicity.

Importantly, this modification strategy avoids chemical derivatization and the use of toxic reagents, aligning with the principles of green and sustainable biochemistry. The enhanced functional performance of the blended polysaccharides highlights their potential application in food stabilization, controlled drug delivery, biodegradable films, and biomedical hydrogel systems. Overall, polymer blending represents an effective biochemical approach to valorize *Anogeissus latifolia* polysaccharides and supports their utilization in sustainable biotechnological applications.

**Keywords:** *Anogeissus latifolia*, Polysaccharide, Blending, viscosity, swelling behaviour.

## Dr. Anjali Trivedi

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### IN VITRO CALLUS CULTURE TECHNIQUES FOR ENHANCED PHYTOCHEMICAL SYNTHESIS

#### Abstract

In vitro callus culture has emerged as a powerful biotechnological tool for the enhanced synthesis of plant-derived phytochemicals of pharmaceutical, nutraceutical, and industrial significance. This technique enables the controlled production of valuable secondary metabolites independent of geographical, seasonal, or environmental constraints. Callus cultures, induced from explants under optimized combinations of plant growth regulators, provide a totipotent and metabolically active system capable of sustained biomass proliferation and metabolite accumulation. Recent advances have demonstrated that strategic manipulation of culture conditions, including nutrient composition, carbon sources, light regimes, and elicitor treatments, can significantly enhance phytochemical yield and consistency. The application of biotic and abiotic elicitors, precursor feeding, and stress induction has further amplified the biosynthetic potential of callus cultures. Moreover, integration with molecular and metabolic engineering approaches has enabled the upregulation of key biosynthetic pathways, offering improved productivity and specificity of target compounds. In vitro callus culture thus represents a scalable, eco-friendly alternative to conventional extraction from field-grown plants, particularly for rare, slow-growing, or endangered medicinal species. This lecture highlights the principles, optimization strategies, and recent innovations in callus-based phytochemical production, emphasizing its role in sustainable bio-manufacturing and future prospects in plant secondary metabolite research.

## Dr. Renu

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### **PHYCOREMEDIATION : AN EMERGING TOOL TOWARDS SUSTAINABLE DEVELOPMENT**

#### **Abstract**

Rapid industrialization, urban expansion, and intensified agricultural practices have led to severe environmental degradation through the release of toxic pollutants, nutrient overloads, and greenhouse gases, thereby posing significant challenges to global sustainability. Phycoremediation—the use of algae and cyanobacteria for the removal, transformation, and detoxification of environmental contaminants—has emerged as a promising, nature-based solution aligned with the principles of sustainable development. This biological approach offers an efficient, eco-friendly, and cost-effective alternative to conventional physicochemical remediation technologies, which are often energy-intensive and environmentally intrusive. Algal systems exhibit exceptional metabolic versatility and adaptive resilience, enabling the sequestration of heavy metals, assimilation of excess nutrients, degradation of organic pollutants, and mitigation of carbon emissions through photosynthetic carbon fixation. Mechanistically, phycoremediation operates via biosorption, bioaccumulation, enzymatic transformation, and mineralization processes, supported by the presence of diverse functional groups and active metabolic pathways. The high growth rates, minimal nutrient requirements, and capacity to thrive in wastewater and extreme environments further enhance their remediation efficiency. Recent advances in algal biotechnology—including strain selection, genetic and metabolic engineering, immobilization strategies, and algal–microbial consortia—have substantially improved pollutant removal efficiency and system stability. Moreover, the integration of phycoremediation with biomass valorization pathways, such as biofuel production, biofertilizers, and high-value bioproducts, promotes waste-to-wealth conversion and supports a circular bioeconomy. Consequently, phycoremediation represents a multifunctional, sustainable remediation strategy with significant potential to address environmental pollution while contributing to the United Nations Sustainable Development Goals. Continued interdisciplinary research and large-scale implementation are essential to fully realize its role in long-term environmental sustainability.

**Key words:** Phycoremediation, Biosorption, Valorization, Biofertilizer.

## Expert Talk



**Mr. Harshad Mehta**  
(S.P. - Junagadh)



**Dr. Arvind Kumar**  
Chief Scientist, CSMCRI



**Dr. R P Bhatt**  
Principal, Bahauddin Science College



**Prof. (Dr.) A H Bapodra**  
Vice Chancellor, BKNMU

## Industrial Visit



**Balaji Wafers Pvt. Ltd. - Rajkot**



**GHCL - Sutrapada**



**GFSL - Gandhinagar**



**Entrepreneurship Development Institute - Ahmedabad**



**Expert Lab Pvt. Ltd - Junagadh**



**Psychology Hand's on Workshop**



**Gopal Snacks Limited - Rajkot**



**Mother Dairy**

## Activity



**Republic Day**



**Self Defence - Traning Prograam**



**Yoga Day**



**Career Classes for Government Exam**



**MOU WITH GMERS - Junagadh**



**Navratri Celebration**



**NCRTC3 National Conference**



**Sport Fest - 2024**

## Study Tour



**Narara Marine National Park**



**G.B.U. - Gandhinagar**



**Vidhan Sabha - Gandhinagar**





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**BETTER FUTURE**



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**KNOWLEDGE**  
TO  
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ISBN: 978-93-340-9856-3

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