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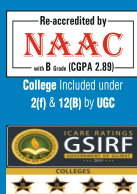
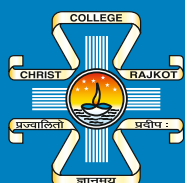
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Abstract Book



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CONTENT

Sr. no.	Subject	Page no.
GROUP A		
1	CHEMISTRY	1 – 4
2	COMPUTER APPLICATIONS	5
3	MATHEMATICS& STATISTICS	6 – 9
4	PHYSICS& ELECTRONICS	10 – 20
GROUP B		
1	BIOCHEMISTRY	21 – 31
2	BIOINFORMATICS	32 – 38
3	BIOTECHNOLOGY	39 – 51
4	BOTANY	52 – 66
5	MICROBIOLOGY	67 – 74
6	ZOOLOGY	75 – 89

GROUP A

CHEMISTRY

GREEN NANOMEDICINE: DRUG DELIVERY SYSTEMS BASED ON NANOTECHNOLOGY AND GREEN CHEMISTRY

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This review examines the role of green chemistry in shaping the field of “green nanomedicine”, which focuses on using environmentally safe methods for drug delivery through nanotechnology. Nanomedicines, while offering promising therapeutic potential, raise concerns due to the toxicity risks posed by their tiny size, which allows them to easily enter the human body. Green chemistry helps address these concerns by promoting the use of safer, eco-friendly materials in the creation of drug-loaded nanoparticles. This approach reduces the reliance on harmful substances and minimizes health risks. Key examples include nanometal particles, polymers, and biological materials. The review highlights the advances in green nanoscale systems, their potential health impacts, and the pathways through which they are delivered. It concludes by looking at future directions for the field, emphasizing the need for safe, low-impact synthesis techniques that can expand the use of nanomedicines while ensuring their safety and effectiveness.

Keywords: Green nanomedicine, drug delivery system, cancer, nanoparticle

SYNTHESIS OF 2-METHYL-6-(NAPHTHALEN-2-YL) NICOTINE HYDRAZIDE SCHIFF BASE AND IT'S METAL COMPLEX & IN VITRO BIOLOGICAL SCREENING

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This research aims to elucidate the structural features and reactivity of these complexes, shedding light on their significance in advancing the field of transition metal coordination chemistry as well as their potential biological screening applications. A Schiff base ligand with tridentate pyridine, denoted as (E)-N'-(2-hydroxybenzylidene)-2-methyl-6-(naphthalen-2-yl) nicotinohydrazide, was derived from 2-methyl-6-(naphthalen-2-yl) nicotine hydrazide and various substituted salicylaldehyde in a 1:1 molar ratio. Furthermore, Cu (II), Co (II) and Ni (II) metal complexes of these ligands were synthesized through a conventional method. The ligands and their complexes underwent characterization using various analytical techniques such as MS, FT-IR, ¹H, ¹³C NMR, thermogravimetric analysis and other methods. In addition, synthesized compounds screened against gram-positive, gram-negative and fungal stains for their antimicrobial assay using the broth dilution method and ciprofloxacin and nystatin were used as standards.

SCIENTIFIC ADVANCES IN *WITHANIASOMNIFERA* (ASHWAGANDHA): MECHANISTIC INSIGHTS, CLINICAL EVIDENCE, AND TRANSLATIONAL PROSPECTS

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Withaniasomnifera (Ashwagandha) is a widely studied adaptogenic herb traditionally used in Ayurvedic medicine for stress, cognitive enhancement, and hormonal balance. Modern research has begun to validate these claims through rigorous mechanistic studies and randomized clinical trials. This review highlights *Ashwagandha*'s multi-faceted mechanisms - including modulation of the hypothalamic–pituitary–adrenal (HPA) axis, antioxidant and neurotransmitter pathways and summarizes the growing clinical evidence supporting its efficacy in stress reduction, mental health symptom relief, cognitive performance, and hormonal regulation. Translational prospects are discussed with emphasis on extract standardization, dose optimization, safety, and potential integration into mainstream therapeutic frameworks. While the evidence base continues to grow, large-scale, long-term studies are needed to fully realize *Ashwagandha*'s therapeutic potential.

Keywords: *Withaniasomnifera*, Ashwagandha, adaptogen, stress modulation, cognitive function, hormonal health, clinical evidence, translational prospects

CO-AMORPHOUS EFONIDIPINE–AMINO ACID MIXTURES: A NOVEL STRATEGY FOR SOLUBILITY ENHANCEMENT

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Co-amorphous systems have been developed to address the solubility challenge of poorly water-soluble crystalline drugs. Recently, co-amorphous drug–amino acid mixtures were introduced as a promising alternative to other amorphous stabilization approaches such as the use of polymers. So far, these co-amorphous mixtures have been mainly prepared via spray-drying. Now this study was investigated as a scale-up preparation method for co-amorphous Efonidipine hydrochloride ethanoate–amino acid mixtures. In addition, the physicochemical properties of the different co-amorphous systems were investigated with respect to the ability of the amino acid to co-amorphous. All co-amorphous systems were characterized by XRD, FTIR, and DSC, and co-amorphous systems of Efonidipine hydrochloride ethanoate, a weakly basic drug, were prepared with each tryptophan, valine, glycine, and histidine. However, amorphous Efonidipine hydrochloride ethanoate–tryptophan exhibited the best dissolution performance. It could be shown that strong intermolecular interactions between drug and co-amorphous co-former that persist during the dissolution are crucial to prevent recrystallization and to enhance the dissolution of a co-amorphous formulation. The co-amorphous system is a potential strategy for apparent solubility enhancement and bioavailability.

Keywords: Co-amorphous, Amino -acid, Spray-drying, Solubility.

SYNTHESIS AND CHARACTERIZATION OF HETEROCYCLIC MOLECULES AS AN ANTICANCER AGENT VIA MULTICOMPONENT REACTION

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In the realm of medicinal chemistry, heterocyclic compounds are increasingly recognized for their potential in anticancer activities. These molecules, by influencing diverse cellular processes and interacting with crucial biological components such as proteins and DNA, exhibit notable anticancer properties. Nitrogen-containing heterocyclic molecules have garnered significant attention for their potential in cancer treatment. This study focuses on the synthesis of tetrazole derivatives using the Ugi multicomponent reaction. The anticancer activity of these compounds against various NCI-60 cell lines is explored. The findings suggest that tetrazole derivatives, synthesized through the Ugi Multicomponent reaction, hold promise for more accurate and effective cancer therapies in the future.

Keywords: Heterocyclic chemistry, Medicinal chemistry, Ugi multi component reaction, tetrazole derivatives, NCI-60 cell lines, Anti cancer agent

GLP – 1 RECEPTER AGONISTS - OZEMPIC IN THE MANAGEMENT OF TYPE -2 DIABETES & OBESITY

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The global prevalence of metabolic disorders such as type 2 diabetes and obesity has increased dramatically, demanding innovative therapeutic strategies. Glucagon-like Peptide – 1 [GLP-1] receptor agonists, particularly semaglutide (commercially known as Ozempic), have emerged as a breakthrough class of drugs originally developed for diabetes management but now reshaping the treatment landscape of metabolic diseases. GLP -1 is an incretin hormone that plays a crucial role in glucose homeostasis by stimulating insulin secretion, suppressing glucagon release, delaying gastric emptying, and regulating appetite through central nervous system pathways. Recent clinical and molecular studies reveal that semaglutide not only improves glycemic control but also induces metabolic inflammation. These findings have positioned GLP-1 receptor agonists as a potential cornerstone in obesity and cardiometabolic disease management. This presentation explores the biochemical mechanism of GLP-1 signaling, its physiological effects on metabolism, and the expanding therapeutic applications of Ozempic beyond diabetes, including obesity and cardiovascular risk reduction. Additionally, the talk highlights emerging concerns such as long-term safety, gastrointestinal side effects, accessibility, and ethical issues related to cosmetic weight-loss usage. By integrating insights from biochemistry, pharmacology, and public health, this study emphasizes how Ozempic represents not just a drug, but a paradigm shift in treating metabolic disorders. Understanding GLP -1-based therapies may guide future drug development and more sustainable approaches to global metabolic health challenges.

DESIGN AND SYNTHESIS OF PYRAZOLO-THIAZOLE DERIVATIVES

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Pyrazole and thiazolidine-4-one scaffolds are well-recognized in medicinal chemistry for their diverse biological activities, including antitumor, anti-inflammatory, and antimicrobial effects. In this study, a novel hybrid molecule incorporating both nuclei was designed and synthesized using a molecular hybridization approach. The product was obtained in good yield and characterized by IR, ¹H NMR, and ¹³C NMR spectroscopy, confirming its structure. This hybrid framework may offer enhanced or unique biological properties, making it a promising lead for therapeutic development.

Keywords : Thiazolo-pyrazolo,thiazolidine-4-one,pyrazole, Heterocycle, Condensation, Thiazole.

PREPARATION OF OLIGOMERIC LACTIC ACID FROM DL-LACTIC ACID

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Lactic acid oligomers, key precursors for biodegradable polylactic acid (PLA) polymers, were synthesized via a two-step process involving purification and ring-opening polymerization (ROP). In the first step, 250 mL of 80% pure lactic acid underwent vacuum distillation. The mixture was heated to its boiling point of 130°C, followed by vacuum application to minimize thermal decomposition. Chemical bumping was controlled by adding a drying agent, yielding highly pure lactide as the cyclic dimer. In the second step, purified lactide was subjected to ROP at controlled temperatures (150–210°C) in the presence of metal catalysts, resulting in high-molecular-weight lactic acid oligomers. This methodology enhances purification efficiency and oligomer yield, offering scalable routes for sustainable polymer production in pharmaceutical and biomedical applications. Preliminary characterization confirmed oligomer formation via increased molecular weight and structural integrity.

COMPUTER APPLICATIONS

COMPUTER VISION IN PRECISION FISHERIES: REAL-TIME BIOMETRIC MONITORING FOR ENHANCED ANIMAL WELFARE

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The integration of Computer Vision (CV) into precision aquaculture represents a transformative shift toward non-invasive, real-time biometric monitoring. Traditional methods of assessing fish health and growth often involve manual handling, which induces significant physiological stress and increases the risk of injury or disease. This paper explores the deployment of automated CV systems designed to monitor key biometric indicators—such as body length, weight estimation, and swimming patterns—without physical intervention. By utilizing high-resolution underwater imaging and Deep Learning architectures, these systems can detect subtle behavioral anomalies that serve as early warning signs for deteriorating water quality or pathogen outbreaks. The real-time nature of this data allows farm managers to optimize feeding regimes and stocking densities, directly correlating technological precision with enhanced animal welfare standards. This study demonstrates that by digitizing the observation process, precision fisheries can achieve a more ethical, sustainable, and commercially viable production model, ensuring that fish health remains a central priority in the scaling of global aquaculture.

Keywords: Real-time Monitoring, Convolutional Neural Networks (CNN), Precision Aquaculture, Biometric Assessment, Non-invasive Monitoring, Fish Behavior Analysis.

MATHEMATICS & STATISTICS

ON VARIETY OF SIGNED PRODUCT CORDIALNESS OF COPPER-OXIDE AND ITS EXTENDED NETWORKS

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Let $G = (V, E)$ be a simple graph. A signed product cordial labeling of G is a function $f: V(G) \rightarrow \{-1, +1\}$ such that for every edge $uv \in E(G)$, the induced edge label is defined by $f^*(uv) = f(u) \cdot f(v) \in \{-1, +1\}$ such that the number of vertices labelled $+1$ and the number labeled -1 and the number of edges labelled $+1$ and the number labeled -1 differ by at most 1. In current article, we have observed signed product cordial labeling on Copper Oxide (CuO) and its extended network. Also, we have defined balanced signed product cordial labeling on CuO and related structures. We have concluded that $\text{CuO}(m, n)$, $\text{CuO}_{\text{EX}}(m, n)$ and $\text{CuO}_{\text{EN}}(m, n)$ admits signed product labeling and also admits balanced signed cordial labeling under some condition.

SPECTRAL PROPERTIES OF GRAPHS WITH SPECIAL EMPHASIS ON ENERGY OF GRAPHS

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Spectral graph theory provides an algebraic approach to the study of graphs by analyzing the eigenvalues of matrices associated with the graph. Let $G = (V, E)$ be a simple undirected graph with $|V| = n$, and let $A(G)$ denote its adjacency matrix. The eigenvalues $\lambda_1, \lambda_2, \dots, \lambda_n$ of $A(G)$ form the spectrum of G and encode its spectral properties. The energy of a graph is defined as, $E(G) = \sum_{i=1}^n |\lambda_i|$, a concept originally introduced by Gutman in chemical graph theory to approximate the total π -electron energy of molecular graphs. From a mathematical perspective, the energy of graph measures the magnitude and distribution of eigen values of $A(G)$ and encodes structural properties of G such as connectivity and complexity. Spectral properties derived from eigen values also arise in network analysis and chemical graph theory under Hückel Molecular Orbital (HMO) theory. By bridging linear algebra and graph theory, spectral analysis offers a powerful methodology for the comparative study and classification of graphs.

STATISTICS IN AI

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Artificial Intelligence (AI) has become a transformative technology across various fields such as healthcare, finance, education, and engineering. At the core of AI lies statistics, which provides the theoretical and practical tools required for data analysis, learning, and decision-making. Statistics plays a vital role in handling large volumes of data by enabling effective data collection, organization, and summarization. Through descriptive statistics, AI systems gain an initial understanding of data patterns, trends, and variability. Probability theory, a major branch of statistics, allows AI models to manage uncertainty and make predictions in real-world situations where data is often incomplete or noisy. Many machine learning algorithms used in AI, including regression, classification, and clustering techniques, are fundamentally based on statistical models. Statistics aids in parameter estimation, model selection, and optimization, ensuring that AI systems learn efficiently from data. Furthermore, statistical methods are essential for evaluating and validating AI models. Techniques such as hypothesis testing, cross-validation, and performance metrics help determine the accuracy,

reliability, and generalizability of models. Statistics also contributes to bias detection and fairness assessment, supporting the development of ethical and transparent AI systems. In conclusion, statistics forms the backbone of artificial intelligence by transforming raw data into meaningful insights. Without statistical principles, AI systems would lack the ability to learn, adapt, and make informed decisions. Therefore, statistics is indispensable for the design, implementation, and responsible use of artificial intelligence technologies.

TIME VALUE OF MONEY

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The concept of the Time Value of Money (TVM) explains the fundamental principle that the value of money changes over time due to its potential earning capacity. A sum of money available in the present is worth more than the same amount in the future because of factors such as interest, inflation, and risk. The present study aims to explore the theoretical framework of the Time Value of Money and its importance in financial decision-making. The study discusses key components of TVM, including present value, future value, interest rates, and time periods, highlighting how these elements interact to influence the valuation of cash flows. The methodology of this study is based on a conceptual and analytical approach, using standard financial principles and illustrative examples to demonstrate the application of TVM in real-life situations. Various financial scenarios, such as savings, loans, investments, and annuities, are examined to understand how time affects monetary outcomes. The findings indicate that incorporating the time value of money is essential for accurate financial evaluation and comparison of alternative investment options. The study concludes that the Time Value of Money plays a crucial role in finance, banking, insurance, and investment planning. Understanding this concept enables individuals and institutions to make informed and rational financial decisions. Thus, the Time Value of Money serves as a foundational concept in financial mathematics and economic analysis.

REAL WORLD SIGNIFICANCE OF DIFFERENTIAL EQUATIONS

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Differential equations form an essential part of mathematical analysis by providing a systematic way to describe phenomena that change continuously over time. They establish relationships between variables and their rates of change, enabling the mathematical modelling of dynamic systems encountered in nature, science, and society. This study aims to present an overview of the conceptual importance of differential equations and their role in interpreting real-world processes. The approach of this work is primarily theoretical and descriptive, focusing on the formulation and interpretation of differential equations rather than detailed solution methods. Through representative examples, the study illustrates its application in diverse areas such as motion of particles, population growth, heat flow, electrical circuits, and economic systems. These examples demonstrate how differential equations translate real-life situations into mathematical models that can be analysed to understand system behaviour and predict future outcomes. The analysis highlights the versatility and effectiveness of differential equations as tools for modelling complex systems. By capturing continuous change in precise mathematical form, they enable deeper insight into both natural and engineered processes. In conclusion, differential equations serve as a vital link between abstract mathematics and practical applications, reinforcing their significance in scientific research, technological advancement, and problem-solving across multiple disciplines.

ANALYSIS OF CRIME RATE USING STATISTICAL TOOLS

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Crime analysis is essential for understanding patterns of criminal activity and supporting effective law enforcement and public safety measures. This study focuses on the analysis of crime rates using statistical tools to obtain meaningful insights from crime data. Crime rate is defined as the number of crimes per 100,000 population, allowing fair comparison across different regions and time periods. Statistical measures such as mean, median, mode, percentage, and standard deviation are used to summarize crime data, study central tendencies, identify dominant crime types, and analyze variability in crime rates. Time series analysis is applied to examine crime trends over time and identify long-term and seasonal patterns, while regression analysis is used to study the relationship between crime rates and influencing factors. Graphical representations including bar graphs, line graphs, and pie charts enhance data interpretation and clarity. The study highlights the importance of statistical analysis in crime prevention, predictive policing, policy formulation, and evidence-based decision-making. Overall, statistical tools provide a systematic and reliable approach for understanding crime behavior and improving public safety.

MAGIC SQUARES AND NUMBER PATTERNS

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Magic squares are square grids of numbers arranged so that the sum of every row, column, and diagonal is the same. This common total is known as the magic constant. More than simple number puzzles, magic squares represent one of the earliest connections between mathematics, philosophy, art, and human curiosity. The earliest known magic square comes from Ancient China around 1900 BCE and is called the Lo Shu Square. According to legend, a turtle emerged from the Luo River with a three by three pattern of dots on its shell. Each row, column, and diagonal added up to fifteen, which was believed to represent cosmic balance and universal harmony. During the ninth century, Islamic mathematicians began studying magic squares in a more systematic and mathematical way. They developed methods and algorithms to construct larger squares such as four by four and even higher order grids. Number patterns also play a crucial role in mathematics. Number patterns are sequences arranged according to specific rules such as addition, multiplication, or fixed formulas. These patterns help in understanding relationships between numbers, predicting future values, and strengthening logical thinking. Together, magic squares and number patterns show how humans across history have searched for meaning, structure, and beauty through numbers.

GRAPH THEORY IN IMAGE AND TEXT

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Graph theory offers a structured approach to model relationships within image and text data. In image analysis, pixels or regions are represented as nodes, and their spatial or similarity relations as edges, facilitating tasks like segmentation and recognition. In text processing, words or documents form graph nodes connected through co-occurrence or semantic links, supporting applications such as keyword extraction and summarization. By applying graph-based algorithms, hidden structural patterns can be efficiently identified, enhancing interpretation and performance in data analysis.

CRYPTOGRAPHY AND SECURE CONNECTION

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Cryptography and secure communication are essential components of modern information security, ensuring the confidentiality, integrity, and authenticity of data transmitted over networks. Cryptography uses mathematical algorithms and encryption techniques to protect sensitive information from unauthorized access, alteration, and misuse. Secure communication systems employ protocols such as SSL/TLS, encryption standards, and authentication methods to safeguard data during transmission. These technologies play a vital role in protecting online transactions, digital identities, confidential messages, and organizational data. With the rapid growth of the internet, cloud computing, and digital services, cryptography and secure communication have become increasingly important in preventing cyber threats, ensuring privacy, and building trust in digital communication systems.

SAMPLING TECHNIQUES AND IT'S IMPORTANCE

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Sampling techniques are systematic methods used to select a representative subset from a larger population for research and analysis. They help save time, cost, and effort while ensuring accurate and reliable results. Since studying the entire population is often impractical, sampling provides an efficient alternative. Techniques such as random, stratified, systematic, and cluster sampling reduce bias and improve precision. The importance of sampling lies in producing valid conclusions that reflect the true characteristics of the population. Proper sampling enhances research quality, supports better decision-making, and increases reliability. It is widely applied in statistics, social sciences, market research, healthcare, education, and industry.

PHYSICS AND ELECTRONICS

STRUCTURAL AND PHOTO-ELECTRICAL PROPERTIES CHANGES IN MnO₂ THIN FILMS INDUCED BY SWIFT HEAVY ION IRRADIATION

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MnO₂ thin films were deposited on ITO-coated glass substrates using the chemical solution deposition method and subsequently subjected to swift heavy ion (SHI) irradiation with 120 MeV Ag⁹⁺ ions at fluences of 1×10^{11} and 1×10^{12} ions cm⁻². X-ray diffraction (XRD) studies confirmed the formation of a polycrystalline cubic MnO₂ phase, while irradiation led to noticeable peak broadening and increased lattice strain, suggesting the generation of irradiation-induced defects. Dielectric measurements demonstrated an increase in the dielectric constant accompanied by a reduction in the loss tangent after irradiation, attributed to enhanced interfacial polarization effects. AC conductivity analysis indicated a frequency-dependent hopping conduction mechanism, with conductivity improving at higher ion fluences. Time-dependent resistivity measurements performed under dark and illuminated conditions revealed a significant reduction in resistivity upon illumination, confirming improved photoresponse behavior. These enhancements are primarily associated with SHI-induced defect states acting as shallow traps, which promote charge carrier generation and transport. Overall, the results highlight that SHI-based defect engineering is an effective strategy for tailoring the structural, dielectric, and photoresponsive properties of MnO₂ thin films for potential optoelectronic applications.

EXPERIENTIAL APPROACHES TO QUANTUM SCIENCE & TECHNOLOGY LITERACY: A REVIEW OF HANDS-ON ACTIVITY- BASED KIT DEVELOPED BY GUJCOST

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Quantum Science & Technology is foundational to emerging scientific and technological innovations, yet its abstract and counterintuitive nature poses persistent challenges for formal education and public understanding. Recent educational research highlights the importance of experiential, conceptual and analogy-driven approaches for introducing complex scientific concepts like Quantum Science & Technology. This review article examines hands-on activity based strategies for quantum science education, with particular emphasis on a 33-activities of Hands-on Activity Kit on Quantum Science & Technology developed by the Gujarat Council on Science & Technology (GUJCOST) as a United Nations recognized academic institution partner for the International Year of Quantum Science & Technology 2025 (IYQ2025). Drawing upon science education and science communication literature, as educational outreach contexts, the review analyzes the pedagogical rationale, learning affordances, and probable impacts of experiential quantum learning. The article identifies key design principles, discusses challenges and limitations, and outlines future directions for making quantum education more accessible and impactful at the school & undergraduate levels.

MASS AS THE FIFTH DIMENSION: A REVIEW OF SPACE–TIME–MASS FRAMEWORK OF THE UNIVERSE

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This article reviews proposed fifth dimension theory to extend general relativity by treating mass as an additional coordinate, thereby constructing a five-dimensional space–time–mass continuum. In this framework, the fifth coordinate is identified directly with physical mass, motivated by the MKS (Meter–Kilogram–Second) system in which length, time, and mass are the three fundamental units. Indian astrophysicist J.J. Rawal and collaborators obtain local five dimensional solutions that reduce the Schwarzschild metric in the weak-field limit and develop a simple cosmological model linking the total mass and age of the universe through a geometric mass–age relation. The present-epoch values predicted by this model are consistent with Λ CDM and Planck 2018 constraints without explicitly introducing dark matter or dark energy as separate components. The approach is compared with other five-dimensional theories such as Kaluza–Klein and induced-matter models, and certain open issues are also highlighted. The review concludes that the five-dimensional framework offers a conceptually clear and phenomenologically promising extension of general relativity at the background cosmological level, with possible significant further research.

INVESTIGATION ON DIELECTRIC AND OPTICAL PROPERTIES OF V₂O₅-CQD-PVA POLYMERIC FILMS

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Polymer–inorganic nanocomposites are of interest due to their tunable electrical and optical responses arising from interfacial effects. In the present work, V₂O₅–carbon quantum dot (CQD)–polyvinyl alcohol (PVA) polymeric films were prepared using a solution-casting method. The effect of V₂O₅–CQD composite incorporation on the structural, dielectric, impedance, and optical properties of the polymer films was investigated. Structural characteristics and filler–polymer interactions were examined using X-ray diffraction, FTIR, and Raman spectroscopy. Surface morphology and elemental distribution were analysed by FESEM and EDX mapping. Dielectric permittivity, dielectric loss, and impedance response were studied over a wide frequency range to understand polarization and charge-transport behaviour in the films. Optical properties were examined using UV–Vis diffuse reflectance spectroscopy, and the optical band gap was estimated using the Kubelka–Munk function. The study focuses on understanding the role of CQD-modified V₂O₅ as an interfacial component in polymer matrices and its influence on the electrical and optical response of PVA-based composite films.

TO INVESTIGATE THE EFFECT OF CADMIUM ON STRUCTURAL AND MICROSTRUCTURAL PARAMETERS OF PURE ADP CRYSTAL

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The present paper deals with the growth of pure and cadmium doped ADP crystals, by varying the weight% of doping of cadmium from 2wt% to 4wt% and 6wt%. The crystals were grown at room temperature using the slow solvent evaporation method. The grown crystals possessed rectangular

shaped morphology and good transparency. All the crystals were characterized by the powder X-Ray Diffraction. The present paper aims to investigate how the presence of cadmium leads to change in the structural and micro structural parameters of pure ADP crystal. The presence of cadmium was confirmed through EDAX analysis. The powder XRD study confirmed the tetragonal crystal system of pure and cadmium doped ADP crystals. The crystallite size and strain were estimated by using various methods; including Scherrer method, Wilson formula, M-S method, W-H method, H-W method and SSP method. All the methods showed the constituent results. Comparing the results of all the methods, satisfactory results have been obtained from H-W method and SSP method.

TO STUDY THE EFFECT OF IRON ON STRUCTURAL, RAMAN AND THERMAL PROPERTIES OF PURE MAGNESIUM SULPHATE HEPTAHYDRATE CRYSTALS

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Pure as well as iron (Fe) doped magnesium sulphate heptahydrate (MSH) crystals were grown at room temperature by the slow solvent evaporation technique. The doping concentration of Fe was changed from 0.05mol%, 0.25mol% and 0.5mol%. Colorless and transparent crystal of pure MSH was grown, while, Fe doped MSH crystals were less transparent compared to pure MSH crystal. The growth period of the crystals was around 5 week. The powder XRD analysis confirmed the orthorhombic crystal system of pure MSH crystal, while Fe doped MSH crystals crystallized in monoclinic crystal system. The crystallite size and lattice strain respectively, observed to increase and decrease by Fe doping. The Raman analysis confirmed the presence of characteristic vibrations of sulphate group in pure and Fe doped MSH crystals. Fe doping resulted into increase in intensity of non-degenerative ν_1 symmetric stretching vibration of the S – O bond without shifting and broadening of the peak. The thermal analysis showed that pure and Fe doped MSH crystals converted into anhydrous MgSO_4 losing different numbers of water molecules at different stages.

INORGANIC NONLINEAR OPTICAL CRYSTAL: POTASSIUM DIHYDROGEN PHOSPHATE (KDP)

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Inorganic nonlinear optical (NLO) crystals are vital in modern photonic and optoelectronic applications due to their ability to manipulate light through nonlinear behavior. Potassium Dihydrogen Phosphate (KDP) is a notable example of an inorganic NLO material, boasting excellent optical transparency, high laser damage threshold, and efficient second harmonic generation (SHG). Although seeded solution growth with controlled temperature lowering is a preferred method for growing KDP crystals, the slow evaporation solvent method is employed in this work for its simplicity and educational value in lab setting.

INORGANIC NONLINEAR OPTICAL CRYSTAL: AMMONIUM DIHYDROGEN PHOSPHATE (ADP)

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Ammonium dihydrogen phosphate (ADP) is a significant nonlinear optical (NLO) crystal known for its excellent optical transparency and frequency conversion efficiency. Among various crystal growth methods, slow evaporation solution growth and seeded solution growth are preferred for NLO ADP crystals. In this study, ADP crystals were grown using the slow evaporation solution method at room

temperature, with variations in water quality. The crystals' growth, structure, and properties were characterized, starting with solubility observations.

STRUCTURAL, ELECTRICAL, AND OPTICAL PROPERTIES OF ULTRASONICALLY PREPARED CuO–MWCNT NANOCOMPOSITES

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The current study focuses on CuO/MWCNT nano composites. CuO nanoparticles were produced using Sol-gel, and MWCNT was readily absorbed at the nanoscale. Using an ultrasonic method, different concentrations of MWCNT (1%, 3%, and 5%) were added to different nano composites to create the CuO/MWCNT nanocomposite. XRD measurements in the θ -2 θ mode confirmed the monoclinic crystal structure and particular space group, C2/c. FESEM was utilized to examine the microstructural characteristics and prove the presence of MWCNT particles in the generated nanocomposites. The energy band gap of CuO and composite materials was measured using UV-visible spectroscopy. Analysis revealed that the energy band shrinks as MWCNT concentration increases. The Agilent LCR meter was used to investigate dielectric behavior in the frequency range of 20 Hz to 2 MHz. The conducting MWCNT and the role of CuO semiconductor nature were investigated in connection to the behavior of dielectric constant, impedance, and ac conductivity.

STABILIZED FINITE ELEMENT TREATMENT OF ADVECTION NEAR AN UNSTABLE EQUILIBRIUM

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Transport problems with dominating advection and unstable flow fields pose significant numerical challenges for standard finite element discretizations. In rotating reference frames, linearized unstable equilibria produce velocity structures with exponential stretching that induce spurious oscillations and numerical artefacts in classical Galerkin solutions. This study presents a stabilized finite element formulation for solving advection-dominated transport equations defined by an unstable linear velocity field. The weak formulation is developed within a continuous Galerkin framework augmented with streamline-upwind Petrov–Galerkin (SUPG) stabilization, and numerical implementation is carried out on a two-dimensional model domain. Comparative numerical experiments show the problems with the standard Galerkin method and how using the right stabilization parameters can reduce non-physical oscillations while keeping the main advective features of the solution. The results reveal significant factors influencing the accuracy and stability of solutions in advection-dominated regimes. They also demonstrate how to use stabilization methods to solve PDE transport problems that happen in systems that are rotating. These results help in better

numerical understanding of how stabilized finite element methods work for complicated flows that are driven by advection.

MULTIPHASE ENGINEERING AND OPTICAL PROPERTIES OF NiCoS₂ NANOCOMPOSITES

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The present study reports the mixed-phase architecture of NiCoS₂ (NCO) nanocomposite, demonstrating reliable and high-rate supercapattery-grade hybrid energy storage performance, coupled with remarkable dielectric polarization. Powder-XRD, along with comprehensive Rietveld analysis, confirmed the coexistence of multiple crystalline phases, namely cubic-Co₃S₄, hexagonal-CoS, cubic-Ni₃S₄, and hexagonal-NiS. HRTEM revealed spherical morphology with 17 nm average particle size and 0.33 nm d-spacing. XPS confirmed to have multiple electronic states, including Ni³⁺ /Ni²⁺, Co³⁺ /Co²⁺, and S²⁻, while EDX provided the elemental composition and sulphur-deficient nature. UV-Vis-NIR absorption spectrum exhibited a strong optical response in the UV and visible region, while an optical band gap and Urbach energy were estimated using Tauc's plot and Urbach plot, respectively. Moreover, the photoluminescence (PL) spectrum has showcased distinct emission peaks at 390 nm, 530 nm, and 655 nm, corresponding to band-edge and defect-related transitions. This analysis highlights the NCO nanocomposites as potential candidate for photonics and optoelectronics applications.

EXPLORING THE STRUCTURAL, ELECTRICAL AND DIELECTRIC PROPERTIES OF BIFeO₃ THIN FILMS OVER FLEXIBLE ITO COATED PET SUBSTRATES

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Flexible multifunctional materials are attracting growing interest for next-generation wearable and bendable electronic devices. In this study, BiFeO₃ (BFO) was deposited at low temperatures using an advanced PLD approach on flexible ITO-coated polyethylene terephthalate (PET) substrates. Grazing Incidence X-ray diffraction has been performed which reveals detailed structural information about the surface and thin layers of materials. Raman spectroscopy reveals characteristic phonon modes of BFO and ITO coated PET. The current-voltage (I-V) characteristics of the film were examined using a source meter at room temperature in both flat and mechanically bent positions, and the dielectric, impedance, and AC conductivity characteristics of the film were examined using an LCR meter at room temperature. The primary goal of this work is to synthesize BiFeO₃ (BFO) film on a flexible substrate and assess its bendability.

INVESTIGATION ON STRUCTURAL, MICROSTRUCTURAL, ELECTRICAL AND ELECTROCHEMICAL PROPERTIES OF Bi₂O₃/g-C₃N₄ NANOCOMPOSITES

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In the present work, Bi₂O₃/g-C₃N₄ nanocomposite has been investigated to explore their structural, microstructural, electrical, and electrochemical properties. Monoclinic α -Bi₂O₃ was synthesized via thermal decomposition technique, while g-C₃N₄ was prepared through polymerization method. Nanocomposite pellets with varying g-C₃N₄ contents (1, 3, and 5 wt%) were prepared using a solid-state mixing route. Structural analysis of the prepared samples was carried out using X-ray diffraction (XRD) to examine phase formation, crystallinity, and lattice parameters. Crystallite size and micro strain were evaluated using Scherrer and Williamson–Hall approaches. Surface morphology and microstructural Analysis were investigated using field-emission scanning electron microscopy (FESEM), while elemental composition and spatial distribution were examined through energy-dispersive X-ray spectroscopy (EDX) and colour mapping. The frequency-dependent electrical properties, including AC conductivity, dielectric constant and impedance were studied at room temperature over frequency range 20Hz to 2MHz using an LCR meter. Dielectric relaxation behavior was analysed using Cole–Cole and universal dielectric response models. In addition, electrochemical properties of selected samples were examined using cyclic voltammetry and galvanostatic charge–discharge measurements to assess their electrochemical response. The comprehensive characterization approach adopted in this work provides a systematic framework for understanding Bi₂O₃-based composite systems for multifunctional device applications.

INTERFACE-DRIVEN COLOSSAL ELECTRORESISTANCE AND FIELD-EFFECT TRANSPORT IN ZNO/LSMO P–N JUNCTION HETEROSTRUCTURES

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In this work, a bilayered ZnO/La_{0.7}Sr_{0.3}MnO₃ (ZnO/LSMO) p–n junction heterostructure was fabricated using a sol–gel assisted chemical solution deposition technique on LaAlO₃ substrates, enabling controlled interface formation between a semiconducting oxide and a strongly correlated manganite. Structural and microstructural investigations confirm epitaxial growth of the LSMO layer with well-defined surface morphology, while transport studies performed under current-in-plane (CIP) and current-perpendicular-to-plane (CPP) measurement protocols reveal distinct interface-dominated conduction mechanisms. The heterostructure exhibits rectifying behavior, non-linear I–V characteristics, and a pronounced positive electroresistance effect, with colossal electroresistance (CER) exceeding 400% in CPP geometry. The enhanced CER is attributed to electric-field-induced modulation of the depletion region, interface defect states, and phase-sensitive charge transport in the

manganite layer. Field-effect tuning demonstrates that the interface plays a decisive role in governing transport anisotropy and resistive switching behavior. Beyond the present electric-field-driven response, the system opens new possibilities for multi-stimuli control, where future studies may explore magnetic field-assisted electroresistance, UV-radiation-induced photocarrier modulation, and hybrid field-photo coupling to dynamically tailor interfacial transport. Furthermore, extending the present architecture toward multi-interface heterostructures rather than a single p-n junction could enable enhanced sensitivity, interfacial charge confinement, and tunable energy landscapes. Such multifunctional oxide heterostructures hold strong potential for next-generation field sensors, optoelectronic devices, neuromorphic elements, and multi-state memory technologies.

INVESTIGATIONS ON STRUCTURAL, MICROSTRUCTURAL AND ELECTRICAL PROPERTIES OF CuO:TiO₂ NANOCOMPOSITES

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In the present communication, CuO:TiO₂ pure and nanocomposites (varying concentration of TiO₂ 25%, 50%, 75%), were successfully synthesized using sol-gel method. X-ray diffraction (XRD) confirms that CuO nanoparticles have a monoclinic crystal structure, while TiO₂ nanoparticles have a tetragonal crystal structure. Crystallite size decreases from 44.98 nm to 29.64 nm and strain increases from 0.00162 to 0.00327 with TiO₂ wt%. Energy dispersive spectroscopy (EDX) indicates that none of the five samples contain any additional impurities. The morphological and optical studies of pure and nanocomposite samples were characterized using FESEM, FTIR and PL spectra. In order to investigate the dipole mechanism of all five samples, dielectric investigations were carried out in the frequency range of 1 kHz–2 MHz using the cole-cole relaxation and UDR model. Frequency-dependent electrical conductivity has been understood on the basis of Jonscher's universal power law, and it follows the CBH conduction mechanism, with the maximum barrier height (W_m) calculated. The ac conductivity was found to increase from CT0 to CT100. It is observed that the impedance (Z) decreases as Ti^{4+} increases, which could be explained by an improvement in crystal boundaries. The electrical characteristics are carefully examined in relation to defects, disorder, oxygen vacancies, and secondary phases.

EFFECT OF SINTERING TEMPERATURE ON STRUCTURAL, MICROSTRUCTURAL AND ELECTRICAL PROPERTIES OF Gd DOPED ZINC OXIDE NANOPARTICLES

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Zn_{0.98}Gd_{0.02}O nanoparticles were synthesized using the sol-gel method and systematically characterized. The θ -2 θ X-ray diffraction (XRD) confirmed the single-phase hexagonal structure without detectable impurities. Crystallite size was estimated using the Scherrer's equation and further

validated through Williamson–Hall analysis, with observed variations attributed to agglomeration effects. Structural phase purity was confirmed by Rietveld refinement using FULLPROF software. Field Emission Scanning Electron Microscopy (FESEM) images revealed sintering temperature-dependent modifications in grain size and morphology. Frequency-dependent dielectric Constant, a.c. conductivity, and impedance were studied at room temperature. Dielectric behavior followed the universal dielectric relaxation (UDR) model, while a.c. conductivity obeyed Jonscher's universal power law, indicating correlated barrier hopping (CBH) as the dominant charge transport mechanism. Impedance decreases with increasing frequency. These results provide comprehensive insight into the structural and electrical properties of Gd-doped ZnO nanoparticles.

COMPREHENSIVE STUDY OF STRUCTURAL, SPECTROSCOPIC AND MAGNETIC PROPERTIES OF HALF-DOPED MIXED VALENT MANGANITE

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The first-order antiferromagnetic–insulator (AFI) to ferromagnetic–metallic (FMM) phase transition in Nd_{0.5}Sr_{0.5}MnO₃ (NSMO) is arrested at low temperatures in a certain range of applied magnetic fields. This effect gives rise to a low temperature magnetic glass state in NSMO. The polycrystalline NSMO sample was synthesized using the sol–gel method and sintered at ~ 1350 °C. X–ray diffraction (XRD) results confirm the single-phase nature with an orthorhombic crystal structure (space group *Imma*), as verified by Rietveld refinement. Mn L edge and O K edge X–ray absorption spectroscopy (XAS) were used to gain insight into the electronic structure of NSMO. The nature of coexisting FMM and AFI phases in NSMO sample is explored through magnetization measurements. Like other first order phase transitions (FOPT), in this case, the FMM to AFI transition is interrupted by glass like arrest of kinetics. As a result, the high temperature FMM phase arrested at low temperature, which significantly contributes to the thermomagnetic irreversibility observed in the NSMO. These findings offer unique perspectives on the temperature–driven phase transitions in NSMO that advances the understanding of magnetic behaviors of manganites. Interestingly, NSMO shows both conventional and inverse magnetocaloric effects (MCE) within a single material, highlighting its unique dual nature.

INVESTIGATIONS ON PERCOLATION-DRIVEN TRANSPORT AND MAGNETORESISTANCE IN Nd_{0.7}Sr_{0.3}MnO₃:SiO₂ NANOCOMPOSITES

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Nd_{0.7}Sr_{0.3}MnO₃:SiO₂ nanocomposites [NS0 (0%), NS5(5%), and NS10 (10%)] with different SiO₂ contents were synthesized via sol–gel method to investigate the influence of an insulating amorphous phase on electrical, transport and magnetoresistive behaviors. X–ray diffraction (XRD) confirms the retention of the single–phase perovskite structure of Nd_{0.7}Sr_{0.3}MnO₃ with the absence of SiO₂ related diffraction peaks which is attributed to its amorphous nature. Field emission scanning electron microscopy (FESEM) and High resolution transmission electron microscopy (HRTEM) characterizations were performed to investigate the microstructural and nanoscale features of the Nd_{0.7}Sr_{0.3}MnO₃:SiO₂ nanocomposites and to understand the role of SiO₂, indicating modification of

granular structure upon addition of amorphous SiO₂. Magnetic field dependent (0–7 T) resistivity measurements show metal–insulator transition for which resistivity increases with SiO₂ content, reduced electrical connectivity and field induced suppression of resistivity for all compositions. The intermediate temperature regime (50–300 K) is well described by a phenomenological percolation model, emphasizing phase–separation driven transport, while the low–temperature resistivity (2–50 K) follows an electron–electron scattering mechanism. Temperature–dependent (2–300 K) magnetoresistance (MR) measurements show enhanced MR response with increasing SiO₂ content. The comparative analysis establishes that controlled incorporation of amorphous SiO₂ enhances magnetotransport behavior by tuning grain–boundary resistance, making Nd_{0.7}Sr_{0.3}MnO₃:SiO₂ nanocomposites a promising platform for magnetoresistive based sensing applications.

STUDY OF THE EFFECT OF SINTERING TEMPERATURE ON THE STRUCTURAL AND ELECTRICAL PROPERTIES OF PURE CUO NANOPARTICLES

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In the present study, pure CuO nanoparticles were synthesized using a simple and cost-effective co-precipitation method. Structural characterization was carried out using X-ray diffraction (XRD) and scanning electron microscopy (SEM). The XRD patterns confirm the single-phase nature of the samples, with no impurity peaks observed. A progressive narrowing of the diffraction peaks with increasing sintering temperature indicates enhanced crystallinity and an increase in grain size. SEM images reveal a clear increase in grain size with rising sintering temperature. The dielectric constant decreases with increasing frequency, indicating that dipoles are unable to follow the rapidly varying electric field at higher frequencies. The universal dielectric response (UDR) was verified by plotting $\log(\epsilon'')$ versus $\log(f)$. The frequency-dependent charge transport mechanism was analyzed by fitting the ac conductivity data using Jonscher's power law. The simultaneous decrease in dielectric constant and conductivity, along with an increase in impedance, is attributed to reduced space charge polarization and restricted charge carrier hopping across grain boundaries. In addition, temperature-dependent resistivity measurements performed at different current values show a decrease in resistivity with increasing temperature, confirming the semiconducting nature of CuO. Furthermore, increasing the applied current results in a reduction in resistance, while higher sintering temperatures lead to an increase in resistivity.

DARK ENERGY: THE SILENT WHISPER THAT REVEALS THE UNIVERSE'S SECRETS

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The discovery that the universe is expanding and the known force behind the expansion is dark energy is still one of the most profound mysteries in modern physics. This presentation is an attempt of scientific exploration of dark energy, including its origin, observational discovery and current understanding with other important concepts such as cosmic microwave background, baryon acoustic oscillations etc. This work establishes dark energy's existence through three independent pillars, Type Ia supernovae measurements, baryon acoustic oscillations from 15 million galaxies, and cosmic microwave background all converging on the same conclusion. Also this includes theoretical models such as cosmological constant (which Einstein saw as biggest blunder of his life), quintessence and phantom energy. This study emphasizes the central role of dark energy in shaping the past, present, and future evolution of the Universe, while underscoring the fact that its true physical nature remains

one of the greatest open questions in fundamental physics. Recent missions and experiments such as Planck, DES, BOSS, and DESI combine cutting-edge detector technology, high-performance computing, and sophisticated statistical methods to probe the expansion history of the Universe with unprecedented accuracy. The study of dark energy thus exemplifies how technological innovation enables fundamental scientific discovery, which also matches with the theme of the symposium.

SPECIFIC ROTATION OF SUGAR

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Optical activity is a phenomenon exhibited by chiral substances that rotate the plane of polarization of plane-polarized light. This property is quantitatively analyzed based on Biot's law, which relates the angle of rotation (θ) to the specific rotation $[\alpha]$, concentration (c), and path length (l). In this experiment, the rotation of an optically active solution (such as sugar) is observed and its specific rotation determined, demonstrating the importance of optical activity in chemical analysis.

DUSTY PLASMA

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Dusty plasma, also known as complex plasma, is a special state of plasma that contains small solid dust particles in addition to electrons, ions, and neutral atoms. These dust grains originate from various sources such as cosmic particles in space, smoke and ash in the atmosphere, or particles intentionally introduced in laboratory experiments. When dust particles enter a plasma, they usually acquire a negative electric charge due to the collection of fast-moving electrons on their surfaces. Because dust grains are much heavier than electrons and ions, their presence significantly alters plasma behavior and leads to new and complex physical phenomena. Dusty plasma is widely observed in nature, particularly in astrophysical environments such as interstellar clouds, comet tails, planetary rings, and star-forming regions. In these settings, dusty plasma plays an important role in processes like planet and star formation. In laboratory experiments, dusty plasma provides a unique platform for studying wave propagation, particle interactions, strong coupling effects, and self-organization. One of the most remarkable observations in dusty plasma research is the formation of plasma crystals, where charged dust particles arrange themselves into ordered structures. In recent years, artificial intelligence (AI) has emerged as a powerful tool in dusty plasma research. Researchers at Emory University have successfully applied AI and machine learning techniques to analyse experimental dusty plasma data. These AI models have helped identify complex particle interactions and uncover non-reciprocal forces that were difficult to detect using traditional methods. The integration of AI has improved data interpretation and contributed to new physical insights. Thus, the study of dusty plasma, combined with modern AI techniques, is important for advancing both fundamental plasma physics and applied research.

PHYSICS CARVED IN STONE

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Ancient Indian architecture demonstrates an advanced understanding of physics and astronomy. This paper explores the physics and astronomy applied in building the Modhera Sun Temple, Konark Sun Temple, Rakhigarhi and stone circles. These examples of excellent architecture prove the vast scientific knowledge possessed by ancient Indian civilizations. They demonstrate understanding of the sun earth motion, the period of rotation of the planets around the sun, the seasons and many such phenomena long before they were proven scientifically.

MICROPROCESSORS AND MICROCONTROLLERS: “FROM FIRST GENERATION TO MODERN INNOVATION”

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Microprocessors and microcontrollers play a crucial role in modern digital and embedded systems by enabling computation, automation, and intelligent control in everyday technology. A microprocessor is mainly designed for general-purpose computing. It functions as a central processing unit that performs arithmetic, logical, and control operations. Since it relies on external memory and peripheral devices, it is well suited for high-performance applications such as personal computers, servers, and complex computing systems. On the other hand, a microcontroller combines the processor core, memory, input/output ports, and peripheral components on a single chip. This compact integration allows microcontrollers to perform specific control tasks efficiently while consuming less power and requiring minimal external hardware. Due to these advantages, microcontrollers are extensively used in embedded systems, including home appliances, automotive control systems, medical equipment, and industrial automation.

GROUP B

BIOCHEMISTRY

CARBON FOOTPRINT OF MARINE FISHERIES: EMISSION SOURCES AND REDUCTION PATHWAYS

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Marine fisheries are integral to ensuring food security, livelihood support and economic development in coastal regions, while also contributing to greenhouse gas emissions throughout fishing activities and related supply chains. The carbon footprint associated with marine fisheries is predominantly linked to fuel combustion during fishing operations, along with emissions generated from vessel construction and upkeep, ice manufacturing, onboard handling, fish processing, cold storage, transportation and marketing. Among these components, fuel consumption during fishing voyages represents the largest source of carbon dioxide emissions, especially within mechanized fleets that operate with greater engine capacity, extended fishing durations and wider spatial coverage. At the global scale, increasing levels of mechanization, technological advancement and expansion of fishing grounds have resulted in higher fuel use per unit of fish harvested, even in situations where overall catch volumes have remained unchanged. In India, the marine fisheries sector exhibits substantial variation in emission intensity due to the presence of non-motorized, motorized and mechanized fleets; although emission intensity is comparatively lower than global averages, total greenhouse gas emissions have risen over time because of increased fishing effort and continued reliance on diesel-powered vessels. Life cycle assessment has gained importance as a scientific approach for estimating emissions and identifying major emission hotspots across the fisheries value chain, thereby supporting climate-resilient and sustainable fisheries management. Reducing the carbon footprint of marine fisheries necessitates improvements in fuel efficiency, adoption of renewable and low-carbon energy alternatives, refinement of fishing practices and post-harvest systems and the implementation of effective policy and governance measures. Addressing emissions from marine fisheries is therefore critical for minimizing climate change impacts while safeguarding the long-term sustainability and resilience of the sector.

Key words: Carbon footprint, Marine fisheries, Greenhouse gas emissions, Sustainable fisheries management

ULTRA-HIGH-PRESSURE TECHNOLOGY (HPP): ADVANCED SYSTEMS SUPPORTING HIGHER PRESSURES FOR IMPROVED MICROBIAL INACTIVATION AND SHELF-LIFE IN SEAFOOD.

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High-Pressure Processing (HPP), also known as ultra-high pressure technology, is an emerging non-thermal and environmentally friendly food preservation technology that has gained significant attention in the seafood industry. This technology utilizes ultra-high hydrostatic pressure, typically ranging from 100 to 600 MPa, applied for short durations to inactivate food-borne pathogens and spoilage microorganisms without the use of heat. HPP effectively enhances seafood safety by controlling pathogenic microorganisms such as *Vibrio*, *Listeria monocytogenes*, and viruses including norovirus, while preserving the freshness, nutritional value, and organoleptic properties of seafood

products. Unlike conventional thermal processing methods, HPP operates on the principle of isostatic pressure, which is uniformly transmitted throughout the product, ensuring consistent microbial inactivation without compromising texture, color, or flavor. The technology also supports clean-label product development by reducing the need for chemical preservatives. In addition to safety and shelf-life extension, HPP has found successful commercial applications in seafood processing, particularly in shellfish shucking and meat extraction, ready-to-eat meals, raw fish products, and crustacean processing. With the global HPP market experiencing rapid growth, especially in North America and the Asia-Pacific region, this technology represents a promising solution for sustainable seafood processing. Overall, HPP offers an innovative approach to meeting consumer demand for safe, high-quality, minimally processed seafood while supporting industry sustainability and food security.

BIOPROSPECTING ACTINOBACTERIA FOR INDUSTRIAL PROTEASE PRODUCTION: MICROBIOLOGICAL SCREENING, OPTIMIZATION, AND FUNCTIONAL EVALUATION

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Proteases are among the most commercially important enzymes due to their extensive applications in detergent, pharmaceutical, food, and biomedical industries. Actinobacteria represent a major microbial resource for extracellular enzyme production owing to their metabolic versatility and environmental adaptability. In the present study, an actinobacterial isolate KhEc-14, was screened for protease production using gelatin agar medium and selected for detailed microbiological and biochemical investigation. Culture conditions and nutritional parameters were systematically optimized to enhance protease yield. Enzyme production was carried out under optimized conditions, followed by purification through sequential precipitation and chromatographic techniques. The purified protease was characterized with respect to molecular weight, optimum pH, temperature, and stability profile. The enzyme exhibited maximum activity under alkaline pH and moderately elevated temperature, along with substantial stability across a broad range of operational conditions. Functional evaluation through blood stain removal from cotton fabric demonstrated efficient proteolytic activity without adverse effects on fabric integrity. These microbiological and biochemical attributes indicate the enzyme's strong potential for detergent and industrial applications. The study highlights actinobacterial isolate KhEc-14 as a promising microbial source of industrially relevant proteases and contributes valuable insights into microbial enzyme bioprospecting. Future investigations will emphasize detailed structural analysis and the development of large-scale production strategies to support commercial utilization.

Keywords: Actinobacteria; Microbial protease; Enzyme bioprospecting; Media optimization; Enzyme characterization; Industrial biotechnology.

APPLICATION OF NON-INVASIVE ELECTRO PHOTON IMAGE (EPI) ANALYSIS FOR EFFECTIVE HERBAL DRUG FORMULATION FROM *OCIMUMGRATISSIMUM* LEAVES

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Ocimumgratissimum L. is an important medicinal species with several therapeutic applications. It is used in traditional medicine as a single drug and in formulations. For effective formulation of herbal

drug selection of proper age of the plant is imperative. In the present study, the *O. gratissimum* (leaves) was collected from the Dhanvantri Aushadhiya Van of VIRSACO. The leaves were grouped into various sizes. The smaller to larger four groups of *O. gratissimum* leaves were evaluated for growth, chlorophyll content and phenol content. The growth was measured in the terms of leaf area, fresh and dry weights and water content. Further, all leaves were evaluated with the EPI technique. This technique is based on electromagnetic energy in unique patterns generated by the object in the given conditions. The EPI parameters like GDV area, average intensity, length of isoline, form coefficient, spatial fractality and entropy by isoline, etc., were measured using its software. The EPI parameter was given a highly significant correlation with physiological and biochemical parameters. Our results indicate that EPI is a new promising tool for material selection and for assessing the therapeutic properties of herbal medicines. The age of leaves for herbal drug formulation and its correlation with Electrophoton image (EPI) technique is discussed.

Key words: *Ocimumgratissimum*, Leaves, Herbal drug formulation, Electrophoton image

ROLE OF FISHERIES IN OCEANIC CARBON STORAGE

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Carbon sequestration in fisheries is increasingly recognized as an effective nature-based solution for mitigating climate change while supporting sustainable aquatic food production. Fisheries-associated ecosystems such as mangroves, seagrass meadows, salt marshes, and environmentally responsible aquaculture systems play a crucial role in capturing and storing atmospheric carbon dioxide, commonly referred to as blue carbon. Mangrove forests are among the most efficient carbon sinks, sequestering approximately 1.5–2.0 Mg C ha⁻¹ yr⁻¹ and storing substantial amounts of carbon in long-term sediment deposits. Seagrass meadows, despite occupying a small fraction of the global ocean area, contribute significantly to oceanic carbon burial by trapping organic matter within sediments. Sustainable fisheries and aquaculture further enhance carbon sequestration through biomass accumulation, biological carbon cycling, and sediment stabilization. Seaweed farming demonstrates high carbon uptake potential, while shellfish aquaculture indirectly supports carbon storage by improving water clarity and promoting benthic carbon deposition. Conversely, destructive fishing practices such as bottom trawling can disturb seabed sediments and release previously stored carbon, reducing climate benefits. Integrating ecosystem-based fisheries management and carbon accounting into fisheries governance can enhance climate resilience, biodiversity conservation, and long-term livelihood sustainability, particularly in coastal and developing regions.

Keywords: Carbon sequestration, Blue carbon, Fisheries management, Mangroves, Seagrass meadows, Sustainable aquaculture, Seaweed farming, Climate change mitigation, Ecosystem-based fisheries management

THE DWAN OF RESTORATIVE MEDICINE

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Restorative medicine represents a transformative shift in healthcare, moving beyond symptomatic management toward the repair and restoration of damaged biological functions. Unlike conventional therapies that primarily control disease progression, restorative medicine aims to reverse pathological conditions at the cellular, genetic, and molecular levels. Recent advances in gene therapy, stem cell technology, regenerative biomaterials, and immune engineering have accelerated this paradigm shift. Breakthroughs such as gene replacement therapies restoring sensory functions, off-the-shelf immune cell therapies targeting cancer and autoimmune disorders, and tissue regeneration through stem cells highlight the clinical potential of this approach. Additionally, progress in precision medicine and genome editing tools like CRISPR-Cas systems has enabled targeted correction of genetic defects. The dawn of restorative medicine marks a new era in which curing, regenerating, and rejuvenating damaged tissues is becoming a realistic goal. This emerging field holds promise for treating previously incurable diseases, improving quality of life, and reshaping the future of personalized healthcare.

ECO-BIOPLASTIC FROM JACKFRUIT AND JAMUN SEED POLYMERS AS SUSTAINABLE PLASTIC ALTERNATIVES

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The increasing environmental problems caused by conventional petroleum-based plastics have created an urgent need for sustainable and biodegradable alternatives. This study focuses on the development of eco-bioplastics using natural polymers extracted from jackfruit (*Artocarpus heterophyllus*) and jamun (*Syzygium cumini*) seeds. These seeds are agricultural waste materials rich in starch and polysaccharides, making them suitable for bioplastic production. The extracted polymers were processed with natural plasticizers to form biodegradable plastic films. The prepared bioplastics were evaluated for physical properties such as flexibility, tensile strength, water absorption, and biodegradability. Results indicate that jackfruit and jamun seed-based bioplastics exhibit good mechanical strength and faster degradation compared to synthetic plastics. Utilizing these renewable resources not only reduces plastic pollution but also adds value to agro waste. This eco-friendly approach offers a promising solution for sustainable material development and environmental conservation.

Keywords: Eco-bioplastic, Jackfruit seed polymer, Jamun seed polymer, Biodegradable plastic, Sustainable materials.

GUT BRAIN AXIS: MICROBES INFLUENCE MENTAL HEALTH

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The gut-brain axis is a complex, two-way communication system between the gastrointestinal tract and the brain. It involves neural, hormonal, and immune pathways that allow the gut and brain to influence each other. Gut microbes play a key role in this connection by helping in digestion, producing vitamins, and releasing bioactive compounds such as neurotransmitters and short-chain fatty acids. These microbial products affect brain function, mood, behavior, and immune responses. An imbalance in gut microbiota, known as dysbiosis, has been linked to various health problems including anxiety, depression, obesity, inflammatory diseases, and neurological disorders. Maintaining a healthy gut microbiome through balanced diet, probiotics, and healthy lifestyle can support both mental and physical health. Thus, gut microbes are essential regulators of human health through their interaction with the gut-brain axis.

KEYWORDS: gut-brain axis, vagus nerve, neurotransmitters, mood regulations, dysbiosis

3D PRINTING USING TISSUE AND ORGAN

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3D bioprinting is an advanced additive manufacturing technology that enables the layer-by-layer fabrication of functional human tissues and organs using bioinks composed of living cells and biomaterials. This computer-aided approach integrates principles of tissue engineering and regenerative medicine to address critical challenges such as organ transplantation shortages, drug testing, and personalized disease modeling. Current bioprinting techniques—including extrusion-based, inkjet-based, and laser-assisted methods—aim to replicate complex biological microarchitectures through biomimicry and controlled cell placement. Despite its transformative potential, significant limitations remain, particularly in achieving effective vascularization, maintaining cell viability during printing, and reducing high production costs. Recent advancements focus on optimizing bioink formulations, scaffold design, and process parameters to enhance structural integrity and biological function. As life expectancy increases, continued innovation in 3D bioprinting is essential to enable clinically viable, patient-specific tissues and organs for future healthcare applications.

Keywords: 3D Bioprinting, Bioinks, Tissue Engineering, Organ Transplantation, Scaffolds, Additive manufacturing

ASPERGILLUS TUBINGENSIS: A LANDFILL FUNGUS REVOLUTIONIZING POLYURETHANE BIODEGRADATION

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Plastic waste is a major environmental problem because most synthetic polymers do not degrade naturally. A large amount of plastic has accumulated in landfills and the environment since the 1950s. This study highlights a sustainable solution using a newly identified fungal strain, *Aspergillus tubingensis*, isolated from a waste disposal site in Islamabad, Pakistan. This fungus has a special ability to degrade polyester polyurethane (PU), a commonly used plastic in industrial products. Its biodegradation potential was tested under laboratory and soil conditions using agar plates, liquid mineral medium, and soil burial methods. The degradation process occurs in three main steps: the fungus first attaches to the plastic surface, then grows over it, and finally releases enzymes such as esterase and lipase that break down the chemical structure of PU. The breakdown of plastic was confirmed through microscopic and chemical analyses, which showed visible damage to the plastic surface and changes in chemical bonds. The process works best under optimized conditions, especially at 37 °C, with enzyme activity influenced by pH. Overall, this research demonstrates that *Aspergillus tubingensis* offers a safe, efficient, and eco-friendly approach for plastic waste management, making it a promising biological tool for reducing polyurethane pollution without producing harmful by-products.

Keywords: *Aspergillus tubingensis*; Polyurethane biodegradation; Esterase; Lipase; Bioremediation; SEM–FTIR analysis

SILK PRODUCTION IN SPIDERS BEYOND WEB MAKING

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Spider silk is a remarkable natural protein fiber produced by specialized glands in the abdomen of spiders and is used for web construction, egg protection, and survival activities. It is mainly composed of fibroin proteins known as spidroins, which are rich in repetitive glycine and alanine sequences. Structurally, spider silk exhibits a unique hierarchical organization consisting of rigid crystalline

regions that impart high tensile strength and semi-amorphous elastic regions that provide flexibility and extensibility. Due to this combination, spider silk shows exceptional mechanical properties, being stronger than steel on a weight basis and tougher than many synthetic fibers such as Kevlar. Certain types of spider silk can stretch several times their original length without breaking. However, large-scale harvesting of natural spider silk is not feasible because spiders are territorial and cannibalistic. Therefore, modern research focuses on recombinant production using transgenic organisms like bacteria, plants, and goats. These bioengineered silks show great potential in biomedical, industrial, and defense applications.

Key Words: Spider silk; Fibroin; Tensile strength; Elasticity; Toughness; Recombinant production; Biocompatibility; Biomedical applications

BIOCHAR: A SUSTAINABLE SOLUTION FOR AQUATIC POLLUTION CONTROL

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Emerging pollutants such as pharmaceuticals, personal care products, heavy metals, nutrients, and microplastics are increasingly detected in aquatic systems due to rapid industrialization, urbanization, and agricultural activities. These contaminants pose serious risks to aquatic organisms, water quality, and human health, while conventional treatment methods are often costly and inefficient for their complete removal. Biochar, a carbon-rich material produced through the pyrolysis of biomass under limited oxygen conditions, has gained significant attention as a low-cost, eco-friendly, and sustainable adsorbent for water and wastewater treatment. Owing to its high surface area, porous structure, surface functional groups, and adjustable physicochemical properties, biochar effectively removes a wide range of emerging pollutants through mechanisms such as adsorption, ion exchange, complexation, and co-precipitation. This seminar reviews the sources and impacts of emerging pollutants, biochar production methods, key properties influencing its performance, and its applications in the removal of heavy metals, pharmaceuticals, nutrients, and microplastics from aquatic environments. In addition, the role of biochar in aquaculture systems, water quality management, and carbon sequestration is highlighted. Overall, biochar represents a promising and sustainable solution for mitigating emerging pollutants and improving aquatic ecosystem health, though large-scale field applications and region-specific studies are still required.

Keywords: Biochar; Emerging pollutants; Aquatic systems; Adsorption; Water treatment; Aquaculture

BOTANICAL ROBOT: THE GREEN MACHINE OF TOMORROW

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Botanical robots, also known as plant robots, are robotic systems designed to support natural plant growth. Plants grow on their own, while robots assist by monitoring soil moisture, nutrients, light, temperature, and plant signals such as growth direction and stress. Using this data, robots provide accurate watering, lighting, nutrient supply, and physical support. These systems use soft and flexible structures to avoid damaging plants, forming a biohybrid system where plants and machines work together. Inspired by biomimicry, botanical robots improve efficiency, reduce human effort, save

resources, and promote sustainability. Botanical robotics has applications in smart agriculture, vertical farming, green architecture, environmental monitoring, and space farming, representing the green machines of tomorrow.

Key Words: Botanical Robotics , Bio-hybrid System , Sustainability , Biomimicry , Plant Signals

ANIMAL THAT PREDICTS NATURAL DISASTERS

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Natural disasters such as earthquakes, tsunamis, floods, and volcanic eruptions are often preceded by subtle environmental changes that remain undetectable to humans but are sensed by animals. This review highlights the role of animals as natural disaster warning systems by focusing on observable behavioural symptoms exhibited prior to catastrophic events. Common symptoms include unusual restlessness, sudden migration, excessive vocalization, erratic movement, abandonment of shelters or habitats, and altered feeding or reproductive behaviour. These responses are believed to arise from animals' heightened sensitivity to changes in seismic vibrations, electromagnetic fields, gas emissions, atmospheric pressure, and infrasound waves. Historical records and recent observations suggest that such symptom-like behavioural alterations occur hours to days before disaster onset. Understanding and systematically studying these biological early-warning symptoms can contribute to the development of complementary disaster prediction models, aiding in risk mitigation and improving human safety. The integration of ethology with geophysical monitoring presents a promising interdisciplinary approach for early disaster detection.

Key Words: Natural disasters, Behavioural symptoms, Animal migration, Electromagnetic field changes, Environmental sensing, Disaster warning

DANDELION ROOT EXTRACTS: REVISITING A TRADITIONAL HERB WITH MODERN ANTI-CANCER POTENTIAL

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Dandelion (*Taraxacum officinale*) is an established medicinal herb that has long been employed in traditional medicine for treating liver ailments, inflammation, digestive troubles, and detoxification purposes. In recent years, scientific research has established that *Taraxacum officinale* Root Extract has remarkable antioxidant, antimicrobial, and anticancer activities. The purpose of this paper is to review and emphasize the therapeutic uses of *Taraxacum officinale* Root, in particular anticancer properties. The root of dandelion contains key bioactive constituents like polyphenols, flavonoids, sesquiterpenes lactones, inulin, and triterpenes, making it have such biological properties. Some lab research studies have also shown that dandelion root extract possesses the capability to cause apoptosis or programmed cell death selectively in cancerous cells without causing any adverse effect on normal cells. The root extract has also shown promising results in curing different types of cancers like leukemia, breast cancer, colon cancer, and pancreatic cancer. The root extract also holds anti-inflammatory and immunomodulatory properties.

Keywords: Dandelion root, Medicinal plant, Anticancer activity, Phytochemicals, Herbal medicine.

GREEN GOLD: ALGAE'S URBAN REVOLUTION

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Algae are emerging as versatile drivers of sustainable innovation, offering solutions in carbon sequestration, wastewater treatment, renewable energy, bio fertilizers, air purification, and architectural design. Despite their simple structure, algae exhibit remarkable adaptability and

functional complexity. This paper examines real-world applications of algae within circular economy models, evaluates their economic and environmental potential, and critically discusses current technological and scalability limitations, positioning algae as a transformative resource for future sustainable development.

Keywords: Algae; Sustainability; Circular economy; Bioenergy; Carbon sequestration; Biotechnology

PROBIOTICS & HUMAN HEALTH

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Probiotics are defined as live microorganisms that, when administered in adequate amounts, confer health benefits to the host by modulating the gut microbiota and related physiological functions. These beneficial microbes—commonly including species of *Lactobacillus*, *Bifidobacterium*, and certain yeasts—have been widely studied for their roles in improving gastrointestinal health, enhancing immune responses, and potentially preventing or alleviating a range of metabolic, infectious, and inflammatory conditions. Emerging evidence supports the involvement of probiotics in regulating weight and glucose metabolism, influencing the gut-brain axis with implications for mental health, and contributing to dermatological and cardiometabolic outcomes. Research also highlights the synergy between probiotics, prebiotics, and synbiotics for improving microbial survival and function in the gastrointestinal tract. Although promising, many claimed health effects still require robust clinical validation, and strain-specificity, dosage, and longterm safety remain key considerations in probiotic applications. Continued exploration of mechanisms of action and targeted therapeutic uses may expand the role of probiotics in preventive and clinical health settings.

Keywords: Probiotics, Gut microbiota, Human health, Gastrointestinal health, Microbiome–host interaction, Functional foods, Strain-specific effects.

ANTIMICROBIAL DRUG RESISTANT

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Antimicrobial resistance (AMR) is a growing global health problem, highlighting the need for alternative anti-infective approaches. This study evaluated the anti-infective and quorum-modulatory activity of the polyherbal Ayurvedic formulation Panchvalkal. *In vitro* assays against *Chromobacterium violaceum*, *Serratia marcescens*, and *Staphylococcus aureus* showed reduced quorum-regulated virulence factors. *In vivo* studies using *Caenorhabditis elegans* confirmed protective effects. Panchvalkal did not induce resistance upon repeated exposure, supporting its potential as a resistance-limiting therapeutic alternative.

UNCOUPLING THE VICIOUS CYCLE OF BONE METASTASIS: INTEGRATING MOLECULAR PATHOPHYSIOLOGY, QUANTUM SENSING, AND BIO-ENGINEERED THERAPEUTIC FRONTIERS

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Bone metastasis remains a catastrophic complication for cancer patients, affecting approximately 70% of those with advanced breast or prostate cancer, and 30–40% of those with lung or kidney cancer, ultimately contributing to the deaths of over 350,000 individuals annually in the U.S. alone. Cancer systematically dismantles skeletal health by hijacking the body's natural remodeling process: disseminated tumor cells (DTCs) secrete factors such as PTHrP and RANKL that overstimulate

osteoclasts—the bone-eating cells—to create a "vicious cycle" where the released bone matrix growth factors, including TGF- β , Myostatin, and Activin A, further fuel tumor proliferation and systemic muscle wasting (cachexia). This destruction leads to a 5-year survival drop from nearly 100% in localized cases to approximately 28%, manifesting in severe skeletal-related events (SREs) such as pathological fractures (occurring in 9–29% of patients), hypercalcemia, and spinal cord compression (MESCC). These events drive excruciating pain—reported by over 80% of patients—through the activation of TRPV1 "heat" sensors and Angiotensin II (AT2R) receptors on sensory neurons. While current gold standards like Bisphosphonates and Denosumab mitigate bone loss, they are primarily palliative and carry risks such as osteonecrosis of the jaw. However, a paradigm shift is emerging through Quantum Sensing, which utilizes nitrogen-vacancy centers to detect sub-cellular metabolic "fingerprints" of DTCs years before tumors appear on traditional scans, and Microfluidic "Bone-on-a-Chip" platforms, which allow for personalized drug testing by recreating the 3D human bone-tumor interface in vitro. These diagnostic advances, paired with innovative research into bone-targeted nanoparticle "smart missiles" for localized delivery, CRISPR-enhanced "logic-gated" CAR-T cells for specific tumor eradication, and exosome-mediated reprogramming to silence bone-destruction signals, offer a definitive roadmap toward transforming bone metastasis from a terminal diagnosis into a manageable or curable condition.

BIODEGRADABLE LAB EQUIPMENT'S

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The extensive use of single-use plastic consumables in laboratories has led to a significant increase in non-degradable waste, posing serious environmental and disposal challenges. The present work focuses on the development and evaluation of **biodegradable lab equipments** as sustainable alternatives to conventional plastic laboratory ware. These equipments are fabricated using eco-friendly polymers such as polylactic acid (PLA), polyvinyl alcohol (PVA), and other plant-based or biodegradable composite materials derived from renewable resources.

The designed biodegradable lab equipments aim to maintain essential laboratory requirements including mechanical strength, usability, sterility compatibility, and cost-effectiveness, while ensuring minimal environmental impact after disposal. Selected products such as petri dishes, inoculation loops, and laboratory accessories were designed using mold-based and 3D printing approaches, followed by preliminary performance and usability assessments. The biodegradability of the materials enables natural degradation under appropriate environmental conditions, significantly reducing plastic accumulation and laboratory waste.

This initiative highlights the feasibility of integrating sustainable materials into routine laboratory practices without compromising functionality. The adoption of biodegradable lab equipments can contribute to greener research environments, promote responsible scientific practices, and support global efforts toward environmental sustainability. The study emphasizes the potential of biodegradable labware as a practical solution for eco-friendly laboratories and future green biotechnology applications.

DECODING THE SPLENIC LIPIDEMIC STATUS IN POLYCYSTIC OVARY SYNDROME RODENT MODEL

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Introduction

Polycystic ovary syndrome (PCOS) is a complex endocrine-metabolic disorder characterized by reproductive, metabolic, and immune dysregulation, affecting nearly one-third of women worldwide. Its etiology involves disruption of the hypothalamic-pituitary-gonadal axis and insulin resistance, leading to an altered endocrine-metabolic milieu that promotes chronic low-grade inflammation through immune activation. Moreover, PCOS is associated with an imbalance in immune cell populations, with increased macrophages and lymphocytes secreting pro-inflammatory cytokines that impair insulin signaling and exacerbate metabolic dysfunction. The spleen, a key immune and also a metabolic regulatory organ, has recently been implicated in reproductive physiology and dyslipidemic states, suggesting a possible role in PCOS pathology.

Materials and Methods

In this study, a letrozole-induced PCOS model was established by administering 0.5 mg/kg body weight of letrozole daily for 21 days to 2–3-month-old virgin Charles Foster female rats. Post-treatment, blood and spleen samples were collected for spectrophotometric analysis of lipid parameters, assessment of leukocyte populations, and transcript profiling of key lipid metabolism regulators.

Discussion

Letrozole induced rats showed an altered hormone profile with disrupted estrous cyclicity and ovarian peripheral cyst indicating PCOS like condition. Altered blood and splenic leukocyte profiles were observed, indicating immune involvement in oligo-ovulation. Disrupted splenic lipid metabolism suggests that the spleen may contribute to dyslipidemia and metabolic dysfunction in PCOS. These findings propose the spleen as a potential immuno-metabolic mediator linking inflammation, metabolism, and reproductive dysfunction in PCOS.

FROM FIELD TO FOOD CHAIN: PESTICIDE MAGNIFICATION AND HUMAN RISK

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Pesticides are widely used in agriculture to improve crop yield and control pests, but their persistence in the environment poses significant risks to ecosystems and human health. Biomagnification refers to the progressive increase in concentration of certain pesticides as they move through different trophic levels of the food chain. From agricultural fields, pesticide residues enter soil and water systems, are absorbed by plants, accumulate in herbivores, and become highly concentrated in top consumers, including humans. Persistent pesticides, especially organochlorines and some organophosphates, are of particular concern due to their lipophilic nature and resistance to degradation. Long-term human exposure to biomagnified pesticides has been linked to neurological disorders, endocrine disruption, reproductive toxicity, immune system impairment, and increased cancer risk. Children and pregnant women are especially vulnerable to these effects. This presentation emphasizes the need for safer pesticide use, sustainable farming practices, effective regulatory measures, and public awareness to reduce health risks and ensure food safety.

NATURE'S PHARMACY: THE HIDDEN POWER OF HEALING HERBS

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Medicinal plants have been an essential part of human healthcare since ancient times and are often referred to as Nature's Pharmacy. Healing herbs possess a wide range of bioactive compounds such as alkaloids, flavonoids, tannins, and essential oils that show antimicrobial, anti-inflammatory, antioxidant, antiviral, and immunomodulatory activities. Traditional systems like Ayurveda, Siddha, and Unani have successfully utilized these herbs for the prevention and treatment of various diseases. Recent scientific studies have validated the therapeutic potential of many herbal medicines, leading to increased interest in plant-based drugs and natural remedies. Compared to synthetic medicines, herbal treatments are generally cost-effective and associated with fewer side effects when used properly. This poster highlights the hidden medicinal potential of healing herbs, their major bioactive compounds, and their role in modern medicine. Emphasis is also given to the conservation and sustainable use of medicinal plants for future healthcare needs.

Key words: Medicinal plants, Bioactive Compounds, Antimicrobial Properties, Phytochemicals

BIOINFORMATICS

AN *IN SILICO* APPROACH FOR TARGET IDENTIFICATION OF *ALLIUM SATIVUM* (GARLIC)

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Medicinal plants have been a good source of new pharmacologically active molecules. *Allium sativum* (garlic) is an aromatic herbaceous plant that is consumed worldwide as food. This species and its active components are reported to reduce the risk of diabetes and cardiovascular diseases, protect against infections by activating the immune system, and exhibit antimicrobial, antifungal, anticancer, antiviral, antidiabetic, anti-atherosclerotic, antioxidant, and anti-inflammatory activities, as confirmed by epidemiological data from human clinical studies. The diverse therapeutic effects of molecules and their targets that underlie their pharmacological activity remain incompletely understood. In the context of increasing drug resistance and the limitations of single-target therapeutics, computational strategies offer an effective route to systematically resolve these interactions. An integrated *in silico* approach was applied to analyse garlic-derived phytochemicals using chemical clustering, followed by target fishing and reverse docking approaches based on pharmacophore models. This strategy enabled the identification of high-affinity protein targets and functional interactions, which were further refined by assessing drug-likeness and metabolic stability.

Keywords: *Allium sativum* phytochemicals, *in silico* target identification, reverse docking, pharmacophore-based target fishing, drug likeness, and metabolic stability

OMICS TECHNOLOGIES IN AQUACULTURE: APPLICATIONS IN FISH HEALTH AND GROWTH

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The rapid expansion of aquaculture demands innovative scientific tools to enhance fish health, growth performance, and sustainability. Omics technologies, including genomics, transcriptomics, proteomics, metabolomics, lipidomics, and phenomics, offer integrative platforms for understanding complex biological systems at molecular and functional levels. These approaches enable the identification of genes, proteins, metabolites, and regulatory pathways associated with disease resistance, stress tolerance, growth efficiency, and nutritional quality in cultured fish species. Genomic and transcriptomic tools support selective breeding and stock improvement by revealing genetic variability and expression patterns linked to economically important traits. Proteomic and metabolomic analyses contribute to biomarker discovery for early disease diagnosis, environmental stress monitoring, and physiological assessment. In addition, microbiome and nutrigenomics studies

provide insights into host-microbe interactions and diet-induced metabolic regulation, facilitating precision feeding strategies. The integration of multi-omics datasets through bioinformatics and systems biology enhances predictive capacity and decision-making in aquaculture management. Collectively, omics-driven applications promote improved fish welfare, optimized productivity, reduced disease outbreaks, and environmentally sustainable aquaculture systems.

Keywords: Aquaculture, Omics technologies, Fish health, Growth regulation, Genomics, Proteomics, Metabolomics, Nutrigenomics, Bioinformatics, Systems biology.

PROTEOME MINING OF *KLEBSIELLA* SPECIES TO IDENTIFY NOVEL BACTERIOCIN

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Currently, most research focuses on developing drugs, antimicrobial agents, and antibiotics for various infectious diseases. Antibiotic use has increased over time, but antibiotics have adverse effects on the body. Researchers are developing new approaches to identify antimicrobial agents beyond chemical entities. Bacteriocins are peptides produced by bacteria that exhibit antimicrobial activity against pathogens. Bacteriocins are present in most of the Gram-negative as well as Gram-positive bacteria. A limited number of known biological bacteriocins are available from *Klebsiella*. This is the time to predict a novel bacteriocin from *Klebsiella*. Protein sequences of *Klebsiella* species were retrieved from NCBI, and various tools were used to predict bacteriocins, including extracellular and secretome predictions. The interacting proteins of the bacteriocin were predicted using the STRING database, which provides information on the bacteriocin's use to inhibit the growth of other pathogens. The three-dimensional structures of screened bacteriocins and interacting proteins were predicted using I-TASSER. To confirm the interaction between bacteriocin and the interacting proteins from other pathogens, protein-protein docking was performed by ClusPro, and Chimera was used to visualize the docked model. Extensive computational power and manual analysis are required to reach the final conclusion. Finally, 3 proteins were predicted as novel bacteriocins from *Klebsiella* species that inhibit the growth of other pathogens.

Keywords: *Klebsiella*, Novel bacteriocins, Proteome mining, Antimicrobial activity, Protein-protein docking

A REVERSE VACCINOLOGY APPROACH FOR THE IDENTIFICATION OF POTENTIAL VACCINE CANDIDATES FROM *ECHINOCOCCUS GRANULOSUS*

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Infectious diseases, caused by the invasion of pathogenic microbes, are a major focus of drug design and vaccine development. This is achievable through host immune responses or drug administration, but for several reasons, the host immune response may be insufficient to control pathogenicity. In such cases, the drugs are administered, but these chemical entities are endowed with copious fatal side effects as well. Thus, there is a pressing need to prevent microbial infection rather than eliminate them

from the body after entry, leading to the development of vaccines to combat these diseases. The impending approach of computational vaccinology along with reverse vaccinology is employed in the work presented, which abets in reducing the wet lab work to a huge extent and to provide highly specific vaccine candidates, which can be further confirmed through wet lab experiments; the work aims at predicting vaccine candidates from a cestode, *Echinococcus granulosus*, a causative agent of echinococcosis, using assorted bioinformatics tools viz., MHCpred: Prediction of MHC class I and II epitopes, BCPREDS: Prediction of B cell epitopes, EpiJen: Prediction of T cell epitopes, EMBOSS antigenic: Confirming the antigenicity of vaccine candidates.

Keywords: Infection, Reverse vaccinology, *In silico*, Immunoinformatics

A BIOINFORMATICS APPROACH TO IDENTIFY NOVEL BACTERIOCIN FROM STAPHYLOCOCCUS.

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Bacteriocins are produced by bacteria, and they inhibit the growth of similar or closely related bacterial strains. Bacteriocins are classified in several ways, including by mode of production, common resistance mechanisms, and mechanisms of action. *Staphylococcus* is a Gram-positive bacterium. It is harmless and normally occurs on human skin and mucous membranes, as well as on the skin and mucous membranes of other organisms. *Staphylococcus* can cause a variety of diseases in humans and other animals through toxin production. There are various side effects associated with different antibiotics. Antimicrobial peptides are a vital component of the innate immune response and are found among all classes of plant and animal life. Gram-positive bacteria contain different types of secretion systems for the transport of proteins into or across the cytoplasmic membrane. Studies of the subcellular localization of specific components of secretion systems and their substrates have shown that these components and their substrates can be present at multiple cellular locations. Pattern construction: discover patterns that are conserved in a set of protein sequences. Prosite is a database of protein families and domains. Important for the function of a protein and for the maintenance of its three-dimensional structure. Virulence is a quantitative measure of pathogenicity, or the likelihood of causing disease. Development of all organisms is mainly determined by molecular interactions, e.g., DNA-protein, protein-protein, and protein-small molecule interactions. Protein-protein interactions appear to be critical in regulating key biological processes, including cell cycle control, cell type differentiation, protein folding, signalling, transcription, translation, post-translational modifications, and transport. The string database identifies a protein's binding partners. 3D structures were predicted for bacteriocin and binding partners. Cluspro is a protein docking program that docks two proteins into each other. Chimera is a highly extensible program for interactive visualization and analysis of molecular structures and related data, including density maps, supramolecular assemblies, sequence alignments, docking results, trajectories, and conformational ensembles. The results from docking chimera studies identified several proteins as novel bacteriocins of *Staphylococcus*.

Keywords: *Staphylococcus* bacteriocins, bioinformatics screening, antimicrobial peptides, protein-protein interaction analysis, protein docking, and 3D structure prediction

IN SILICO FUNCTIONAL ANNOTATION OF HYPOTHETICAL PROTEINS IN THE HYPERTHERMOPHILIC ARCHAEON *METHANOPYRUSKANDLERI*

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Methanopyruskandleri AV19 is a phylogenetically distinct hyperthermophilic archaeon adapted to extreme environments; although it has a complete genome sequence, a significant portion of its proteome remains functionally uncharacterized. Thus, by functionally characterizing *M. kandleri*'s unannotated proteome. To assign possible functions to previously hypothetical proteins, domain-enhanced sequence analysis, distant homology identification, and structural fold modelling can help with annotation. This method enabled the discovery of enzymes and structural motifs relevant to genome stability and thermotolerance, including proteins involved in topoisomerase activity and in cyclic 2,3-diphosphoglycerate-mediated stabilization. Analyses of secretion potential and subcellular localization also showed metabolic architecture consistent with extreme environmental adaptation. Taken as a whole, our results enhance the proteomic framework of *M. kandleri* and illuminate the evolution of archaea in hyperthermophilic environments.

Keywords: *Methanopyruskandleri* AV19, hypothetical proteins, in silico functional annotation, structural fold modelling, thermotolerance, and genome stability

INTELLECTUAL PROPERTY RIGHTS IN BIOINFORMATICS: A REVIEW OF LEGALITY AND PROTECTION STRATEGIES

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Bioinformatics is the interaction between computer science and the life sciences, enabling the transformation of biological data into proprietary assets through the framework of intellectual property rights (IPR). It involves evaluating the global IPR landscape with a focus on protecting valuable biotechnological innovations alongside diverse computational architectures. Also investigate cross-jurisdictional differences in patentability standards, particularly the “technical effect” of bioinformatics algorithms and the eligibility of modified industrial organisms. The review further delineates the categories of protection for bioinformatics assets, including patents for unique diagnostic techniques, copyrights for original software code, and trade secrets for proprietary datasets. By combining these internationally recognized legal norms, this study creates an exhaustive basis for addressing the challenges of ownership, execution, and compatibility within the international scientific ecosystem.

Keywords: Intellectual property rights, bioinformatics patents, algorithm patentability, copyright protection, trade secrets for datasets

COMPUTATIONAL DOCKING AND PHARMACOKINETIC EVALUATION OF ANTI-CANCER COMMIPHORAWIGHTIIMETABOLITES TARGETING AKT ISOFORMS

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Cancer cells exhibit extensive alterations in protein expression, driving their malignant transformation. Proteins with dysregulated expression participate in processes such as protein synthesis and degradation, signaling and metabolic pathways, and DNA repair, whose perturbations contribute to tumor development and progression. Modulating the expression or activity of these proteins represents a promising strategy for cancer control. Plants are rich sources of bioactive compounds with potential anticancer properties. *Commiphorawightii*, a medicinal plant from the Burseraceae family, contains diverse active compounds responsible for multiple pharmacological effects. In this study, metabolite profiling of *C. wightii* was conducted using LC-MS Q-tof, leading to the selection of ten compounds for further investigation. The binding interactions of these compounds were evaluated against dysregulated AKT isoforms (AKT1 and AKT2) within the oncogenic PI3K/AKT pathway using the AutoDock tool. Pharmacokinetic properties were assessed through Molinspiration and Osiris Property Explorer. Comparative docking with standard chemotherapeutics, Fluorouracil and Hydroxyurea, revealed that several *C. wightii* compounds exhibited superior binding affinities. Notably, Sampangine, Acamelin, and Lucidenic Acid M demonstrated strong interactions with the target proteins. Our findings highlight these phytochemicals as potent, multi-target lead compounds capable of modulating AKT signaling to disrupt tumour progression. This computational study provides a robust theoretical foundation for the therapeutic potential of *C. wightii* metabolites as novel AKT inhibitors. These findings suggest that *C. wightii* could be a valuable source of novel compounds for the development of preventive and therapeutic strategies against cancer.

Keywords: *Commiphorawightii*, LC-MS, Docking, PI3K/AKT pathway, Cancer

CRISPR TECHNOLOGY AND ITS IMPACT ON HUMAN HEALTH

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CRISPR technology has emerged as a revolutionary genome-editing tool with profound implications for human health. It enables precise, efficient, and cost-effective modification of DNA, allowing targeted correction of disease-causing genetic mutations. CRISPR-based approaches are being widely explored in the diagnosis and treatment of genetic disorders, cancer, infectious diseases, and inherited metabolic conditions. Beyond therapeutics, CRISPR is also used in developing rapid diagnostic platforms and advancing personalized medicine. Despite its transformative potential, ethical concerns, off-target effects, and regulatory challenges must be addressed to ensure safe clinical applications. Overall, CRISPR technology represents a significant advancement in modern healthcare.

SYNTHETIC SWITCHES: GENETIC LOGIC GATES FOR COMPUTATIONAL BIOLOGY

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Synthetic switches are genetic elements that control gene expression based on specific inputs, acting like biological logic gates. They are crucial for programming cellular behavior, enabling cells to respond dynamically to environmental signals. There are different types of synthetic switches present such as Bistable switches, Toggle Switch Motifs, Dynamic Bistable switches. These switches are made using the genetic gates or the circuits. Genetic circuits are genetically engineered gates or synthetic cells that are made by arranging different types of DNA, RNA, promoters, repressors, and many other parts of cells. This paper explains how genetic circuits are made into logic gates, which will assist in computational biology by using simulations created by these circuits. This also falls under synthetic biology and bioinformatics, indicating that we can create these circuits and keep managing the DNA sequence using this circuits and constantly keeping them in check. In this presentation it shows how AND, NOT, NAND, OR and many other gates are explained and it shows how and why we should use particular type of genetic gates in different situations based on the behavioral pattern. These circuits can create genetically modified cells that help in detecting cancer and neurological disorders by acting as sensors.

AI in Drug Discovery

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Artificial Intelligence (AI) has emerged as a transformative force in drug discovery and development, addressing the limitations of conventional trial-and-error approaches that are time-consuming, costly, and resource-intensive. By integrating machine learning, deep learning, and big data analytics, AI enables rapid identification of drug targets, prediction of drug–target interactions, and optimization of lead compounds with enhanced precision and efficiency.

AI-driven models analyze vast biological and chemical datasets to accelerate hit identification, virtual screening, and structure-based drug design. Recent advancements (2023–2025) demonstrate the successful application of AI in predicting molecular properties, improving clinical trial design, reducing drug attrition rates, and repurposing existing drugs for new therapeutic indications. These technologies significantly shorten drug development timelines while improving success rates.

The convergence of AI with bioinformatics, cheminformatics, and systems biology paves the way for personalized medicine, where therapies are tailored to individual genetic and molecular profiles. As AI continues to evolve, it promises to revolutionize pharmaceutical research by enhancing innovation, improving patient outcomes, and ensuring cost-effective and sustainable healthcare solutions.

Keywords: Artificial Intelligence, Drug Discovery, Machine Learning, Virtual Screening, Personalized Medicine, Bioinformatics

DIGITAL TWINS AND GENETIC LOGIC GATES: A COMPUTATIONAL FRAMEWORK FOR IDENTIFYING AND TRAGETING CANCER AND NEUROLOGICAL DISORDER

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This study explores a unified diagnostic-therapeutic framework that replaces static nanocarriers with programmable genetic circuits integrated into Patient Digital Twins (PDTs). While nanocarriers are limited by low specificity and lack of feedback, synthetic genetic circuits—comprising orthogonal promoters, repressors, and RNA-based sensors—provide a high-fidelity interface with human

physiology. We also use biosensors inside the genetic circuits and these are able to identify cancer molecules and neurodegenerative gene and give information. These circuits operate as biological "edge-computing" units, performing real-time signal processing of biomarkers associated with oncogenesis and neurodegeneration. By mapping these biological outputs onto a Digital Twin framework (consistent with NIH IMAG multi-scale protocols), we demonstrate a closed-loop system where molecular data continuously recalibrates virtual models. This allows for the simulation of "what-if" therapeutic scenarios in a virtual environment before triggering the in vivo genetic response. Our results suggest that this combination significantly enhances sensing sensitivity (up to 10^3 times over traditional assays) and provides a stable, programmable platform for the autonomous delivery of specialized drug payloads, effectively bridging the gap between computational modeling and biological intervention

BIOTECHNOLOGY

NATURE- BASED FLOATING TREATMENT WETLANDS FOR AQUATIC POLLUTION MITIGATION

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Despite abundant global water resources, only about 3% is freshwater, which is increasingly polluted by human activities such as agricultural runoff and industrial discharge. These pollutants promote harmful algal blooms, causing hypoxia, biodiversity loss, and health risks. Conventional treatment methods are often costly and inefficient, leading to interest in sustainable alternatives such as floating treatment wetlands (FTWs), which are soil-less, nature-based systems that improve water quality effectively and economically. Floating treatment wetlands are made up of emergent macrophytes constructed on artificial mats of buoys that are suspended on top of the water surface instead of sinking on the sediments. These plants have a well-developed aerenchyma, large root and rhizome systems, making it more buoyant and thus increasing the colonization area of microorganisms. Various interacting processes can be involved in the removal of pollutants within FTWs, such as sedimentation, direct absorption of nutrients such as nitrogen and phosphorus by plant tissue, adsorption of heavy metals, and degradation of pollutants by microbes, which is promoted by the root-associated biofilms. Other biochemical mechanisms including nitrification, denitrification, assimilation, redox interactions, mineralization, and the degradation of organic contaminants are other biochemical mechanisms that add to the effectiveness of treatment. FTWs have been extensively used in the treatment of stormwater run-off, agricultural drainage, secondary effluents, sewage discharges, contaminated rivers and industrial wastewater because of their low cost, ease of construction and suitability. The intricate root networks make the microbes more active, decreasing the metabolic pressure on the plants, and stimulating the conversion of pollutants to less harmful ones. All in all, nature-based floating wetlands have been an effective and sustainable solution towards curbing aquatic pollution and enhancing the water quality and preserving aquatic ecosystems against further deterioration.

COMPARATIVE EFFICACY OF PROBIOTIC ENCAPSULATION SYSTEM

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Probiotics exert significant health benefits by modulating gut microbiota, enhancing barrier function, and regulating immune responses. However, their therapeutic efficacy is strongly limited by poor survival during processing, storage, and passage through the harsh gastrointestinal environment. Encapsulation has emerged as a promising strategy to improve probiotic stability and targeted delivery. This abstract comparatively evaluates the efficiency of major probiotic encapsulation systems, including coatings, nanoparticles, and polymer-based matrices, in ensuring optimal gut survival and therapeutic performance. Conventional coating techniques, such as lipid and polysaccharide coatings, offer simplicity and cost-effectiveness but often provide limited protection against gastric acidity and bile salts. Nanoparticle-based systems, including lipid nanoparticles and Nano emulsions, enable enhanced surface interaction, controlled release, and improved bioavailability; however, concerns regarding scalability, regulatory approval, and long-term safety remain. Polymer-based encapsulation systems, particularly those utilizing natural biopolymers like alginate, chitosan, and pectin, demonstrate superior protection, biocompatibility, and controlled release properties under gastrointestinal conditions. Comparative analysis indicates that polymer-based systems generally outperform simple coatings in gut survival, while nanoparticles excel in targeted delivery and functional enhancement. Hybrid approaches combining polymers with nanoparticles or coating technologies show the greatest potential by integrating mechanical strength, environmental

responsiveness, and precise release profiles. Overall, the selection of an encapsulation system should be guided by probiotic strain characteristics, intended therapeutic application, and delivery site. Advances in encapsulation design are expected to play a critical role in translating probiotics into more effective, reliable, and personalized therapeutic agents for gut health management. Future research should emphasize validation, sustainability, and scalable manufacturing for real-world applications.

Keywords: Probiotics, Probiotic strength, Nanoparticles, Polymers, Hybrid approaches

PROTEIN–PROTEIN INTERACTION NETWORKS FOR BACTERIAL DRUG AND VACCINE TARGET DISCOVERY

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Antimicrobial resistance (AMR) and multidrug resistance (MDR) in bacterial pathogens necessitate target discovery strategies that go beyond single genes and consider the broader network context of virulence and resistance determinants. Protein–protein interaction (PPI) networks provide such a framework by representing proteins as nodes and their interactions as edges, enabling graph theoretical analyses to identify central functional “chokepoints” in infection pathways; collectively, the work presented here integrates multiple network-based models across diverse bacterial pathogens, demonstrating the general applicability of PPI-driven approaches for drug and vaccine target discovery in infectious diseases. In *Salmonella enterica* serovar Typhimurium, proteins from five *Salmonella* pathogenicity islands (SPI-1 to SPI-5) and two two-component systems were assembled into SPI-only, TCS-only, and combined interactomes. Multi-centrality analysis (degree, betweenness, closeness, and eigenvector) together with k-core decomposition revealed a deeply connected inner core dominated by Type III secretion system (T3SS) proteins. Among these, the chaperone ScaA emerged as the most indispensable virulence hub. This finding was independently supported by microarray-based expression changes following LacI and CheY perturbations. Applying the same framework to *S. Typhi* CT18 and its 17 pathogenic islands within a whole-genome interactome similarly highlighted SPI-1 and SPI-2 T3SS needle components and regulators as deep-core connector hubs. These results reinforced their suitability as potential drug targets in typhoid. A virulence-focused interactome pipeline was further applied to MDR *S. enterica* serovars Typhimurium, Typhi, and Paratyphi. Network prioritization combined with antigenicity, B-cell epitope prediction, allergenicity assessment, structural availability, and human similarity filtering yielded a compact panel of T3SS and membrane-associated proteins. These included SptP, SsaQ, SpaO, PrgH, SipB, SsaD, SctC, SsaJ, PrgK, SspH2, and TorS, proposed as rational molecular vaccine candidates and dual vaccine–drug targets. The same network logic was extended to MDR *Proteus mirabilis* HI4320. Integrated quorum sensing (QS/AI-2), virulence, and genome-scale PPI networks were analysed using eigenvector centrality, k-core decomposition, and functional cartography (the KFC strategy). This approach identified GltB, the histidine kinase-like protein PMI3678, and RcsC as indispensable quorum-sensing-linked biofilm regulators in catheter-associated urinary tract infection. More recently, analogous PPI-based centrality analyses coupled with epitope filtering were applied to *Acinetobacter baumannii*. This led to the identification of promising outer membrane and virulence associated vaccine candidates and druggable targets, demonstrating that the interactome-driven strategy is portable across MDR Gram-negative pathogens. Independently, network diffusion analysis of the *Escherichia coli* K-12 MG1655 interactome was performed using 34 curated AMR genes as seeds. This expanded the resistance neighborhood to 127 candidate proteins enriched in ribosomal, β -lactam, CAMP, and envelope homeostasis pathways. Gene knockouts of *uhpB*, *mdaB*, *rpmG*, and *rplA* showed altered susceptibility to ampicillin, ciprofloxacin, and streptomycin, providing experimental validation of network-based predictions. Collectively, these studies establish PPI network construction, multi-centrality ranking, k-core hierarchy, diffusion-based scoring, and functional module annotation as a coherent and experimentally supported blueprint for identifying indispensable bacterial drug and vaccine targets across *Salmonella*, *Proteus*, *Acinetobacter*, and *E. coli*.

INTEGRATED MULTI-BIOMARKER ASSESSMENT OF ACUTE AMMONIA TOXICITY IN NILE TILAPIA (*OREOCHROMIS NILOTICUS*): GENOTOXIC, OXIDATIVE, AND HISTOPATHOLOGICAL RESPONSES

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Ammonia is a ubiquitous aquatic pollutant that poses significant threats to freshwater ecosystems and aquaculture systems worldwide. Understanding its multi-level toxic mechanisms is essential for effective water quality management and sustainable aquaculture practices. This study employed an integrated multi-biomarker approach to comprehensively evaluate the acute toxicity of ammonia in Nile tilapia (*Oreochromis niloticus*), following OECD Test Guideline 203 for fish acute toxicity testing. The 96-hour median lethal concentration (LC₅₀) of total ammonia nitrogen (TAN) was determined using probit analysis following exposure to seven concentrations (1, 3, 6, 9, 12, 15, and 18 mg/L). Ammonia concentrations were analytically verified using the spectrophotometric method. Water quality parameters were maintained within acceptable ranges: temperature 26 ± 1°C, dissolved oxygen 6.5 ± 0.6 mg/L, pH 7.1±0.12, and total hardness 150 ± 5 mg/L. The calculated 96-hour LC₅₀ value was 7.07 mg/L, establishing the acute sensitivity threshold for this species. Exposed fish exhibited concentration-dependent behavioural alterations including surface respiration, erratic and uncoordinated swimming, sluggish movement, respiratory distress, and excessive mucus secretion. Genotoxic assessment revealed significant DNA damage. The alkaline comet assay showed concentration-dependent increases in % tail DNA in liver and gill cells. The micronucleus cytome assay detected multiple nuclear abnormalities (notched, clubbed, elongated, binucleated, fragmented nuclei) and cytotoxic anomalies (cytokaryotic fusion, cytoplasmic degeneration, cell rupture) in erythrocytes, indicating severe chromosomal and cellular damage. Quantitative real-time PCR analysis revealed concentration-dependent expression patterns in oxidative stress genes (*sod*, *cat*, *gpx*), detoxification gene (*cyp1a*), and tumour suppressor gene (*p53*). Lower concentrations induced antioxidant gene upregulation, while higher concentrations caused suppression, indicating adaptive capacity exhaustion. The *cyp1a* and *p53* genes showed significant upregulation, reflecting enhanced detoxification attempts and DNA damage responses. Histopathological examination revealed concentration-dependent organ damage. Gills exhibited lamellar fusion, epithelial lifting, hyperplasia, and necrosis. Livers showed vacuolar degeneration, nuclear pyknosis, and hepatocellular necrosis. Kidneys displayed tubular necrosis, glomerular degeneration, and interstitial haemorrhage. The integration of behavioural, cytogenetic, molecular, and histological endpoints provides robust evidence of ammonia's multi-level toxic mechanisms in freshwater fish. These findings are critical for establishing water quality criteria, developing biomonitoring strategies, and implementing effective management practices in aquaculture and natural freshwater ecosystems.

Keywords: Ammonia, Acute Toxicity, Genotoxicity, Oxidative Stress, Gene Expression, Histopathology

BIODEGRADABLE LAB EQUIPMENTS

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The extensive use of single-use plastic consumables in laboratories has led to a significant increase in non-degradable waste, posing serious environmental and disposal challenges. The present work focuses on the development and evaluation of biodegradable lab equipments as sustainable alternatives to conventional plastic laboratory ware. These equipments are fabricated using eco-friendly polylactic acid (PLA), polyvinyl alcohol (PVA), and other plant-based or biodegradable composite materials derived

from renewable resources. The designed biodegradable lab equipment's aim to maintain essential laboratory requirements including mechanical strength, usability, sterility compatibility, and cost-effectiveness, while ensuring minimal environmental impact after disposal. Selected products such as petri dishes, inoculation loops, and laboratory accessories were designed using mold-based and 3D printing approaches, followed by preliminary performance and usability assessments. The biodegradability of the materials enables natural degradation under appropriate environmental conditions, significantly reducing plastic accumulation and laboratory waste. This initiative highlights the feasibility of integrating sustainable materials into routine laboratory practices without compromising functionality. The adoption of biodegradable lab equipment can contribute to greener research environments, promote responsible scientific practices, and support global efforts toward environmental sustainability. The study emphasizes the potential of biodegradable labware as a practical solution for eco-friendly laboratories and future green biotechnology applications.

EARLY DETECTION OF BREAST CANCER BY 2D PHOTONIC BIOSENSOR

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Early detection of breast cancer requires diagnostic techniques that are highly sensitive, reliable, and minimally invasive. This poster proposes two-dimensional photonic crystal based optical sensor for breast cancer detection by analyzing refractive index variations between healthy and malignant breast tissues. Biosensors are analytical devices that combine a biological recognition element, such as an enzyme, antibody, or cell, with a transducer, such as an optical or electrochemical detector, to detect and measure specific chemical substances. The biological interaction is converted into a measurable signal, enabling accurate analysis. In recent years, biosensor research has gained significant attention due to its rapid response, high sensitivity, and portability, which support early disease detection and timely treatment. This poster aims to explain the role of biosensors in the field of cancer detection, their origin, key advantages, and recent scientific and technological advancements that have improved cancer cell detection and identification. The structure of the proposed 2D photonic crystal gives rise to a photonic band gap whose resonant characteristics are highly sensitive to changes in the surrounding medium. When breast tissue sample is given into the sensing region, measurable shifts in resonant wavelength and transmission response are recorded. The sensing mechanism utilizes these optical parameters to identify affected tissue with improved sensitivity. The proposed design offers edges such as compactness, label free operation, fast response, and compatibility with accommodate optical systems. Compared to conventional imaging and biopsy-based techniques, the photonic crystal sensor provides a non-invasive and cost-effective alternative for early-stage breast cancer diagnosis. The results indicate that 2d photonic crystal sensors have strong potential for biomedical sensing applications and can serve as a reassuring platform for early breast cancer detection and clinical screening.

Keywords: Optical biosensor; breast cancer; 2D photonic crystal

EFFECT OF MODIFIED ATMOSPHERE PACKAGING AND CHITOSAN EDIBLE COATING ON THE SHELF LIFE AND QUALITY OF SILVER POMFRET (*PAMPUS ARGENTEUS*) STEAKS DURING CHILLED STORAGE

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Silver pomfret (*Pampus argenteus*) is a high-value marine fish species of significant commercial importance; however, its marketability is constrained by high perishability and the limited shelf life conferred by conventional chilling methods. This study aimed to evaluate the efficacy of a hurdle technology combining Modified Atmosphere Packaging (MAP) and Chitosan edible coating to enhance the chilled storage stability of silver pomfret steaks. The research was conducted in three phases: the standardization of the optimal gas mixture, the determination of the effective Chitosan concentration, and the comparative analysis of the combined treatment. Sensory analysis identified a gas mixture of 70% CO₂ and 30% O₂ as optimal, while a concentration of 1% Chitosan (w/v) was selected based on biochemical quality indices. In the final experiment, silver pomfret steaks were subjected to four treatments: air-packed control (AP), air-packed with 1% Chitosan (APC1), MAP-packed without coating (MAP1), and MAP-packed with 1% Chitosan (MAPC1). Samples were stored at 0–4°C for 32 days and analyzed periodically for microbiological (Total Plate Count, *E. coli*, *S. aureus*), biochemical (pH, TVB-N, TMA-N, PV, FFA, TBA), physical (color, texture profile), and sensory attributes. The results demonstrated that the combined application of MAP and Chitosan coating (MAPC1) yielded a synergistic preservative effect. While the air-packed control samples were rejected after 12 days based on organoleptic and microbiological limits, the MAPC1 treatment maintained acceptable quality for up to 32 days. This treatment effectively suppressed microbial growth, minimized drip loss, and retarded the accumulation of spoilage metabolites and lipid oxidation products. Instrumental texture analysis further confirmed that the MAPC1 treatment significantly preserved the hardness, cohesiveness, and springiness of the fish muscle compared to control groups. The study concludes that the integration of 1% Chitosan coating with a Modified Atmosphere of 70% CO₂:30% O₂ extends the shelf life of silver pomfret steaks by more than two and a half times compared to traditional air packaging. This combination of technology of packaging and coating on pomfret steaks confers logistics and economic benefit to chilled product distribution and retailing of silver pomfret steaks a high-priced fish commodity in the export market.

Keywords: *Pampus argenteus*, Modified Atmosphere Packaging, Chitosan, Biopreservative, Shelf Life, Chilled Storage, Quality Indices

PHYTOCHEMICAL AND MOLECULAR CHARACTERIZATION OF MEMORY-ENHANCING MEDICINAL PLANTS *CENTELLA ASIATICA* AND *BACOPA MONNIERI*

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Centella asiatica and *Bacopa monnieri* are well-known medicinal plants extensively used in traditional systems of medicine for their wide range of therapeutic properties, particularly as memory enhancers. These plants are traditionally employed in the treatment of various ailments, including ulcers, tumors, eczema, and anemia. In the present study, fresh leaf samples of *C. asiatica* and *B. monnieri* were collected from the DhanvantriAuśadhiya Van of VIRSACO, Patidad, Rajkot. Leaf extracts were prepared and subjected to phytochemical screening to identify major bioactive constituents, including tannins, coumarins, saponins, steroids, phenols, flavonoids, and alkaloids. Further, the genomic DNA was isolated from fresh leaves using the CTAB method, and the quality of DNA was evaluated through agarose gel electrophoresis, confirming the presence of intact, high-molecular-weight DNA suitable for molecular analysis. DNA purity and concentration were determined using an ELISA plate reader by measuring the A260/A280 ratio. The purified DNA was further utilized for PCR amplification of three chloroplast barcode genes *rbcl*, *matK*, and *psbB*, using universal primers. Phytochemical analysis revealed the presence of diverse bioactive compounds such as alkaloids, phenols, flavonoids, tannins, saponins, glycosides, and terpenoids, with notable variations between the two species. The combined

phytochemical and molecular approaches employed in this study provide valuable information for the authentication, quality control, and comparative evaluation of these important medicinal plants.

Key words: *Centella asiatica*, *Bacopa monnieri*, Phytochemical, Barcode genes

CURRENT PERSPECTIVES OF BREAST CANCER THERAPEUTICS

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Breast cancer remains one of the leading causes of mortality in women worldwide. It is a multistage and heterogeneous disease which can be in situ or invasive in nature which is further categorized by their tissue of origin which are breast ducts, lobules and connective tissues. Clinically, TNM classification system is widely accepted to designate the type, severity and staging of breast cancer. Additionally, breast cancer is classified into four major molecular subtypes viz Luminal A, Luminal B, HER2-positive and triple negative. The breast cancer treatment regimens vary according to their subtype, physiological parameters of the patients and the stages of severity. The conventional approaches include surgery, systemic chemotherapy, endocrine therapy, and radiation therapy. Nevertheless, conventional therapeutic strategies lack specificity, have several adverse effects and lead to poor quality of life among the patients. In recent decades, emerging therapeutic strategies have raised the interest of the scientific community. The Emerging therapies contain targeted drug therapy, immunotherapy, stem cell therapy, gene therapy to list a few. The researchers have explored major breast cancer signaling pathways leading to establishment of the hallmark breast cancer events and, hence unveiling the molecular therapeutic targets. In this review, we aim to summarize various therapeutic approaches against breast cancer for patient remission and increased disease-free survival rate.

THE LONG AND SHORT OF IT: HOW FRAGMENT LENGTH AFFECTS EDNA PERSISTENCE

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Environmental DNA (eDNA) analysis has emerged as a cornerstone of non-invasive biodiversity monitoring. However, the integrity of extracellular DNA is compromised by biotic and abiotic factors, resulting in a degradation continuum that heavily influences detection probability. This study investigates the size distribution of eDNA fragments in aquatic environments and evaluates the bias introduced by amplicon length on species detection. We utilized paired quantitative PCR (qPCR) assays targeting short 80-100 bp and long >300 bp fragments of the mitochondrial cytochrome oxidase I (COI) gene to monitor decay rates over a 4-day period. Additionally, we compared metabarcoding community profiles derived from primers targeting varying fragment lengths. Our results demonstrate a significant inverse correlation between fragment length and persistence. While long fragments offered higher taxonomic resolution, they degraded rapidly, falling below detection thresholds significantly earlier than shorter fragments. Consequently, assays targeting larger amplicons yielded high false-negative rates for rare or elusive species. Conversely, targeting "mini-barcodes" (<150 bp) extended the detection window by percentage/time but occasionally reduced taxonomic resolution at the species level. We conclude that eDNA persistence is highly size-dependent. To maximize detection sensitivity—particularly for low-density populations or in environments with high UV/enzymatic activity—protocols should prioritize shorter amplicons. We recommend a multi-marker approach that balances the high persistence of short fragments with the taxonomic precision of longer reads. These findings are critical for standardizing sampling protocols and interpreting false negatives in international biomonitoring efforts.

Keywords: eDNA degradation, Amplicon size, Metabarcoding, Biomonitoring, Sensitivity

DECIPHERING THE INHIBITORY POTENTIAL OF *PLECTRANTHUS BARBATUS* ANDR. PHYTOCHEMICALS AGAINST BREAST CANCER PROTEINS BY IN-SILICO APPROACH

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Breast cancer is one of the leading causes of female mortality worldwide. It originates in breast lobules, ducts, or connective tissues. BC occurrence and progression are driven by key signaling proteins. Conventional treatments for BC are surgery, chemotherapy, radiotherapy and endocrine modulators, but they lack specificity and have many side effects. This issue calls for alternative therapeutics with more specific, safer and more sustainable targeted drug molecules. Plant-derived chemicals (phytochemicals) have been utilized for therapeutic purposes from the past to the present era. *Plactranthus barbatus* Andr. (PB) Indian coleus, commonly known as Indian coleus, exhibits multiple bioactivities that are well-documented. In this study, we explored silico interactions of 154 PB phytochemicals against proteins associated with BC. We also conducted Drug-likeness and ADMET analysis. The results showed PB phytochemicals with multi-target potential with substantial binding energies. The top phytochemicals indicate significant inhibitory potential towards BC target proteins, and thus, the current study sets a strong foundation for further in vitro and vivo investigations.

Keywords: Breast cancer, *Plactranthus barbatus*, Phytochemicals, Molecular Docking, Drug likeness, ADMET

REGENERATING LIFE: THE POWER OF STEM CELL TECHNOLOGY **Ms. Bhimani Bhumika Mukeshbhai**

Stem cell technology has emerged as a powerful and innovative approach in regenerative medicine, offering new possibilities for the repair and replacement of damaged tissues and organs. Stem cells are unique due to their ability to self-renew and differentiate into various specialized cell types, making them ideal candidates for therapeutic applications. This technology utilizes different types of stem cells, including embryonic stem cells, adult stem cells, and induced pluripotent stem cells, each contributing distinct advantages in regenerative therapies. In regenerative medicine, stem cells are isolated, expanded under controlled laboratory conditions, and directed to differentiate into specific functional cells before transplantation. These cells promote tissue regeneration through direct cell replacement, secretion of growth factors, and modulation of immune responses. Stem cell-based therapies have shown significant potential in the treatment of degenerative diseases, traumatic injuries, and organ failure, such as in bone marrow transplantation, cardiac repair, and neurological disorders. Recent advancements in stem cell engineering, tissue scaffolding, and gene editing have further enhanced therapeutic outcomes. Despite these promising developments, challenges including ethical concerns, immune rejection, and risk of tumor formation remain. Continued research and clinical evaluation are essential to fully harness the regenerative potential of stem cell technology for future healthcare applications

GENDER, BRAIN PLASTICITY, AND DEPRESSION: AN EPIGENETIC PERSPECTIVE FROM INDIA

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Indian gender norms trigger chronic stress that epigenetically methylates BDNF genes, reducing neuroplasticity and elevating depression risk 1.3–2× higher in women. This science-humanities synthesis reveals how cultural psychology (norm-driven stigma), biotechnology (BDNF biomarkers), and neuroscience (gendered amygdala hyperconnectivity) interlink: patriarchal structures literally rewrite brain circuits. Intersectional science demands diverse cohorts; 2024–2025 cultural neuroscience meets AI neuroimaging (97% accuracy) to detect norm-specific patterns. Future applications converge precision psychiatry with social justice: mobile EEG screening, HDAC inhibitors restoring plasticity, culturally-adapted CBT—all translating humanities insights into biotech solutions. This psychology-biotech nexus charts molecular pathways from cultural oppression to neural resilience, demonstrating how understanding human suffering requires decoding both social scripts and biological code through intersectional science.

Keywords: Cultural neuroscience, BDNF epigenetics, AI neuroimaging, gender norms, precision psychiatry

AI-Enhanced CRISPR

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The CRISPR-Cas9 system has revolutionized genome editing by enabling precise modification of DNA sequences. However, traditional CRISPR technology faces challenges such as off-target effects, limited efficiency, and trial-and-error guide RNA design. Recent advances in artificial intelligence (AI) have significantly improved the accuracy and safety of genome editing techniques. AI-enhanced CRISPR integrates machine learning algorithms with genomic data to design optimal guide RNAs, predict off-target mutations, and improve the performance of Cas enzymes. By analyzing large datasets of DNA sequences and previous gene-editing outcomes, AI models can identify the most effective editing strategies before laboratory experiments are performed. This reduces experimental time, cost, and unintended genetic modifications. Furthermore, AI plays an important role in advanced genome editing methods such as base editing and prime editing, where it predicts successful edits and minimizes errors. These developments have opened new possibilities in medical biotechnology, including treatment of genetic disorders, cancer research, and personalized medicine. In agricultural biotechnology, AI-enhanced CRISPR is being applied to develop disease-resistant and climate-tolerant crops. Environmental applications include engineering microorganisms for pollution control and sustainable bioremediation. Despite its potential, challenges such as data bias, ethical concerns, and biosafety regulations must be carefully addressed. Overall, AI-enhanced CRISPR represents a next-generation approach to genome editing, offering greater precision, efficiency, and safety, and holds strong promises for future biotechnological innovations.

IVF: INTERSECTION WITH THE PSYCHOLOGY OF THE MOTHER AND FETUS

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In Vitro Fertilization (IVF) has revolutionized assisted reproductive technology, offering hope to individuals and couples facing infertility. Beyond its biological and clinical dimensions, IVF profoundly intersects with the psychological well-being of the mother and the developing foetus. The emotional journey of IVF—characterized by stress, anxiety, anticipation, and repeated clinical interventions—can significantly influence maternal mental health during preconception and pregnancy.

Maternal psychological states such as stress, depression, and emotional bonding are increasingly recognized as critical factors affecting fetal development. Emerging research in prenatal psychology

suggests that maternal emotions and hormonal fluctuations during IVF pregnancies may influence fetal neurodevelopment, stress regulation, and early behavioural patterns through mechanisms such as epigenetic modifications and altered intrauterine environments.

This interdisciplinary field bridges reproductive biotechnology, psychology, and neuroscience, emphasizing the need for holistic IVF care that integrates psychological counselling alongside medical treatment. Understanding the psychological dynamics between the mother and fetus during IVF not only enhances treatment outcomes but also promotes healthier maternal-fetal bonding and long-term developmental well-being of the child.

Keywords: In Vitro Fertilization, Maternal Psychology, Fetal Development, Prenatal Stress, Assisted Reproductive Technology, Maternal-Fetal Bonding

ANTIMICROBIAL RESISTANCE (AMR)

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Antimicrobial resistance (AMR) is a critical global health threat caused by bacteria evolving mechanisms to survive antibiotics. *Pseudomonas aeruginosa*, a WHO-priority pathogen, exhibits multidrug resistance through enzymatic drug inactivation, reduced membrane permeability, efflux pump overexpression, target site modification, and biofilm formation. This presentation highlights these mechanisms and explores emerging biotechnological solutions, including CRISPR-based gene targeting, phage therapy, nanoparticle-based antimicrobials, and traditional herbal interventions such as Panchvalk extract. Understanding the molecular basis of resistance is crucial for developing innovative strategies to mitigate AMR.

TRANSGENERATIONAL EPIGENETIC INHERITANCE

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Transgenerational epigenetic inheritance is the transmission of biological traits across generations without alterations in the underlying DNA sequence. This process is mediated through epigenetic mechanisms such as DNA methylation, histone modifications, chromatin remodeling, and non-coding RNAs. Various environmental factors including nutrition, psychological stress, lifestyle, and exposure to toxins can induce stable epigenetic changes in germ cells, allowing these modifications to be inherited by subsequent generations. Increasing evidence from animal models and human studies indicates that such inherited epigenetic marks can influence disease susceptibility, metabolic regulation, developmental pathways, and behavioral traits. Unlike classical genetic inheritance, transgenerational epigenetic inheritance demonstrates that environmentally acquired traits may persist even in the absence of the original stimulus. This challenges the traditional view that epigenetic information is completely erased during gametogenesis and early embryonic development. Understanding the mechanisms of transgenerational epigenetic inheritance provides important insights into complex diseases, evolutionary adaptation, and the long-term impact of environmental exposures on human health.

ELECTROCHEMICAL APTAMER-BASED BIOSENSORS WITH NANOPARTICLES INTEGRATION

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Electrochemical aptamer-based biosensors have emerged as powerful analytical platforms due to their high sensitivity, selectivity, and compatibility with miniaturized and point-of-care devices. Aptamers—synthetic single-stranded DNA or RNA molecules—serve as highly specific biorecognition elements that bind target analytes ranging from small molecules and proteins to pathogens and cells. The integration of nanomaterials has significantly enhanced the performance of these biosensors by improving signal transduction, surface area, and electron transfer kinetics. Nanomaterials such as gold nanoparticles, carbon nanotubes, graphene, metal-organic frameworks, quantum dots, transition-metal oxides and conductive polymers provide favorable electrochemical properties and enable efficient immobilization of aptamers while preserving their biological activity. Electrochemical aptamer-based biosensors with nanomaterial integration have demonstrated wide-ranging applications in medical diagnostics, environmental monitoring, food safety, and biosecurity. Electrochemical aptamer-based biosensors have been extensively investigated as promising analytical tools due to their high selectivity, sensitivity, and rapid response. Recent progress has been driven by the integration of advanced nanomaterials, which has been demonstrated to significantly enhance electrochemical signal transduction and sensing performance. Various signal amplification strategies, such as redox-active nanocomposites and nanozyme-assisted electrocatalysis, have been implemented to achieve ultra-low detection limits for a wide range of targets. The incorporation of nanostructured electrodes has also facilitated improved detection in complex biological matrices. Furthermore, recent efforts have focused on the development of miniaturized, wearable, and microfluidic electrochemical aptasensors for real-time and point-of-care applications. Despite notable improvements, challenges related to sensor stability, reproducibility, and scalable fabrication remain. Overall, nanomaterial integration has been shown to play a critical role in advancing electrochemical aptamer-based biosensors toward high-performance sensing platforms suitable for next-generation diagnostic and monitoring applications.

ORGANOIDS: MINI BRAINS FOR MENTAL DISORDER STUDIES

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Mental disorders are complex conditions that are difficult to study using traditional animal models. Brain organoids, also known as mini-brains, are three-dimensional structures derived from human stem cells that mimic early human brain development. These organoids provide a human-relevant model to study neurodevelopmental and psychiatric disorders such as autism, schizophrenia, and Alzheimer's disease. Brain organoids help in understanding disease mechanisms, genetic factors, and drug responses, and also support personalized medicine approaches. Although ethical and technical challenges exist, brain organoids represent a promising tool in biotechnology for advancing mental disorder research.

PLASTIC AND MICROPLASTIC BREAKDOWN

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Plastic and microplastic pollution has emerged as a persistent global environmental challenge due to the extensive use and slow degradation of synthetic polymers. Conventional physical and chemical remediation methods have been found to be energy-intensive, costly, and limited in effectiveness, particularly for microplastics. In recent years, biotechnology has been increasingly explored as a sustainable and innovative approach for the degradation, detection, and management of plastic waste. Biological strategies involving microorganisms, enzymes, and genetically engineered systems have been investigated for their ability to break down complex polymer structures into simpler and less harmful compounds. Plastic-degrading enzymes such as PETase, MHETase, cutinases, and laccases have been identified and enhanced through protein engineering to improve catalytic efficiency and environmental

stability. Additionally, microbial consortia and engineered bacteria have been developed to facilitate plastic degradation under controlled and natural conditions, including wastewater treatment systems. The role of microbial communities associated with plastic surfaces, known as the plastisphere, has also been examined to better understand biodegradation mechanisms and ecological interactions. Furthermore, biotechnological tools combined with molecular biology and computational techniques have been applied for the detection and quantification of microplastics in environmental and biological samples. Despite notable advancements, challenges related to degradation efficiency, scalability, environmental safety, and regulatory acceptance have been recognized. Overall, biotechnology has been demonstrated to hold significant potential for addressing plastic and microplastic pollution, and continued research is required to enable its effective application in real-world environmental remediation.

MUNCHAUSEN SYNDROME

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Munchausen syndrome, clinically categorized as Factitious Disorder Imposed on Self (FDIS), is a rare psychiatric condition in which individuals deliberately fabricate, exaggerate, or induce symptoms of illness without external incentives. The primary motivation is an internal psychological need to assume the role of a patient and receive medical attention. Affected individuals often present dramatic medical histories, inconsistent clinical findings, frequent hospital admissions, and a readiness to undergo invasive diagnostic or therapeutic procedures. This disorder poses significant challenges to healthcare systems due to diagnostic difficulty, unnecessary medical interventions, and potential patient harm. Etiology is multifactorial, involving psychological trauma, personality disorders, and maladaptive coping mechanisms. Diagnosis relies mainly on careful clinical evaluation, exclusion of genuine medical conditions, and recognition of characteristic behavioral patterns rather than laboratory tests. Early identification and multidisciplinary management, including psychiatric intervention, are essential to reduce morbidity, prevent misuse of healthcare resources, and ensure ethical medical practice.

POST-EPIGENETICS IN EMBRYONIC DEVELOPMENT.

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Post-Epigenetics is the study of changes in gene expression that do not involve alterations in the DNA sequence. During embryonic development, epigenetic mechanisms play an essential role in controlling how a single fertilized egg develops into different types of specialized cells and tissues. Important epigenetic processes such as DNA methylation, histone modification, and the action of non-coding RNAs regulate which genes are turned on or off at specific stages of development. These mechanisms are crucial for normal growth, cell differentiation, organ formation, genomic imprinting, and X-chromosome inactivation. Any disturbance in epigenetic regulation during early development can lead to developmental disorders and long-term health problems. Environmental factors like maternal nutrition, stress, and exposure to toxins can also influence epigenetic patterns in the developing embryo. Studying epigenetics in embryonic development helps in understanding reproductive health, developmental abnormalities, and improves the outcomes of assisted reproductive technologies.

FLUORESCENCE AND BIOLUMINESCENCE IMAGING IN BIOTECHNOLOGY

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Fluorescence and bioluminescence imaging are powerful optical imaging techniques widely used in biotechnology to visualize and study biological processes in living systems. These methods enable non-invasive, real-time monitoring of molecular and cellular events, making them essential tools in biomedical research and diagnostics. Fluorescence imaging is based on the ability of fluorescent molecules (fluorophores) to absorb light at one wavelength and emit it at a longer wavelength. Common fluorophores include organic dyes, quantum dots, and genetically encoded proteins such as Green Fluorescent Protein (GFP). When excited by an external light source, these molecules emit detectable signals that help researchers observe gene expression, protein localization, cell signaling, and cellular transport. It is widely used in cancer diagnostics, drug screening, and immunofluorescence studies. Advanced methods like confocal microscopy, FRET, and FLIM provide high-resolution and quantitative insights. For example, fluorescence-based oral cancer screening systems have shown high sensitivity and accuracy in distinguishing abnormal tissues. Bioluminescence imaging works through a biochemical reaction in which the enzyme luciferase oxidizes luciferin in the presence of oxygen and ATP to produce light. Since it does not require external excitation, background noise is very low, resulting in high sensitivity. It is especially useful for in vivo studies in small animal models. Researchers use it to monitor gene expression, tumor growth, infection spread, transplanted cells, and treatment responses. For instance, luciferase-labeled tumor cells in mice allow real-time tracking of cancer progression and drug effectiveness. Combining both techniques provides complementary benefits: fluorescence offers detailed cellular resolution, while bioluminescence enables deep-tissue, high-contrast imaging. Despite advantages such as real-time and non-invasive monitoring, challenges like photobleaching, autofluorescence, and limited tissue penetration remain.

INTERNET OF THINGS (IOT) IN BIOTECHNOLOGY

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The Internet of Things (IoT) is a network of interconnected devices and sensors that collect and exchange data through the internet. In biotechnology, IoT enables real-time monitoring, automation, and data-driven decision-making, improving accuracy, efficiency, and productivity across biological and industrial systems. In healthcare biotechnology, IoT-based biosensors and wearable devices are used to monitor vital signs, biochemical parameters, and disease biomarkers. These tools support early diagnosis, continuous patient monitoring, remote healthcare, and personalized treatment. In India, IoT adoption has expanded through the Ayushman Bharat Digital Health Mission (ABDM), where connected devices such as digital BP monitors, glucometers, and pulse oximeters enable remote patient tracking. IoT is also used for ICU monitoring, vaccine cold-chain tracking, and biomedical equipment management. In agricultural biotechnology, IoT supports precision farming using smart sensors that measure soil moisture, nutrients, temperature, and crop health. This helps optimize irrigation and fertilizer use, increase yield, and promote sustainability. Initiatives under India's Digital Agriculture Mission and projects by ICRISAT use IoT field sensors to guide farmers in efficient water and nutrient management, especially in semi-arid regions. In industrial and pharmaceutical biotechnology, IoT systems monitor bioprocess parameters such as pH, temperature, oxygen, and nutrient levels during fermentation and cell culture. This ensures consistent product quality and higher efficiency. Praj Industries applies IoT monitoring in bioethanol and biorefinery

plants to improve yield and process safety. In the pharmaceutical sector, companies like the Serum Institute of India use IoT-enabled cold-chain systems to maintain proper temperature and humidity during vaccine storage and transport. In environmental biotechnology, IoT is used for real-time air and water quality monitoring, pollution detection, and waste treatment control. In India, the Central Pollution Control Board (CPCB) operates IoT-based monitoring networks to track pollutants and support environmental protection efforts.

MICRONEEDLE-BASED BIOSENSORS FOR REAL-TIME, NON-DESTRUCTIVE FRESHNESS MONITORING OF SEAFOOD

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Maintaining the freshness of seafood is essential not only for public health but also for economic sustainability and food wastage minimization. Traditional analytical techniques are usually destructive, lengthy, and limited to laboratory settings, thereby being hardly suitable for real-time monitoring. Microneedle (MN) technology developments have emerged as rapid, sensitive, non-destructive alternatives for assessing the seafood quality. Arrays of biocompatible MNs made from materials such as regenerated silk, gelatin, and cellulosic fibers can be used for food or packaging penetration to get to interstitial fluids. Such devices use different sensing modes, for instance, colorimetric hydrogels that change in response to pH and biogenic amines, ratiometric fluorescent probes, and enzyme electrochemical sensors for hypoxanthine detection. Comparison studies reveal that MN devices have higher sensitivity and provide results faster than conventional methods, and have a good correlation with spoilage markers such as histamine and the Biogenic Amine Index (BAI). Coupling with smartphone-based imaging and machine learning allows the products' freshness to be automatically and impartially verified. Besides, these MN-based methods are economical, easy to use, and compatible at any stage in the food supply chain, from factory plants to retail stores and households. Real-time, on-the-spot monitoring using microneedle biosensors can revolutionize seafood safety, reduce spoilage, and transform current food quality assessment practices.

Key Words: Microneedle biosensors; Seafood freshness; Non-destructive sensing; Food quality assessment

BOTANY

ISOLATION AND CHARACTERIZATION OF CHITIN BINDING PROTEIN FROM *PELTOPHORUM PTEROCARPUM* L.

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The present study investigates a natural chitin is present in *Aedes aegypti* larvae cell walls the chitin-binding proteins can degrade that cell wall of larvae. Chitin-binding proteins have the ability to specifically interact with chitin, a natural chitin present in larvae cell walls and insect exoskeletons. These proteins are involved in plant defense mechanisms to protect themselves. Seed powder of *Peltophorum pterocarpum* was defatted using n-hexane and proteins were extracted with 0.15 M NaCl solution. The crude protein extract was subjected to ammonium sulphate precipitation followed by dialysis using Tris-HCl buffer to obtain purified total protein. Chitin-binding protein was purified by affinity chromatography and confirmed by SDS-PAGE. The total protein content of *Peltophorum pterocarpum* seeds was estimated to be 259.9 mg/ml, while the chitin-binding protein concentration was found to be 147.4 mg/ml. The study confirms the presence of chitin-binding proteins in *Peltophorum pterocarpum* seeds and from larvicidal activity it was confirmed that it eliminates the *Aedes aegypti* larvae within one hour.

SEED-DERIVED CHITIN-BINDING PROTEINS FROM WINGED BEAN AND THEIR LARVICIDAL POTENTIAL

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Psophocarpus tetragonolobus, commonly known as the winged bean, is a highly nutritious tropical legume recognized as a "poor man's food" due to its versatile edible parts. The seeds are particularly significant, containing a high protein concentration (32% to 37%) comparable to soybeans, making them a potent source for biochemical research. Chitin-binding proteins are specialized defense molecules that interact with chitin, a structural component found in many pests and pathogens. These proteins were successfully isolated and purified from both brown (WSB) and purple (WSP) winged bean varieties using affinity chromatography with chitin flakes. The research involved defatting winged bean seed powder with n-hexane, followed by protein extraction using 0.15M NaCl and precipitation with 40% ammonium sulfate. The isolated proteins were purified through dialysis and chitin-affinity incubation, with their molecular profiles subsequently analyzed using SDS-PAGE. The study found high total protein content in the brown variety (487.0 mg/ml) and the purple variety (334.9 mg/ml), with purified chitin-binding protein concentrations of 224.7 mg/ml and 169.0 mg/ml, respectively. SDS-PAGE confirmed the presence of distinct protein bands, and the isolated proteins demonstrated powerful chitin-degrading capabilities, causing significant erosion of chitin flakes. Furthermore, the proteins exhibited potent larvicidal activity, achieving complete mortality of larvae in as little as 32 minutes at a concentration of 80.9 mg/400µl. Due to their potent larvicidal and chitin-degrading properties, these proteins can be developed as effective biopesticides for agricultural use. Furthermore, they can be applied in sewage water treatment to eliminate harmful larvae and microbial contaminants, providing a sustainable and biological method for cleaning wastewater.

AMPLIFICATION OF BARCODE GENES (RBCL AND MATK) FROM DIFFERENT PLANT SPECIES

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A DNA barcode is a gene or DNA sequence with a known chromosome position that regulate a particular gene or determine evolutionary relationship between organisms. It can also be used for phylogenetic classification of plants. In present studies, *rbcL* and *matK* genes were selected as DNA marker to study the phylogeny of different plant species. Initially DNA was isolated from 21 plants and then concentration and purity of DNA was determined. The amplification of *rbcL* and *matK* gene was performed from all the purified DNA samples. The amplification of *rbcL* gene was observed in 18 plants. The amplification of *matK* gene was observed in 12 plants. Further sequencing of these genes will be carried out in future to observe the phylogenetic arrangement of plants.

TRANSCRIPTOME ANALYSIS TO REVEAL SALINITY ADAPTATION MECHANISM IN *UROCHONDRA SETULOSE*

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Plants growing in different regions have different adaptation mechanism to survive in those areas. Plants growing in the saline habitat are known as halophytes. Halophytes adapt to saline soil by morphological, biochemical, proteomic and transcriptomic level adaptations. *Urochondra setulose* is an endemic halophyte to Banni grassland region, Kutch, Gujarat, India. Growing in isolated patch-like manner, *Urochondra* can grow in extreme saline condition. Genes responsible for its adaptation can be studied using transcriptome analysis. Illumina sequencing generates forward and reverse sequences. Sequences are obtained first quality checked and trimmed. After that De novo transcriptome assembly was done using Trinity. Redundancy reduction was performed using CD-HIT tool. Pathway assignment and mapping of the CDS to the biological pathways were performed using KEGG automatic annotation server (KAAS). Pathway analysis reveals that most genes belong to pathways like Carbohydrate metabolism, Signal transduction, Amino acid metabolism, Transport and catabolism etc. Further transcripts were classified based on its function using Gene ontology (GO) platform. GO classifies transcripts into categories like biological processes, molecular function and cellular component related transcripts. Protein prediction was done using Uniprot database. Isoform count analysis was done to isolate highly expressing transcripts for primer designing.

COMPARATIVE ANALYSIS OF AUTOFLUORESCENCE AND HISTOCHEMICAL LOCALIZATION OF METABOLITES IN PLANT CELLS

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Plant metabolites are biologically active organic compounds synthesized by plants that play a crucial role in defense, adaptation & structure organization. In plant metabolites such as lignin, flavonoids, anthocyanin, alkaloid, phenols and phytohormones are unevenly distributed among different tissues & contributed significantly to mechanical strength, protection against biotic & abiotic stresses and regulations of physiological processes. In present studies, plant metabolites were localized in stem cells of different five plants and comparative analysis of their distribution in cells was observed. Even detection of secondary metabolites was done using fluorescence microscopy as some metabolites have autofluorescence properties. In present studies, lignin was localized using phloroglucinol, anthocyanin was localized using ammonium hydroxide and auxin was localized using Salkowski reagent. Lignin was present in xylem vessels, fibers & sclerenchyma cells of all plant five plant stems providing rigidity and facilitating efficient water transportation. In *Acalpha indica*, lignin was localized in xylem vessels. Anthocyanin was localized in epidermis, collenchyma cell, phloem and pith region. Auxin was localized in epidermis & pith region. In *Cassia roxburghii*, lignin was localized in phloem, xylem vessels and pith region. Anthocyanin was localized in stem hair, epidermis, phloem, xylem vessels. Auxin was localized in epidermis, collenchyma cell, phloem, xylem vessels and pith region. In *Cassia*

tora, lignin was localized in phloem and xylem vessels. Anthocyanin was localized in epidermis and xylem vessels and auxin was localized in epidermis, collenchyma cell, xylem vessels, cambium and phloem. In *Catharanthus roseus*, lignin was localized in xylem vessels. anthocyanin was localized in epidermis, collenchyma cell, xylem vessels and pith region and auxin was localized only to epidermis. In *Nerium oleander*, lignin was localized in xylem vessels. anthocyanin was localized in epidermis, collenchyma cell phloem and pith region, auxin was localized in epidermis.

LARVICIDAL ACTIVITY FROM CHITIN BINDING PROTEIN PURIFIED FROM SEEDS OF CAESALPINIA CRISTA L.

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The present study investigates the occurrence and larvicidal potential of chitin-binding proteins (CBPs) isolated from the seeds of *Caesalpinia crista* against *Aedes aegypti* larvae. Chitin is a structural polysaccharide that forms an essential component of insect larval cell walls and exoskeletons, making it a strategic target for biological control. Chitin-binding proteins, widely reported as part of plant defense systems, possess the ability to bind and disrupt chitinous structures in insects. In the present work, *Caesalpinia crista* seed powder was defatted using n-hexane, followed by protein extraction with 0.15 M NaCl solution. The crude protein extract was partially purified by ammonium sulphate precipitation and subsequently dialysed against Tris-HCl buffer to obtain total soluble proteins. Isolation of chitin-binding proteins was achieved by affinity chromatography, allowing selective binding. The isolated protein fractions were further analyzed and confirmed by SDS-PAGE. Quantitative analysis revealed that the total protein content of *Caesalpinia crista* seeds was 651.8 mg/ml, of which 231.7 mg/ml corresponded to chitin-binding proteins, indicating efficient purification and enrichment. Bioassay results demonstrated that the isolated chitin-binding proteins exerted a significant inhibitory effect on *Aedes aegypti* larvae by disrupting the chitin-based cell wall, ultimately leading to larval mortality. The findings of this study confirm the presence of biologically active chitin-binding proteins in *Caesalpinia crista* seeds and highlight their potential application as an eco-friendly, plant-derived larvicidal agent for mosquito control.

PHYSIO-BIOCHEMICAL CHARACTERIZATION OF SELECTED GROUNDNUT (ARACHIS HYPOGAEA L.) VARIETIES

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Groundnut (*Arachis hypogaea* L.) is one of the most important oilseed crops cultivated in tropical and subtropical regions of the world. It is valued for its edible oil, high protein content, and use as food and fodder. Groundnut seeds are rich in fats, proteins, vitamins, and minerals, making them nutritionally important. The crop improves soil fertility through nitrogen fixation as it belongs to the legume family. In India, groundnut contributes significantly to agricultural economy and edible oil production. Due to its adaptability, groundnut is grown under diverse agro-climatic conditions. In this study, physiological and biochemical changes in groundnut were carried out on selected groundnut genotype viz. Girnar, G-100, G-72, G-66, G -39, G-32, G-20. The physiological parameters such as chlorophyll a, chlorophyll b and total chlorophyll. The biochemical parameters like amino acid, protein content, sugar and peroxidase, catalase enzyme were also performed.

OPTIMIZED MULTIPLE SHOOT REGENERATION IN GARLIC THROUGH TISSUE CULTURE

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Plant tissue culture is an important biotechnological technique used for the rapid multiplication of plants. The study was done to understand the basic principles, methods, and application of plant tissue culture and multiple shoot culture. Various techniques such as callus culture and multiple shoot culture were studied through standard laboratory practices and literature review. The explant used was a garlic clove. Garlic has antimicrobial properties that kill bacteria, fungi, and viruses. It also lowers blood pressure and cholesterol, reduces inflammation, and boosts immunity. Garlic tissue culture was performed in MS media culture. After inoculation of explant, growth was observed after 4 days. Formation of root and shoot was observed. After it was transferred for hardening into soil for better growth. Second time hormone treatment was given to observe growth and time duration. IAA and BAP were added into two sets of media (each 500 ml). The hormone ratios were 3:1 (BAP:IAA) and 1:3 (BAP:IAA). The growth was observed after a week. Shoot Formation was observed in higher concentration of BAP (3:1). No root Formation was observed. Later it was transferred for hardening into a soil for better growth.

ASTROBOTANY: ISRO'S CROPS-1 AND SOILLESS FARMING

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With India's plans for human spaceflight through the Gaganyaan mission, the development of sustainable life-support systems is an essential botanical endeavour. This review looks into the recent trending CROPS-1 (Compact Research Module for Orbital Plant Studies) experiment on ISRO's POEM-4 platform. This study investigates the biological success of the germination of Cowpea (*Vigna unguiculata*) in microgravity conditions. The research reviews how soilless technologies, specifically Hydroponics and Aeroponics, overcome gravitational inhibitions. A core focus has been the porous clay method, which utilises capillary-driven nutrient delivery to replace traditional soil while attempting to mitigate the lack of gravitational sedimentation. Second, the principle of Vertical Farming was discussed to maximise biomass within the restricted volumes of spacecraft. This study has shown that space-based botanical research not only secures astronaut nutrition for future orbital habitats but also offers revolutionary, land-saving agricultural solutions for high-density urban environments on Earth.

ASPERGILLUS TUBINGENSIS: A LANDFILL FUNGUS REVOLUTIONISING POLYURETHANE BIODEGRADATION

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Plastic waste is a major environmental problem because most synthetic polymers do not degrade naturally. A large amount of plastic has accumulated in landfills and the environment since the 1950s. This study highlights a sustainable solution using a newly identified fungal strain, *Aspergillus tubingensis*, isolated from a waste disposal site in Islamabad, Pakistan. This fungus has a special ability to degrade polyester polyurethane (PU), a commonly used plastic in industrial products. Its biodegradation potential was tested under laboratory and soil conditions using agar plates, liquid mineral medium, and soil burial methods. The degradation process occurs in three main steps: the fungus first attaches to the plastic surface, then grows over it, and finally releases enzymes such as

esterase and lipase that break down the chemical structure of PU. The breakdown of plastic was confirmed through microscopic and chemical analyses, which showed visible damage to the plastic surface and changes in chemical bonds. The process works best under optimized conditions, especially at 37 °C, with enzyme activity influenced by pH. Overall, this research demonstrates that *Aspergillus tubingensis* offers a safe, efficient, and eco-friendly approach for plastic waste management, making it a promising biological tool for reducing polyurethane pollution without producing harmful by-products.

Keywords: *Aspergillus tubingensis*; Polyurethane biodegradation; Esterase; Lipase; Bioremediation; SEM–FTIR analysis

3D PRINTING USING TISSUE AND ORGAN

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3D bioprinting is an advanced additive manufacturing technology that enables the layer-by-layer fabrication of functional human tissues and organs using bioinks composed of living cells and biomaterials. This computer-aided approach integrates principles of tissue engineering and regenerative medicine to address critical challenges such as organ transplantation shortages, drug testing, and personalized disease modeling. Current bioprinting techniques—including extrusion-based, inkjet-based, and laser-assisted methods—aim to replicate complex biological microarchitectures through biomimicry and controlled cell placement. Despite its transformative potential, significant limitations remain, particularly in achieving effective vascularization, maintaining cell viability during printing, and reducing high production costs. Recent advancements focus on optimizing bioink formulations, scaffold design, and process parameters to enhance structural integrity and biological function. As life expectancy increases, continued innovation in 3D bioprinting is essential to enable clinically viable, patient-specific tissues and organs for future healthcare applications.

Keywords: 3D Bioprinting, Bioinks, Tissue Engineering, Organ Transplantation, Scaffolds, Additive manufacturing

ANTIBIOTIC RESISTANCE: A GROWING THREAT TO GLOBAL HEALTH

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Antimicrobial resistance (AMR) is one of the most serious global public health challenges of the 21st century, responsible for millions of deaths worldwide and threatening the effective treatment of infectious diseases. AMR occurs when microorganisms such as bacteria evolve mechanisms that render antibiotics ineffective, leading to persistent infections, prolonged illness, increased mortality, and higher healthcare costs. The problem has intensified due to the excessive and inappropriate use of antibiotics in human medicine, veterinary practice, agriculture, and animal husbandry. The gradual decline in the discovery of new antibiotics, combined with the rapid emergence of drug-resistant pathogens known as “superbugs” has worsened the crisis. Resistance develops through intrinsic, acquired, and adaptive mechanisms and spreads rapidly via horizontal gene transfer involving plasmids, transposons, bacteriophages, and processes such as transformation, conjugation, and transduction. Antibiotic-resistant infections are associated with treatment failure, recurrent disease, increased hospitalization, and elevated mortality rates. If no effective action is taken, AMR is projected to cause up to 10 million deaths annually by 2050. Addressing this silent pandemic requires global surveillance, responsible antibiotic use, improved diagnostics, infection control measures, and

the development of alternative therapeutic strategies. Combating AMR is essential to safeguard modern medicine and global health security.

Keyword: Antimicrobial Resistance, Multidrug Resistance, genetic mutation, Global health impact, Prevention

ISOLATION AND IDENTIFICATION OF PHOSPHATE SOLUBILIZING RHIZOSPHERIC BACTERIA FROM SELECTED PLANT

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Increasing crop production to feed a growing population has driven the use of mineral fertilizers to ensure nutrients availability and fertility of agricultural soils. After nitrogen, phosphorus (P) is the second most important nutrient for plant growth and productivity. However, P availability in most agricultural soils is often limited because P strongly binds to soil particles and divalent cations forming insoluble P-complexes. Therefore, there is a constant need to sustainably improve soil P availability. In the present investigation, phosphate solubilization bacteria were isolated from medicinal plants. In order to study their *in vitro* characteristics, SUCH 11 are able to solubilize phosphate (Pi) on Pikovskaya agar plates 24 mm (5 DAI). The results strongly suggest that the PGPR strains isolated under present investigation may be useful as a novel biofertilizers for crop production.

Keywords: Rhizospheric bacteria; phosphate solubilization; Agricultural applications, PVK agar

INDUSTRIAL UTILIZATION OF PHYCOCOLLOIDS DERIVED FROM RED MACROALGAE

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Red macroalgae is one of the most important and renewable marine resources and it is commercially harvested to produce valuable phycocolloids such as agar and carrageenan. These biopolymers possess gelling, thickening, stabilizing, and emulsifying, and these functions are used in many industries. This abstract will focus on the industrial use of phycocolloids from red macroalgae, especially in terms of production, market value, and the economics of the industry. In the food industry, agar and carrageenan from red seaweeds are used as texturizing agents and stabilizers in dairy products, confections, beverages, and processed food. In the pharmaceutical and biomedical science, they are used as biocompatible and safe excipients and in culture media, as wound healing materials, and in controlled drug delivery systems. Phycocolloids of red algae are also increasingly used in the cosmetics, biotechnology, and nutraceutical industries. Production of agar and carrageenan is a highly valued segment in the seaweed-based hydrocolloid industry, which is a multi-billion dollar industry and continues to grow by the increasing demand for hydrocolloids from natural and biodegradable sources. Cultivation of macroalgae is eco-friendly as it does not require any input and helps in climate mitigation.

Keywords: Red macroalgae, Phycocolloids, Carrageenan, Agar, Industrial applications

PHYTOREMEDIATION FOR SOIL AND WATER CONSERVATION: A COMPREHENSIVE STUDY

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Phytoremediation is an emerging multidisciplinary technology that utilizes plants and their associated microorganisms to reduce, remove, or immobilize contaminants from soil and water systems. With escalating industrialization, urban growth, and agricultural expansion, soil degradation and water pollution have become critical global challenges. This study investigates the potential of phytoremediation as an eco-friendly, cost-effective strategy for restoring and conserving soil and water quality, focusing on heavy metals, organic pollutants, and nutrient overload. Using both qualitative and quantitative research methods, this paper synthesizes existing literature, examines field case studies, and presents empirical evidence from surveys conducted in three contaminated sites across southern India: industrial effluent discharge zones, agricultural runoff areas, and municipal wastewater channels. The methodology involved soil/water sampling, plant species selection based on tolerance and uptake efficiency, monitoring pollutant concentration changes, and community surveys to assess local perceptions of phytoremediation effectiveness. Data were analyzed using statistical tools and visualized through graphs to evaluate pollutant reductions and plant growth correlations. The findings reveal that certain plant species such as *Brachiaria mutica*, *Vetiveria zizanioides*, *Phragmites australis*, and *Helianthus annuus* exhibited significant contaminant uptake, reducing heavy metals (lead, cadmium) by up to 65% in soils and organic pollutants (pesticides, hydrocarbons) by up to 58% in water within 6–9 months. Survey results indicate high community acceptance but highlight knowledge gaps regarding long-term maintenance and scalability. This research underscores phytoremediation's role in sustainable environmental management and proposes integrative frameworks involving policy support, community participation, and technological innovations. The study concludes with recommendations for future research on genetic enhancement of hyperaccumulator species and large-scale implementation models.

Keywords: Phyto remediation Soil conservation Water quality management Heavy metal uptake Sustainable remediation

ECO-BIOPLASTIC FROM JACKFRUIT AND JAMUN SEED POLYMERS AS SUSTAINABLE PLASTIC ALTERNATIVES

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The increasing environmental problems caused by conventional petroleum-based plastics have created an urgent need for sustainable and biodegradable alternatives. This study focuses on the development of eco-bioplastics using natural polymers extracted from jackfruit (*Artocarpus heterophyllus*) and jamun (*Syzygium cumini*) seeds. These seeds are agricultural waste materials rich in starch and polysaccharides, making them suitable for bioplastic production. The extracted polymers were processed with natural plasticizers to form biodegradable plastic films. The prepared bioplastics were evaluated for physical properties such as flexibility, tensile strength, water absorption, and biodegradability. Results indicate that jackfruit and jamun seed-based bioplastics exhibit good mechanical strength and faster degradation compared to synthetic plastics. Utilizing these renewable resources not only reduces plastic pollution but also adds value to agro-waste. This eco-friendly approach offers a promising solution for sustainable material development and environmental conservation.

Keywords: Eco-bioplastic, Jackfruit seed polymer, Jamun seed polymer, Biodegradable plastic, Sustainable materials.

GUT BRAIN AXIS: MICROBES INFLUENCE MENTAL HEALTH

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The gut–brain axis is a complex, two-way communication system between the gastrointestinal tract and the brain. It involves neural, hormonal, and immune pathways that allow the gut and brain to influence each other. Gut microbes play a key role in this connection by helping in digestion, producing vitamins, and releasing bioactive compounds such as neurotransmitters and short-chain fatty acids. These microbial products affect brain function, mood, behavior, and immune responses. An imbalance in gut microbiota, known as dysbiosis, has been linked to various health problems including anxiety, depression, obesity, inflammatory diseases, and neurological disorders. Maintaining a healthy gut microbiome through balanced diet, probiotics, and healthy lifestyle can support both mental and physical health. Thus, gut microbes are essential regulators of human health through their interaction with the gut–brain axis.

Keywords: gut-brain axis, vagus nerve, neurotransmitters, mood regulations dysbiosis

SILK PRODUCTION IN SPIDERS BEYOND WEB MAKING

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Spider silk is a remarkable natural protein fiber produced by specialized glands in the abdomen of spiders and is used for web construction, egg protection, and survival activities. It is mainly composed of fibroin proteins known as spidroins, which are rich in repetitive glycine and alanine sequences. Structurally, spider silk exhibits a unique hierarchical organization consisting of rigid crystalline regions that impart high tensile strength and semi-amorphous elastic regions that provide flexibility and extensibility. Due to this combination, spider silk shows exceptional mechanical properties, being stronger than steel on a weight basis and tougher than many synthetic fibers such as Kevlar. Certain types of spider silk can stretch several times their original length without breaking. However, large-scale harvesting of natural spider silk is not feasible because spiders are territorial and cannibalistic. Therefore, modern research focuses on recombinant production using transgenic organisms like bacteria, plants, and goats. These bioengineered silks show great potential in biomedical, industrial, and defense applications.

Keywords: Spider silk; Fibroin; Tensile strength; Elasticity; Toughness; Recombinant production; Biocompatibility; Biomedical applications

BOTANICAL ROBOT: THE GREEN MACHINE OF TOMORROW

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Botanical robots, also known as plant robots, are robotic systems designed to support natural plant growth. Plants grow on their own, while robots assist by monitoring soil moisture, nutrients, light, temperature, and plant signals such as growth direction and stress. Using this data, robots provide accurate watering, lighting, nutrient supply, and physical support. These systems use soft and flexible structures to avoid damaging plants, forming a biohybrid system where plants and machines work together. Inspired by biomimicry, botanical robots improve efficiency, reduce human effort, save resources, and promote sustainability. Botanical robotics has applications in smart agriculture, vertical farming, green architecture, environmental monitoring, and space farming, representing the green machines of tomorrow.

Keyword: Botanical Robotics, Bio-hybrid System, Sustainability, Biomimicry, Plant Signals

ANIMAL THAT PREDICT NATURAL DISASTERS

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Natural disasters such as earthquakes, tsunamis, floods, and volcanic eruptions are often preceded by subtle environmental changes that remain undetectable to humans but are sensed by animals. This review highlights the role of animals as natural disaster warning systems by focusing on observable behavioural symptoms exhibited prior to catastrophic events. Common symptoms include unusual restlessness, sudden migration, excessive vocalization, erratic movement, abandonment of shelters or habitats, and altered feeding or reproductive behaviour. These responses are believed to arise from animals' heightened sensitivity to changes in seismic vibrations, electromagnetic fields, gas emissions, atmospheric pressure, and infrasound waves. Historical records and recent observations suggest that such symptom-like behavioural alterations occur hours to days before disaster onset. Understanding and systematically studying these biological early-warning symptoms can contribute to the development of complementary disaster prediction models, aiding in risk mitigation and improving human safety. The integration of ethology with geophysical monitoring presents a promising interdisciplinary approach for early disaster detection.

Keywords: Natural disasters, Behavioural symptoms, Animal migration, Electromagnetic field changes, Environmental sensing, Disaster warning

DANDELION ROOT EXTRACS: REVISITING A TRADITIONAL HERB WITH MODERN ANTI-CANCER POTENTIAL

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Dandelion (*Taraxacum officinale*) is an established medicinal herb that has long been employed in traditional medicine for treating liver ailments, inflammation, digestive troubles, and detoxification purposes. In recent years, scientific research has established that *Taraxacum officinale* Root Extract has remarkable antioxidant, antimicrobial, and anticancer activities. The purpose of this paper is to review and emphasize the therapeutic uses of *Taraxacum officinale* Root, in particular anticancer properties. The root of dandelion contains key bioactive constituents like polyphenols, flavonoids, sesquiterpenes lactones, inulin, and triterpenes, making it have such biological properties. Some lab research studies have also shown that dandelion root extract possesses the capability to cause apoptosis or programmed cell death selectively in cancerous cells without causing any adverse effect on normal cells. The root extract has also shown promising results in curing different types of cancers like leukemia, breast cancer, colon cancer, and pancreatic cancer. The root extract also holds anti-inflammatory and immunomodulatory properties.

Keywords: Dandelion root, Medicinal plant, Anticancer activity, Phytochemicals, Herbal medicine.

GREEN GOLD: ALGAE'S URBAN REVOLUTION

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Algae are emerging as versatile drivers of sustainable innovation, offering solutions in carbon sequestration, wastewater treatment, renewable energy, bio fertilizers, air purification, and architectural design. Despite their simple structure, algae exhibit remarkable adaptability and functional complexity. This paper examines real-world applications of algae within circular economy models, evaluates their economic and environmental potential, and critically discusses current technological and scalability limitations, positioning algae as a transformative resource for future sustainable development.

Keywords: Algae; Sustainability; Circular economy; Bioenergy; Carbon sequestration; Biotechnology

PROBIOTICS AND HUMAN HEALTH

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Probiotics are defined as live microorganisms that, when administered in adequate amounts, confer health benefits to the host by modulating the gut microbiota and related physiological functions. These beneficial microbes—commonly including species of *Lactobacillus*, *Bifidobacterium*, and certain yeasts—have been widely studied for their roles in improving gastrointestinal health, enhancing immune responses, and potentially preventing or alleviating a range of metabolic, infectious, and inflammatory conditions. Emerging evidence supports the involvement of probiotics in regulating weight and glucose metabolism, influencing the gut-brain axis with implications for mental health, and contributing to dermatological and cardiometabolic outcomes. Research also highlights the synergy between probiotics, prebiotics, and synbiotics for improving microbial survival and function in the gastrointestinal tract. Although promising, many claimed health effects still require robust clinical validation, and strain-specificity, dosage, and longterm safety remain key considerations in probiotic applications. Continued exploration of mechanisms of action and targeted therapeutic uses may expand the role of probiotics in preventive and clinical health settings.

Keywords: Probiotics, Gut microbiota, Human health, Gastrointestinal health, Microbiome–host interaction, Functional foods, Strain-specific effects.

NATURE’S PHARMACY: THE HIDDEN POWER OF HEALING HERBS

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Medicinal plants have been an essential part of human healthcare since ancient times and are often referred to as Nature’s Pharmacy. Healing herbs possess a wide range of bioactive compounds such as alkaloids, flavonoids, tannins, and essential oils that show antimicrobial, anti-inflammatory, antioxidant, antiviral, and immunomodulatory activities. Traditional systems like Ayurveda, Siddha, and Unani have successfully utilized these herbs for the prevention and treatment of various diseases. Recent scientific studies have validated the therapeutic potential of many herbal medicines, leading to increased interest in plant-based drugs and natural remedies. Compared to synthetic medicines, herbal treatments are generally cost-effective and associated with fewer side effects when used properly. This poster highlights the hidden medicinal potential of healing herbs, their major bioactive compounds, and their role in modern medicine. Emphasis is also given to the conservation and sustainable use of medicinal plants for future healthcare needs.

Keywords: Medicinal plants, Bioactive Compounds, Antimicrobial Properties, Phytochemicals

EXPLORING THE ANTIBACTERIAL EFFICACY OF DATURASTRAMONIUM L. AGAINST CLINICAL ISOLATES

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Plants produce secondary bioactive compounds with medicinal importance, offering tremendous potential for the discovery of novel pharmaceutical agents. As a result, green pharmaceuticals have recently become an important area of research. Medicinal plants synthesize a diverse range of bioactive compounds, including both primary and secondary metabolites, which are well recognized for their potent antimicrobial activity against a wide variety of pathogenic organisms.

This study investigates the antibacterial activity of *Datura stramonium* against two bacterial strains: *Escherichia coli* (Gram-negative) and *Bacillus* spp. (Gram-positive). Plant extracts were prepared using three different solvents—methanol, petroleum ether, and water—and antibacterial activity was evaluated by measuring the zone of inhibition (ZOI).

Qualitative phytochemical analyses were conducted to identify the presence of bioactive compounds. The results revealed the presence of alkaloids, tannins, flavonoids, anthraquinones, carotenoids, proteins, saponins, lipids, terpenoids, steroids, and other secondary metabolites. Antibacterial activity was assessed using the Kirby–Bauer disc diffusion method, and all extracts exhibited significant antibacterial effects.

The findings indicate that *D. stramonium* possesses a broad spectrum of antibacterial activity, with higher efficacy against Gram-positive *Bacillus* spp. compared to Gram-negative *E. coli*.

Keywords: Bioactive compounds, Antimicrobial activity, Extraction, Natural products

TERRARIUM: CONSERVATION OF PLANTS IN A CONTROLLED ENVIRONMENT

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A terrarium is a miniature, enclosed or semi-enclosed system designed to grow and conserve plants under controlled environmental conditions. It represents a practical model of a self-sustaining ecosystem where factors such as light, temperature, humidity, and moisture are regulated to support plant growth. Terrariums are increasingly recognized as valuable tools for plant conservation, environmental education, and sustainable horticulture.

In a terrarium, plants interact with their environment through natural processes such as photosynthesis, respiration, transpiration, and nutrient cycling. Water evaporates from the soil and plant surfaces, condenses on the container walls, and returns to the soil, creating a closed water cycle. This controlled microclimate allows plants—especially shade-loving, slow-growing, and moisture-dependent species—to thrive with minimal external input. Suitable plant species include ferns, mosses, Fittonia, Peperomia, miniature orchids, and succulents in open terrarium systems.

In India, terrariums are gaining popularity as eco-friendly decorative items for homes, offices, educational institutions, and commercial spaces. They are prepared and sold through local nurseries, floriculture units, exhibitions, online platforms, and urban gardening markets. The growing interest in indoor gardening, sustainable décor, and green lifestyles has created significant market potential for terrarium-based products. Terrarium preparation offers opportunities for small-scale entrepreneurship, particularly for students, women self-help groups, and horticulture enthusiasts.

Thus, terrariums combine scientific principles of plant conservation with aesthetic value and commercial viability, making them an innovative approach to sustainable plant management and environmental awareness in India.

Keywords: Terrarium, Biodiversity Conservation, Entrepreneurship

HERBARIUM: FROM TRADITIONAL TO DIGITAL

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The herbarium is a systematically arranged collection of preserved plant specimens that serves as a permanent scientific record for plant identification, taxonomy, floristic studies, and biodiversity conservation. Traditionally, herbarium preparation involves field collection, pressing, drying, mounting, labelling, and physical storage of plant specimens. Such conventional herbaria have been the foundation of botanical research for centuries. In India, important traditional herbaria include the Central National Herbarium (CAL), Howrah, and regional herbaria of the Botanical Survey of India (BSI), while internationally renowned examples include the Royal Botanic Gardens, Kew (UK) and the Muséum National d'Histoire Naturelle, Paris.

Traditional herbaria, however, face challenges such as limited accessibility, physical deterioration, pest infestation, and restricted data sharing. To overcome these limitations, herbaria are increasingly being transformed into digital herbaria. Methods of digitization include specimen selection and preparation, barcode labelling, high-resolution imaging or scanning, image processing and quality control, digitization of label data, taxonomic verification, and georeferencing of collection localities. The digitized records are stored in searchable databases and shared through online platforms.

In India, initiatives such as the BSI Digital Herbarium and Indian Virtual Herbarium enhance accessibility, while global platforms like GBIF, JSTOR Global Plants, and Kew Herbarium Catalogue provide international visibility. Digitization of Gujarat and Saurashtra herbarium collections ensures long-term preservation of regional plant diversity and strengthens botanical research, education, and biodiversity conservation at local and global levels.

Thus, the transition from traditional to digital herbaria represents a crucial advancement in modern plant science, conservation, and education.

Keywords: Digital herbarium, BSI, Taxonomic verification, Kew Herbarium

DRY FLOWER BOUQUET: BLENDING BOTANY WITH AESTHETIC VALUE

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Dry flower bouquets represent a unique intersection of botanical science and decorative art. Unlike fresh flowers, dried flowers retain their form, texture, and in many cases colour for extended periods, making them a sustainable and long-lasting alternative in floral arrangements. The practice of drying flowers has been traditionally used for preservation, craft, and cultural purposes, and in recent years it has gained popularity due to growing interest in eco-friendly décor and sustainable floral art. Understanding the botanical properties that allow flowers to be effectively dried is essential for enhancing both their durability and aesthetic appeal.

The objective of the present study is to explore the botanical basis of dry flower preparation and to evaluate the aesthetic value of dry flower bouquets as decorative and sustainable art forms. Various flowering plants and ornamental foliage were selected based on their structural strength, pigmentation, and moisture content. Flowers were subjected to one of the drying techniques that is air drying. The dried materials were then arranged into bouquets using basic principles of floral design, including balance, color harmony, and texture. Observations were made on shape retention, color stability, and overall visual appeal.

The study revealed that flowers with firm petals, low moisture content, and strong vascular tissues showed better preservation after drying. Desiccant drying resulted in superior colour retention, while air drying maintained natural form and texture. The prepared dry flower bouquets exhibited high aesthetic value, characterized by pleasing color combinations, varied textures, and long shelf life. These bouquets required minimal maintenance and remained visually appealing over extended periods.

Dry flower bouquets successfully blend botanical knowledge with artistic creativity. They offer an eco-friendly, cost-effective, and durable alternative to fresh floral arrangements. The study highlights their significance in sustainable décor, interior design, and craft industries, while also promoting appreciation of plant diversity and botanical properties in aesthetic applications.

Keywords: Dry Flower Bouquet, Air drying, Eco- friendly, Preservation, Sustainability

ANATOMICAL AND DEVELOPMENTAL STUDY OF OIL GLANDS IN *EUCALYPTUS* LEAVES.

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Eucalyptus species are well known for their aromatic leaves, which are rich in essential oils of high medicinal, industrial, and commercial value. These oils are synthesized and stored in specialized secretory structures known as oil glands. Understanding the anatomical organization and developmental pattern of oil glands is essential for correlating leaf structure with oil yield and quality. The present study aims to investigate the anatomical structure and developmental stages of oil glands in Eucalyptus leaves, with emphasis on their origin, distribution, and structural characteristics.

Fresh and mature leaves of Eucalyptus were collected and subjected to anatomical analysis. Thin transverse sections of leaves were prepared using standard microtomy techniques. Sections were stained with suitable histological stains and examined under a light microscope to study the position, structure, and development of oil glands at different stages of leaf growth. Microscopic observations revealed that oil glands are schizogenous in origin and are embedded within the mesophyll tissue of the leaf. They appear as spherical to oval cavities lined by a layer of secretory epithelial cells. During early leaf development, oil glands originate from a group of meristematic cells, which gradually separate to form a cavity. As the leaf matures, the glands increase in size and accumulate essential oil. The distribution of oil glands was found to be uniform, contributing to the characteristic aroma of Eucalyptus leaves. The study provides detailed insight into the anatomical features and developmental pattern of oil glands in Eucalyptus leaves. Understanding these structures is significant for improving essential oil extraction, quality assessment, and species identification. The findings also contribute to botanical, pharmacological, and industrial applications related to Eucalyptus essential oils.

Keywords: Essential oils, Yield, quality, Extraction, Applications, Microscopic observations.

FROM EXPLANT TO CALLUS: IN VITRO CALLUS INDUCTION IN *BRASICA JUNCEA*

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Plant tissue culture techniques play a vital role in modern plant biotechnology, providing efficient tools for plant improvement, conservation, and secondary metabolite production. Among these techniques, callus induction represents a fundamental step for *in vitro* regeneration and genetic manipulation studies. The present study focuses on *in vitro* callus induction in *Brassica juncea* (Indian mustard), an economically important oilseed crop widely cultivated in India. Healthy explants such as leaf, hypocotyl, and stem segments were excised from aseptically germinated seedlings and cultured on Murashige and Skoog (MS) medium supplemented with different concentrations and combinations of plant growth regulators. Auxins and cytokinin, particularly 2,4-dichlorophenoxyacetic acid (2,4-D) and kinetin or benzyl aminopurine (BAP), were evaluated for their effectiveness in inducing callus

formation. Cultures were maintained under controlled conditions of temperature, photoperiod, and humidity. The initiation of callus was observed within two to three weeks of inoculation, with variations in callus texture, color, and growth rate depending on the type of explant and hormonal combination used. Leaf explants exhibited a higher frequency of callus induction compared to other explants. The induced callus ranged from friable to compact and creamy white to light green in appearance, indicating active cellular dedifferentiation.

The study highlights the importance of explant selection and hormonal balance in achieving efficient callus induction in *B. juncea*. This standardized protocol can serve as a foundation for further applications such as plant regeneration, genetic transformation, and secondary metabolite production. Overall, the findings demonstrate the potential of *in vitro* callus culture as a powerful tool in crop improvement and plant biotechnology research.

Keywords: *Brassica juncea*, Callus, Auxins, Cytokinin, Plant Tissue Culture

POST-HARVEST TECHNIQUE FOR ENHANCING LONGEVITY OF *TABERNAEMONTANA DIVARICATA*

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Post-harvest deterioration of *Tabernaemontana divaricata* flower buds limits their marketability due to rapid wilting and reduced shelf life. An experiment was conducted to evaluate the effectiveness of boric acid treatments in enhancing post-harvest longevity and quality of flower buds. Uniform, freshly harvested buds at the tight bud stage were subjected to post-harvest dipping treatments using boric acid at concentrations of 2%, 4%, 6%, and 8%, with distilled water serving as the control. The treated buds were surface-dried and stored under controlled ambient and cool conditions (~4-7°C). Post-harvest parameters such as shelf life, physiological loss in weight, bud opening percentage, colour retention, and overall visual quality were periodically assessed. The results indicated that boric acid treatments significantly influenced the post-harvest performance of *T. divaricata* buds. Moderate concentrations (2–4%) were found to effectively delay senescence, reduce moisture loss, and maintain bud firmness and colour when compared to the control. In contrast, the highest concentration (8%) resulted in adverse effects, likely due to phytotoxicity, leading to reduced longevity and quality. The control treatment exhibited rapid deterioration and early wilting. The study demonstrated that post-harvest application of boric acid, particularly at moderate concentrations, is a simple, cost-effective, and eco-friendly technique for extending the shelf life of *T. divaricata* flower buds, thereby improving their commercial value.

Keywords: *Tabernaemontana Divaricate*, Boric Acid, Post-harvest

SITE-SPECIFIC GROWTH, WATER QUALITY INFLUENCE AND PHYCOCOLLOID CONTENT OF *KAPPAPHYCUS ALVAREZII* ALONG THE DEVBHUMI DWARKA COAST, GUJARAT

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This study on site-specific growth performance, water quality influences, and carrageenan productivity of the red seaweed *Kappaphycus alvarezii* cultivated at three coastal locations-Beyt Dwarka, Okha, and Mithapur-along the Devbhumi Dwarka coast of Gujarat, India. Cultivation was

carried out using the tub net raft method for 60 days, and biomass and environmental parameters were recorded at 15-day intervals. Pearson correlation analysis was used to evaluate relationships between growth, carrageenan content, and environmental parameters. At all sites, seaweed with an initial weight of 2.00 kg were deployed. Among the three locations, Beyt Dwarka showed the highest productivity, attaining a final mean biomass of 15.54 kg with a maximum average daily growth rate (DGR) of 3.42% day⁻¹. Okha exhibited comparable growth, with a final mean weight of 15.12 kg and an average DGR of 3.37% day⁻¹. In contrast, Mithapur, lowest growth was observed, reaching a final mean biomass of 13.53 kg and a DGR of 3.19% day⁻¹. Carrageenan yield showed a similar trend, with the highest mean value observed at Beyt Dwarka (28.16%), followed by Okha (28.09%) and Mithapur (28.00%). At all sites, carrageenan content highest at Day 15 of cultivation, reaching up to 28.86% at Beyt Dwarka, and gradually declined to approximately 27% by Day 60. Water quality parameters remained relatively stable throughout the study period. Correlation analysis revealed strong positive relationships between growth and temperature (0.96-0.99), salinity (0.90-0.99), and nutrient availability, including nitrite, nitrate, and phosphate (0.90-0.99) at all sites. In contrast, dissolved oxygen showed a strong negative correlation with both growth (-0.91 to -1.00) and carrageenan yield (-0.87 to -0.95). Carrageenan content was also positively correlated with temperature and nutrient levels. Findings indicate that Beyt Dwarka are the most favorable environmental conditions for the commercial-scale cultivation of *Kappaphycus alvarezii* along the Devbhumi Dwarka coast.

Keyword: *Kappaphycus alvarezii*; Daily growth rate; Carrageenan yield; Water quality parameters; Nutrient dynamics; Coastal mariculture; Gujarat coast

PHARMACOGNOSTICAL STANDARDIZATION AND PHYTOCHEMICAL EVALUATION OF SALACIA RETICULATA WIGHT STEM

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Salacia reticulata Wight commonly known assaptarangi or saptachakra belongs to Celastraceae Family. It is mainly habitat in south India and Sri Lanka. It contains vast chemical constituents like salacinol, kotalenol, mangiferin etc. which gives wide range of therapeutics effect. *Salacia* genus contains more than 200 species worldwide and from than 18 species recognised in India. Due to morphological similarity in all species, it is difficult to identify the correct species so our study focuses in detail pharmacognostical and other phytochemical analysis to give the direction for proper identification of plant. Microscopic study of transverse section and powder of *S. reticulata* stem were done by compound microscope. Physicochemical studies like ash value, acid insoluble ash value, extractive value, loss on drying, fluorescence analysis was done as per WHO guidelines. Quantitative phytochemical analysis like total phenolic content, total tannin content, total flavonoids content and total triterpenoids content were also performed. Results of studies showed the details of macroscopy, microscopy of stem. Physicochemical characteristics of stem powder, such as its ash value, extractive value, and fluorescence behaviour, have also been established. Phytochemical screening of extracts confirmed the presence of tannin, saponin, alkaloids and flavonoids. Total Phenolic contents of stem were 499.03±2.82 mg GAE/g while total flavonoids, total tannin and total triterpenoids contents were found to be 629.55±0.78 mg QE/g, 279.19±0.80 mg/ml of tannic acid and 273.17±2.42 mg UAE/g, respectively. HPTLC study of extracts Showed that the stem of *S. reticulata* contains 0.02% of mangiferin. This current pharmacognostical study helps with both standardisation criteria establishment and crude drug material identification of plant.

MICROBIOLOGY

POSTBIOTICS IN AQUACULTURE: A NEW ERA FOR SUSTAINABLE FISH FARMING

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Aquaculture has attracted significant global interest for its ability to meet rising food demand. However, one of the issues faced by aquaculture is disease susceptibility, which can have a severe influence on both production quality and quantity. This needs the development of long-term strategies to sustain and increase aquaculture productivity. Bacterial-derived compounds have emerged as a possible method for addressing this issue in recent decades. Probiotics, prebiotics, and synbiotics have long been thought of as promising feed additions for treating bacterial, viral, and parasitic illnesses in fish and shellfish. However, recent research has shown that to reap the health benefits of these bacterial additions, a healthy bacterial culture is not necessary. Instead, the health benefits may be related to bacterial metabolites and cellular components. Therefore, new terms such as paraprobiotics and postbiotic have emerged based on the observation that the beneficial effects of microbiota are mediated by the secretion of various metabolites.

OPTIMIZATION AND CHARACTERIZATION OF EXOPOLYSACCHARIDE PRODUCED BY *KOCURIA FLAVA* 29 ISOLATED FROM THE ROOT OF *ARACHIS HYPOGAEA* L.

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Exopolysaccharides (EPS) are complex, microbially derived carbohydrate polymers that have recently attracted considerable research interest due to their distinctive physicochemical properties. However, developing cost-effective strategies to increase EPS yield remains a key challenge. Using the Central Composite Design (CCD) of response surface methodology, EPS production was optimized with sucrose, yeast extract, and inoculum size, resulting in a maximum yield of 15.6 g/L at 7.5 g/L, 0.55 g/L, and 2%, respectively. In this study, GPC determined the average molecular weight of the purified EPS to be 0.93×10^5 Da. High performance liquid chromatography confirmed the presence of five constituent monosaccharides: glucose, galactose, mannose, arabinose and xylose. Functional groups, such as carboxyl and hydroxyl, were identified through FT-IR analysis, while ¹H and ¹³C NMR spectra showed α - and β -D-(+)-glucose residues linked via glycosidic bonds. Morphological analysis by SEM revealed a fibrous, porous framework. AFM proved that the micro-structure of EPS is compact and rough. XRD confirmed the amorphous nature of EPS, with a crystallinity index of 15.6%. Thermogravimetric analysis indicated a thermal degradation temperature of 241 °C. Functional characterization demonstrated the EPS's solubility in various solvents. Additionally, the EPS exhibited excellent emulsifying activity and maintained strong stability across a wide range of hydrocarbons and oils. These features highlight its promising potential for diverse agricultural and industrial applications.

Keywords: Exopolysaccharides, *Kocuria flava*, Statistical optimization, Functional characteristics, *Arachis hypogaea* L.

A COMPARATIVE STUDY OF PHOSPHATE SOLUBILIZATION ACTIVITY IN MONO CROPPIC POMEGRANATE RHIZOSPHERIC SOILS OF MORBI AND DWARKA REGION.

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The availability of phosphorous in soil is largely dependent on the activity of enzymes such as phytase and phosphatase, which plays an important role in phosphate solubilization. Phytases are enzymes that catalyze liberalization of inorganic phosphate from phytic acid. Phosphatases are enzymes which are responsible for breakdown ester bonds of inorganic phosphorous. Measure and compare phytase and acid phosphatase enzymes activity directly from the extracted soils of Morbi and Dwarka region. For the comparative study soil samples were collected from mono cropping Pomegranate rhizosphere. Phytase activity was determined by directly measuring inorganic phosphate released from the soil by taking absorbance at 415nm while soil acid phosphatase activity was determined by directly measuring the absorbance of 4-nitrophenyl liberated due to hydrolysis of P-nitrophenyl phosphate at 420nm. In Morbi and Dwarka soil sample activity of phytase enzyme was respectively - 2.88 $\mu\text{mol Pireleased g}^{-1}$ dry soil h^{-1} and -1.60 $\mu\text{mol Pireleased g}^{-1}$ dry soil h^{-1} at 5.5pH and activity of acid phosphatase enzyme was respectively 12.03 $\mu\text{g of P-nitrophenol g}^{-1}$ soil h^{-1} and 5.42 $\mu\text{g of P-nitrophenol g}^{-1}$ soil h^{-1} at 6.5 pH. By this study it was found that the average phosphatase activity is 3.5x fold is higher than average activity of phytase enzyme in both the samples.

Key words: Phytase, Phosphatase, soil.

EXPLORING POTENT PHYTOCHEMICALS FROM PLECTRANTHUS BARBATUS ANDR. TO COMBAT OXA-48 AND NDM-1-MEDIATED CARBAPENEM-RESISTANCE OF KLEBSIELLA PNEUMONIAE THROUGH VIRTUAL SCREENING

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Antimicrobial resistance (AMR) is a serious global health threat, with dire projections of 10 million deaths per year globally by 2050. Among the AMR organisms, ESKAPE pathogens (Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, and Enterobacter spp.) create a critical challenge due to their multidrug-resistant profiles. Only a limited number of antibiotics are effective against them, particularly those of the carbapenem class. However, in recent times, there has been a conspicuous rise in the prevalence of carbapenem resistance. Among them, carbapenem-resistant K. pneumoniae (CRKP) poses an urgent therapeutic challenge due to its perilous rate of morbidity, mortality, and economic burden. The prevalence of carbapenemases plays a vital role in the occurrence of multidrug resistance in CRKP, which accentuates the urgent need to identify novel carbapenemase inhibitors. Even though growing resistance in pathogenic bacteria threatens the modern medicinal approaches, phytochemicals from medicinal plants show potency for a wide range of biological activities, including the eradication of AMR infections. Thus, for the development of novel therapeutics to combat infection caused by CRKP, we turned to ethnomedicinal plants. Plectranthus barbatus Andr. (PB) (also known as Coleus forskohlii) is a plant of the Lamiaceae family, which holds therapeutic importance since ancient ethnomedicinal practices. In the present study, we aim to screen phytochemicals of PB to target major carbapenem resistance contributors OXA-48 and NDM-1, of CRKP through an in-silico approach. Additionally, ADMET (Absorption, distribution, metabolism, excretion, and toxicity) properties and

drug-likeness of hit phytochemical(s) were analysed to avoid late-stage drug development failure. Our results revealed that Betulic acid shows the strongest interaction with OXA-48 (-9.4 kcal/mol), and α -amyrin shows the strongest interaction with NDM-1 (-9.3 kcal/mol). Moreover, our findings suggest that phytoconstituents such as Betulic acid, α -amyrin, 11,14-dihydroxy-8,11,13-abietatrien-7-one, Taxodione, β -sitosterol, and Coleonolic acid could prominently interact with both the targets. Collectively, our study suggests that phytoconstituents of PB may serve as potent inhibitors of OXA-48 and NDM-1 and could be an alternative therapeutic strategy for targeting CRKP, which could be further validated by in vitro screening.

Keywords: Carbapenem resistance, *Klebsiella pneumoniae*, Molecular docking, NDM-1, OXA-48, *Plectranthus barbatus* Andr.

A COMPREHENSIVE STUDY ON ISOLATION, OPTIMIZATION, AND MULTIFACETED INDUSTRIAL APPLICATIONS OF *RHIZOBIACEAE* DERIVED EXOPOLYSACCHARIDES

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Exopolysaccharides (EPS) are high-molecular-weight carbohydrate polymers with diverse industrial applications. In this study, 28 bacterial isolates were obtained from spoiled fruits, vegetables, and sour curd, from which four potent EPS producers (U1, U6, C4, and U5) were screened. MALDI-ToF analysis identified three of these isolates (U1, U6, and C4) as members of the *Rhizobiaceae* family, while isolate U5 was identified through 16S rRNA gene sequencing. To ensure a cost-effective process, fruit wastes such as sugarcane bagasse and pineapple peels were utilized as alternative sugar sources in the production medium. Various parameters, including pH, temperature, sucrose concentration (%), and incubation time, were optimized for optimum EPS production. The dry weight EPS yields of 26.62, 114.23, 128.50, and 139.78 g/L for C4, U6, U1, and U5, respectively. The EPS was purified via acetone precipitation and characterized using TLC and FTIR. TLC Retention factor (R_f) values were consistent with the galactose monosaccharide, and FTIR analysis confirmed the presence of characteristic carbohydrate functional groups. The crude EPS demonstrated potential applications as an effective bio-emulsifier for various oils, an enhancer for seed germination, and a protective agent against fruit spoilage.

Keywords: Exopolysaccharide, 16S rRNA sequencing, MALDI-ToF, TLC, FTIR, Bio-emulsification, Seed Germination.

MICROBIAL TRANSFORMATION OF SHRIMP POND SLUDGE INTO BIODEGRADABLE POLYMERS: A CIRCULAR BIOECONOMY APPROACH

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Shrimp aquaculture generates large quantities of nutrient-rich pond sludge, which is often treated as waste and poses environmental disposal challenges. This study explores the potential of shrimp pond sludge as a sustainable feedstock for the production of biodegradable bioplastics, specifically polyhydroxyalkanoates (PHA) and polyhydroxybutyrate (PHB). Pond sludge, rich in carbon compounds, nitrogen, minerals, and diverse microbial communities, was subjected to a multi-step process involving collection and dewatering, pre-treatment to remove sand and adjust pH and salinity, followed by anaerobic fermentation. During fermentation, microbial consortia including *Clostridium*,

Bacillus megaterium, *Lactobacillus*, purple non-sulfur bacteria (*Rhodobacter*), and *Ruminococcus* converted organic matter into volatile fatty acids (VFAs). These VFAs served as substrates for PHA/PHB-producing bacteria such as *Cupriavidus necator*, *Halomonas bluephagenesis*, *Pseudomonas putida*, and *Azohydromonas lata*. The biopolymers were subsequently extracted, purified, dried, and processed into pellets or films. The resulting bioplastics are fully biodegradable, non-toxic, biocompatible, and derived from renewable waste resources, offering significant advantages over conventional petrochemical-based polymers. Potential applications include micro-encapsulation, drug delivery systems, slow-release probiotics, biofilm carriers, degradable aquaculture gear, and feed or vaccine delivery platforms. This approach demonstrates a circular bioeconomy pathway by transforming aquaculture waste into high-value, eco-friendly bioplastics, contributing to waste reduction, pollution control, and sustainable aquaculture practices.

Keywords: Shrimp pond sludge, Bioplastics, Polyhydroxyalkanoates (PHA), Polyhydroxybutyrate (PHB), Anaerobic fermentation, Circular bioeconomy.

TAPPING INTO MARINE BIODIVERSITY: A NEW FRONTIER FOR ANTI-VIRULENCE THERAPY

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The rapid escalation of antibiotic resistance among clinical pathogens has necessitated the development of alternative therapeutic strategies. Unlike traditional antibiotics, quorum sensing inhibition (Quorum Quenching) targets bacterial communication rather than cell viability. This anti-virulence approach exerts less selective pressure on bacteria, significantly reducing the likelihood of developing resistance. In this study, marine samples were collected from undisturbed coastal regions of Gujarat to explore novel bioactive compounds. A total of 78 bacterial strains, including both free-living and macro-organism-associated species, were isolated. The quorum-quenching potential of these isolates was evaluated using a co-culture assay against the reporter strain *Chromobacterium violaceum* MK026. This method allowed for the detection of both signal-degrading and non-degrading quorum-sensing inhibitors. The screening identified specific marine isolates capable of disrupting bacterial signaling. These findings suggest that the underexplored marine biodiversity of the Gujarat coast is a promising source of quorum-sensing inhibitors. Such marine-derived leads could serve as the foundation for novel anti-virulence therapies to combat multi-drug resistant infections.

Keywords: Quorum Sensing, QS inhibition, Marine Microbes

ISOLATION AND CHARACTERIZATION OF PLANT GROWTH-PROMOTING BACTERIA

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Bacteria that colonize plant roots and promote plant growth are referred to as plant growth-promoting rhizobacteria (PGPR). The increasing demand for crop production with a significant reduction of synthetic chemical fertilizers and pesticide use is a big challenge nowadays. The use of PGPR has been proven to be environmentally sound way of increasing crop yields by facilitating plant growth through either a direct or indirect mechanism. The mechanism of PGPR includes regulating hormonal

and nutritional balance, solubilizing nutrients for easy uptake by plants comes under category of direct mechanism where's indirect mechanism includes resistance against plant pathogens mostly. In present study, rhizospheric soil of groundnut plants (*Arachis hypogea* L.) from an agriculture field near Amreli region, Gujarat, was collected for isolation of PGPR. A total of 15 different bacteria were isolated on 3 different culture media in order to analyse bacterial diversity present in the soil sample. These isolates were further screened in *In-vivo* for plant growth-promoting traits like catalase activity, Nitrogen fixation, Phosphate solubilization and Potassium solubilization in N-broth, Jensen's medium, Pikovskaya's agar and Aleksandrow agar respectively.

Keywords: PGPR, nitrogen fixation, solubilization, *Arachis hypogea* L.

HARNESSING THE HUMAN GUT MICROBIOTA: A NEW FRONTIER IN DISEASE MANAGEMENT AND THERAPEUTICS

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The human gut microbiota plays a pivotal role in maintaining health and has emerged as a key regulator in the prevention and management of numerous diseases. Comprising trillions of microorganisms, the gut microbiome influences host metabolism, immune modulation, nutrient absorption, and protection against pathogenic invasion. Alterations in gut microbial composition, known as dysbiosis, have been strongly associated with metabolic disorders, inflammatory bowel diseases, cardiovascular diseases, allergies, neurological conditions, and certain cancers. Recent advances highlight the therapeutic potential of modulating gut microbiota through probiotics, prebiotics, synbiotics, dietary interventions, fecal microbiota transplantation, and microbiome-targeted drugs. These approaches have shown promise in restoring microbial balance, enhancing immune responses, reducing inflammation, and improving treatment outcomes. Personalized microbiome-based strategies are gaining attention as innovative tools in precision medicine. This review emphasizes the critical roles of the human gut microbiota in disease management and underscores its potential as a novel target for preventive and therapeutic interventions, offering new perspectives for improving human health.

MICROPLASTIC: PREVALENCE, ABUNDANCE AND BACTERIAL INTERACTION AT COASTAL REGION OF SAURASHTRA

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Microplastics represent one of the most pervasive and challenging environmental threats of the 21st century. Plastic was originally engineered for its durability and versatility; these same traits have led to a global accumulation which led to microscopic debris that now infiltrates every level of the ecosystem. Microplastic contamination has become a growing environmental issue due to its interaction with microbial communities. This study aims to evaluate the presence, abundance, and microbial association of microplastics from the coastal region of Saurashtra. Here, microplastic was extracted using density separation and chemical digestion methods, followed by microscopic quantification and characterization based on morphology. The microbial load associated with isolated microplastics have been assessed using the Standard Plate Count (SPC) technique and the Most Probable Number (MPN) method. The correlation between number of microplastic and microbial load is under exploration. Further, investigation will be conducted to study the type of microplastic and their abundance.

Keywords: Microplastic contamination, SPC, MPN, Coastal region of Saurashtra.

BIOPROCESSING OF AGRO-WASTES FOR HALOALKALINE AMYLASE PRODUCTION USING ACTINOBACTERIA FROM MANGROVE ECOSYSTEMS

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Actinobacteria are metabolically versatile microorganisms known for their ability to produce industrially important enzymes, including amylases. In the present study, two haloalkaline actinobacterial isolates were recovered from the mangrove rhizosphere of Guneri, Kutch, Gujarat, India, and evaluated for extracellular amylase production. Both isolates exhibited sustained growth and enzyme activity under alkaline conditions (pH 9) and varying salinity levels (0 to 12%), indicating strong adaptation to extreme environmental conditions. To address the environmental challenges associated with agro-industrial waste disposal, the potential of low-cost substrates like banana peel, pomegranate peel, pineapple peel, potato peel, groundnut shells, corn cob, sugarcane bagasse, wheat bran, and wheat straw was investigated for amylase production under solid-state fermentation (SSF). SSF was selected due to its lower energy requirement, reduced wastewater generation and operational simplicity compared to submerged fermentation. The isolates produced substantial amylase activity, ranging from approximately 600 to 1400 U/mL/min, depending on the substrate used. The findings highlight the potential of haloalkaline actinobacteria from mangrove ecosystems as efficient producers of amylase using agro-industrial residues, offering a sustainable and economically viable approach for industrial enzyme production.

Keywords: Rhizospheric actinobacteria, Haloalkaline tolerance, Solid state fermentation, Agro-industrial residues.

BIOGENIC SYNTHESIS OF METAL NANOPARTICLES USING PLANT EXTRACTS: A COMPREHENSIVE REVIEW OF ANTIMICROBIAL APPLICATIONS

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The rapid evolution of multidrug-resistant (MDR) pathogens has necessitated the development of novel antimicrobial agents. Biogenic synthesis using plant extracts has emerged as a sustainable and eco-friendly alternative to traditional chemical methods, utilizing natural phytochemicals as potent reducing and stabilizing agents. This review provides a comprehensive overview of the synthesis of both monometallic and bimetallic nanoparticles. Bimetallic systems are particularly highlighted for their enhanced stability and biological performance, which often surpass those of their single-metal counterparts.

A significant highlight of this study is the synergistic effect observed when biogenic nanoparticles are used in combination with conventional antibiotics. Evidence from recent research indicates that these nano-antibiotic conjugates can significantly lower the Minimum Inhibitory Concentration (MIC) required to neutralize resistant strains, effectively resensitizing bacteria to drugs they had previously evolved to resist. By eliminating the need for hazardous chemicals and high-energy processes, plant-mediated synthesis offers a commercially viable and ecologically responsible framework for the next generation of nanomedicine. Overall, this research shows that using plants to make nanoparticles provides a safe, simple, and effective way to help solve healthcare problems and fight against drug-resistant infections.

Keywords: Green Synthesis, Plant Extracts, Monometallic Nanoparticles, Bimetallic Nanoparticles, Antibiotic Synergy, Antimicrobial Activity.

EXPLORING MANGROVE RHIZOSPHERIC MICROBIAL DIVERSITY FOR ENZYMATIC ACTIVITY, PLANT GROWTH PROMOTION, AND ENHANCEMENT OF CROP PERFORMANCE UNDER SALINITY AND DROUGHT STRESS

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Mangrove ecosystems harbor unique rhizospheric microbial communities adapted to extreme environmental stresses, making them a valuable source of stress-tolerant and agriculturally beneficial microorganisms. In the present study, soil samples were collected from the rhizosphere of mangroves and subjected to four different soil pre-treatment methods like moist heat, dry heat, calcium carbonate and microwave irradiation to enhance the isolation of diverse microbial populations. The rhizospheric soil was also analyzed using 16S rRNA gene-based metagenomic sequencing to profile the microbial community structure and assess taxonomic diversity associated with this stress-prone habitat. Further, actinobacterial isolates obtained were screened for the production of industrially and agriculturally relevant enzymes like amylase, protease, cellulase, chitinase and for plant growth-promoting (PGP) traits such as nutrient solubilization, indole and ammonia production. Among the isolates, three potent strains were assessed for their in vitro tolerance to abiotic stresses, specifically high salinity (0-12%) using NaCl and drought conditions (0-30%) using PEG, reflecting the increasing impact of climate-induced stress on agricultural productivity. Furthermore, the selected strains were evaluated through seed germination and early growth assays of *Sorghum bicolor* under induced salt and drought stress conditions. The results demonstrated that the isolates significantly improved seed germination and seedling vigor under stress, highlighting their potential as stress-resilient bioinoculants.

Keywords: Rhizospheric microbiome, 16S rRNA metagenomics, Abiotic stress tolerance, Plant growth-promoting actinobacteria, Bioinoculants

BIOPROSPECTING ACTINOBACTERIA FOR INDUSTRIAL PROTEASE PRODUCTION: MICROBIOLOGICAL SCREENING, OPTIMIZATION, AND FUNCTIONAL EVALUATION

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Proteases are among the most commercially important enzymes due to their extensive applications in detergent, pharmaceutical, food, and biomedical industries. Actinobacteria represent a major microbial resource for extracellular enzyme production owing to their metabolic versatility and environmental adaptability. In the present study, an actinobacterial isolate KhEc-14, was screened for protease production using gelatin agar medium and selected for detailed microbiological and biochemical investigation. Culture conditions and nutritional parameters were systematically optimized to enhance protease yield. Enzyme production was carried out under optimized conditions, followed by purification through sequential precipitation and chromatographic techniques. The purified protease was characterized with respect to molecular weight, optimum pH, temperature, and stability profile. The enzyme exhibited maximum activity under alkaline pH and moderately elevated temperature, along with substantial stability across a broad range of operational conditions. Functional evaluation through blood stain removal from cotton fabric demonstrated efficient proteolytic activity without adverse effects on fabric integrity. These microbiological and biochemical attributes indicate the enzyme's strong potential for detergent and industrial applications. The study highlights actinobacterial isolate KhEc-14 as a promising microbial source of industrially relevant proteases and contributes valuable insights into microbial enzyme bioprospecting. Future investigations will emphasize detailed structural analysis and the development of large-scale production strategies to support commercial utilization.

Keywords: Actinobacteria; Microbial protease; Enzyme bioprospecting; Media optimization; Enzyme characterization; Industrial biotechnology.

MONITORING COVID-19 TRENDS AND VARIANT EMERGENCE THROUGH WASTEWATER SURVEILLANCE IN GUJARAT, INDIA

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Wastewater-based epidemiology (WBE) has emerged as an effective approach for community-level monitoring of SARS-CoV-2, offering a complementary strategy to clinical testing. This study investigated the prevalence and genetic diversity of SARS-CoV-2 in sewage samples collected from three major cities of Gujarat Ahmedabad, Gandhinagar, and Vadodara between January 2023 to December 2023. Viral concentration measured using digital PCR revealed distinct peaks in viral load, which were consistently observed 15 to 20 days earlier than the reported active cases in the respective cities. High-load samples were subjected to whole genome sequencing using Illumina technology, and lineage analysis was performed with the Freyja pipeline. Results showed good concordance between wastewater and clinical data, with major circulating variants XBB.1.16 and its sub-lineages (XBB.1.16.4 and XBB.1.16.5) being dominant. In addition, several minor lineages and key mutations in spike, nucleocapsid, envelope, and ORF regions were detected. These findings highlight the utility of WBE for early outbreak warning, variant tracking, and hotspot identification. Overall, wastewater surveillance proves to be a cost-effective and reliable method for supplementing clinical surveillance, particularly valuable for anticipating community-level SARS-CoV-2 trends.

Keywords: Wastewater-based epidemiology, SARS-CoV-2, Gujarat, Digital PCR, Whole Genome Sequencing.

ISOLATION AND PRODUCTION OPTIMIZATION OF HALOPHILIC AMYLASE PRODUCING ORGANISMS FROM COSTAL REGION OF SOMNATH

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Halophilic enzyme in last few decades have gained the significant attention due to its increased commercial applications. In the presented study, coastal region of Somnath was explored in search of potent halophilic amylase producing bacteria. The water sample from the coastal region of Somnath was collected and used for isolating the halophilic amylase producing bacteria. The 10 isolates showed zone of hydrolysis on the starch agar plate. Amongst all isolates, I1 and I9 showed biggest zone of hydrolysis and so was selected for further studies. The isolates I1 and I9 was studied at different NaCl concentration, pH and incubation time to study the optimum conditions for halophilic amylase production. The results showed 0.5M salt, pH 7 and 48 hours of incubation as the optimum conditions for the halophilic amylase production for I1 and I9. The other amylase production optimization parameters such as effect of temperature, salts, carbon and nitrogen sources are under study. The studied isolate can be the potential producer of halophilic amylase and may gain significant commercial attention.

Key words: Halophiles, Amylase, Somnath

ZOOLOGY

EFFICACY OF CLOVE AND CINNAMON ESSENTIAL OILS AS NATURAL PRESERVATIVES IN REFRIGERATED STORAGE OF BROWN SHRIMP

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The present study evaluates the effect of clove and cinnamon essential oils on the preservation and quality of peeled shrimp (*Metapenaeus affinis*) during refrigerated storage at -4°C. Shrimp samples were divided into three groups: control (untreated), 1% clove oil-treated, and 1% cinnamon oil-treated. Following treatment, the samples were packaged in polyethylene bags and analyzed over 15 days for physical, biochemical and sensory attributes. The results revealed that both essential oils effectively delayed lipid oxidation and moisture loss, with the clove oil-treated group showing superior preservation. Sensory evaluation showed higher acceptability for the clove oil-treated shrimp compared to the cinnamon oil-treated and control groups. The study concludes that clove oil has strong potential as a natural preservative, enhancing shelf life and maintaining the quality of shrimp during refrigerated storage.

Keywords: Clove oil, cinnamon oil, *Metapenaeus affinis*, refrigerated storage, shelf life, shrimp preservation

ORGANIC AQUACULTURE TOWARDS ENVIRONMENTAL SUSTAINABILITY

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Organic aquaculture originated from the organic agriculture movement. Organic aquaculture is an eco-friendly and sustainable method of producing fish and other aquatic organisms. The principle of organic aquaculture includes maintaining water quality, reducing pollution, and sustainably preserving biodiversity. It involves using natural feeds, minimal use of chemicals and promoting a healthy aquatic ecosystem. Production from organic aquaculture has grown rapidly over the last few years, although it remains at low volumes worldwide. Farmers can produce high-quality fish/shellfish by practising organic aquaculture with minimizing the environmental impact. Sustainable production through organic aquaculture can provide a reliable and safe source of protein for human consumption while reducing the industry's carbon footprint. However, the transformation from conventional aquaculture to organic aquaculture is a multidimensional, complex, and non-conventional process. Converting to organic aquaculture brings a wide range of environmental and human health advantages. Aquaculture under organic management intends to produce fish which are economically viable and sustainable. Organic aquaculture can be practised under different systems, including in tanks, ponds, net-pens, cages, raceways, and recirculating aquaculture systems (RAS). Hence, organic aquaculture can open new dimensions for future endeavours.

NEUROENDOCRINE REGULATION OF REPRODUCTIVE PERFORMANCE IN PENAEID SHRIMP THROUGH EYESTALK ABLATION

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Penaeid shrimp reproduction is regulated by neuroendocrine functions, particularly from the neuroendocrine center in the eyestalk. In shrimp hatchery, eyestalk ablation is commonly used to induce reproductive maturation by removing the source of GIH from the X-organ–sinus gland complex, which produces the gonad-inhibiting hormone. Without this control, broodstock shrimp experience greater ovarian development, increased vitellogenesis, and higher spawning rates and overall fecundity. This practice has resulted in a greater efficiency in hatcheries and seed production in penaeid farming. The practice can result in shorter lifespans, stressed physiology, compromised quality of offspring, and decreased welfare of the shrimp, raising questions about the sustainability of the practice. This abstract outlines the neuroendocrine functions involved in the reproduction of penaeid shrimp and the reproductive enhancing effects of eyestalk ablation, while synthesizing the call for other environmental and endocrine methods to provide reproductive control in a sustainable manner in shrimp farming.

Keywords: Neuroendocrine regulation, Penaeid shrimp, Eyestalk ablation, Gonadal maturation, Reproductive performance

VERMICOMPOST TEA EFFECT ON SPINACH IN AQUAPONICS

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Vermicompost prepared using epigeic earthworms, as well as to analyze the physico-chemical properties of the vermi tea using flame atomic absorption spectroscopy (FAAS). Vermi tea was produced by percolating non-chlorinated distilled water through vermicompost and applied at three concentrations (400, 680, and 880 g L⁻¹). Nutrient analysis revealed significant levels of nitrogen, phosphorus, potassium, and organic carbon across all treatments. Growth parameters such as plant height, number of leaves, and leaf area showed a significant positive response with increasing vermi tea concentration. The highest concentration (880 g L⁻¹) resulted in maximum growth performance. The findings demonstrate that vermi tea is an effective organic liquid fertilizer for enhancing spinach growth and can be recommended for sustainable cultivation of spinach and other vegetable crops.

FIRST REPORT OF LORDO-KYPHO-LORDOSIS SYNDROME IN THE NEEDLESCALED QUEENFISH *SCOMBEROIDES TOL* (CUVIER, 1832) FROM INDIAN WATERS

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Morphological deformities in wild marine fishes are insufficiently documented, despite their potential impacts on individual performance, population fitness, and fisheries economics. The Needlescaled queenfish, *Scomberoides tol* (Cuvier, 1832), is an ecologically valuable pelagic carnivore widely distributed along the Indian coast. However, no previous reports exist regarding skeletal abnormalities in this species. This study documents the first confirmed case of lordo-kypho-lordosis (L-K-L) syndrome in *S. tol*, collected from trawl bycatch at Veraval Fishing Harbour, Gujarat, during 2024–2025. Comprehensive morphological and radiographic examinations revealed a compound spinal deformity restricted to the caudal peduncle, characterised by a ventral lordotic curvature (vertebrae 1–15) followed by a dorsal kyphotic curvature (vertebrae 15–20), again followed by a ventral lordotic curvature (vertebrae 20–26). These deviations resulted in a pronounced shortening of the vertebral

axis, increased body depth, and a reduction in the length of the dorsal and anal fin bases compared with a healthy individual, indicating a substantial alteration in structural biomechanics. Such abnormalities likely impair swimming efficiency, manoeuvrability, feeding capability, and predator avoidance, ultimately reducing survival and commercial value. Potential etiological factors include exposure to environmental pollutants, abrupt temperature fluctuations, nutritional imbalance, and genetic predisposition. Although deformities did not appear lethal in this adult specimen, the associated physiological and ecological costs may influence population resilience. The scarcity of reports on skeletal deformities in wild marine fishes suggests that such cases may go undetected. Therefore, continued monitoring and advanced diagnostic approaches are crucial for evaluating their prevalence, identifying causative mechanisms, and assessing the implications for fisheries sustainability and marine ecosystem health.

Keywords: Fisheries Management, Pelagic Fish, Radiographic Analysis, Spinal Deformity, Vertebral Anomaly

SPECIES-SPECIFIC FRAMEWORK FOR PREDICTING JELLYFISH BLOOMS USING A CITIZEN SCIENCE AND REMOTE SENSING APPROACH IN THE NORTH-EASTERN ARABIAN SEA

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Jellyfish blooms are increasingly reported worldwide and acknowledged as critical factors that affect ecosystems and ecosystem services. Despite growing concerns, the environmental drivers governing jellyfish blooms remain poorly understood, largely due to limited long-term monitoring and a lack of species-specific ecological studies. Different jellyfish species exhibit distinct physiological tolerances, resulting in species-specific responses to the environmental drivers. Based on this background, an integrated study combining citizen science jellyfish observation, satellite remote sensing and non-linear Generalized Additive Modelling (GAM) was carried out to understand the key environmental drivers, more specifically species-specific drivers of the jellyfish. Jellyfish catches in the trawls operated along the North eastern Arabian Sea was recorded through a participatory citizen science monitoring programme between January 2023 and December 2025, yielding a total of 103 Jellyfish observations. Three scyphozoan jellyfishes, *Rhopilema hispidum*, *Netrostoma coerulescens* and *Chrysaora caliparea*, dominated the trawl catch. Citizen science records collected were analysed using Generalized Additive Models (GAMs) together with the remotely sensed environmental factors of sea surface temperature, sea surface salinity, sea surface height, nutrients, dissolved oxygen, and surface current. Species-specific GAM model revealed marked jellyfish species adaptability for different environmental variables. *Rhopilema hispidum* showed ~58% of the variance with a nonlinear relationship with low SST, salinity, nutrients and SSH. *Netrostoma coerulescens* has ~49% variability, which favoured significant influence of SST, salinity, and SSH, which indicates that the physical hydrographic environment is a primary filter defining the physiological niche and spatial distribution. However, *Chrysaora caliparea* showed ~34.4% variability but negative statistically significant relationships with nitrate, sea surface temperature and salinity. Overall, this interdisciplinary study, combining citizen science, satellite remote sensing, and species-specific GAM modelling, revealed that jellyfish blooms are governed by species-specific interactions between biogeochemical forces and physical variables rather than uniform environmental drivers. Thus, this approach can be instrumental and provide a viable policy-relevant framework for understanding and managing jellyfish blooms globally. Moreover, understanding the species-level complexities of jellyfish swarms can be useful for future bloom prediction, forecasting, and public and fishers' awareness.

Keywords: Jellyfish, Environmental management, GAM model, Citizen science,

POPULATION STRUCTURE AND ABUNDANCE OF BLUE BULL (*BOSELAPHUS TRAGOCAMELUS*) IN BHANDARIYA VIDI, KAGVAD, GUJARAT

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The blue bull (*Boselaphus tragocamelus*), the largest Asian antelope, frequently attains high local abundance in semi-arid grasslands and agro-ecosystems, often leading to human–wildlife conflict. The present study assessed the population density, age–sex structure, and group composition of Blue Bull in Bhandariya Vidi, Kagvad, Gujarat, a traditional grassland ecosystem covering 167 ha (1.67 km²). Population assessment was conducted using line transect surveys with direct sightings, recording group size, age–sex composition, and perpendicular distance from transects.

A total of 51 individuals were recorded, resulting in a high population density of 30.54 individuals/km². The population exhibited a female-biased structure, with adult females constituting 54.9%, followed by adult males (23.5%) and juveniles (21.6%), yielding an adult male to adult female sex ratio of 1:2.33. Group size ranged from 1 to 9 individuals, with a mean group size of 5.1 ± 1.8 , and mixed herds were the dominant social unit. Larger groups were detected closer to transect lines, indicating higher detectability of aggregated herds.

The Vidi ecosystem offers blue bull populations extremely favorable and supportive habitat conditions, as evidenced by the high density, female-biased population structure, and significant juvenile recruitment. The ecological significance of vidi habitats as efficient havens for large herbivores is reflected in this limited population concentration. These habitats have a great potential to minimize human-animal conflict while promoting sustainable cohabitation between wildlife conservation and nearby agricultural landscapes with proper site-specific management and frequent population monitoring.

Keywords: *Boselaphus tragocamelus*, population density, age–sex structure, group size, vidi ecosystem

GROWTH RESPONSE OF THE MEDICINAL PLANT *CENTELLA ASIATICA* TO DIFFERENT INLAND SALINITY LEVELS

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The present investigation evaluated the growth performance and salinity tolerance of the economically and medicinally important aquatic plant *Centella asiatica* (L.) Urban (Jalbrahmi) under inland saline water (ISW) conditions. *C. asiatica*, a perennial herb belonging to the family *Apiaceae*, is widely used as a medicinal crop due to its diverse pharmacological properties, including wound healing, neuroprotective, antioxidant, antibacterial, antifungal, anti-inflammatory, and anticancer activities. It is traditionally known as “brain food” owing to its beneficial effects on cognitive functions and mental health. An experimental study was conducted to assess the effect of different salinity levels on plant growth using five treatments: Control (0 ppt), T1 (2 ppt ISW), T2 (4 ppt ISW), T3 (6 ppt ISW), and T4 (waste pond water, 3 ppt). Growth parameters such as shoot length, number of branches, and number of leaves were recorded at regular intervals. Significant differences were observed among treatments for all growth parameters. The highest shoot length gain (9.76 cm), branch gain (3.70), and leaf gain (66.40%) were recorded in the control treatment. Among saline treatments, T1 (2 ppt ISW) showed better growth performance with shoot length gain of 7.79 cm, branch gain of 3.25, and leaf gain of 60.85%, followed by T4 (waste pond water) and T2 (4 ppt

ISW). Growth parameters declined progressively with increasing salinity. At 6 ppt salinity (T3), negative growth values were observed, and complete mortality of plants occurred. The results indicate that, there is a good growth of *Centella asiatica* in 0 ppt, 2 ppt water, and waste pond water, suggesting its potential for cultivation in low-salinity inland saline water resources.

Keywords: *Centella asiatica*, Inland saline water, Salinity tolerance, Growth performance, Medicinal aquatic plants, Shoot length, Branch and leaf gain.

SEASONAL HYDROCHEMICAL PATTERNS AND THEIR FUNCTIONAL IMPACT ON THE LENTIC ECOLOGY OF VIJARKHI DAM, JAMNAGAR, GUJARAT (INDIA)

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This investigation explores the seasonal dynamics of key physicochemical water quality parameters in Vijarkhi Dam (22°24'N, 70°11'E), a prominent lentic freshwater reservoir located in Jamnagar, Gujarat. Seasonal evaluations were conducted for pH, electrical conductivity (EC), turbidity, dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), and total suspended solids (TSS) across winter, summer, and monsoon periods. Clear seasonal patterns were evident among all measured variables. DO concentrations reached their highest values during winter, largely due to lower ambient temperatures that enhance oxygen solubility and reduce biological oxygen consumption. In contrast, a notable decline in DO was observed during summer, driven by elevated temperatures and increased respiration rates. Turbidity and TSS increased considerably during the monsoon season, reflecting substantial runoff, sediment influx, and elevated particulate matter within the water column. EC exhibited a pronounced rise in summer, attributed to evaporative concentration of dissolved ions and minimal hydrological dilution. Seasonal shifts in BOD and COD, though moderate, signalled changes in organic loading and microbial degradation processes, largely influenced by temperature and hydrological conditions. Collectively, these trends underscore the sensitivity of the Vijarkhi Dam ecosystem to seasonal environmental fluctuations and emphasize the importance of continuous water quality surveillance. The findings provide essential baseline information on the temporal behaviour of physicochemical properties in Vijarkhi Dam and contribute to developing season-specific management strategies aimed at preserving ecological integrity and long-term water resource sustainability.

Keywords: Vijarkhi Dam, Physicochemical Properties, Seasonal Dynamics, Water Quality Assessment, Lentic Environment

EVALUATION OF SEASONAL PHYSICOCHEMICAL FLUCTUATIONS AND THEIR ENVIRONMENTAL IMPLICATIONS FOR KABIR LAKE, JAMNAGAR, GUJARAT (INDIA)

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This investigation examines the seasonal fluctuations in key physicochemical parameters of Kabir Lake (22°28'N, 70°03'E), a significant lentic freshwater body located in Jamnagar, Gujarat. The study quantifies variations in pH, electrical conductivity (EC), turbidity, dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), and total suspended solids (TSS) across winter, summer, and monsoon seasons. Results indicate distinct seasonal signatures across all parameters. DO concentrations reached their highest values during winter due to increased solubility

of oxygen at lower temperatures, whereas summer exhibited marked reductions associated with thermal stratification and higher metabolic consumption. Turbidity and TSS showed substantial elevations during the monsoon, attributed to watershed runoff and sediment influx. EC values increased prominently in summer as a consequence of evaporative concentration and reduced freshwater inflows. Moderate shifts in BOD and COD across seasons reflected variability in organic load and microbial activity, influenced mainly by hydrological patterns and temperature regimes. Collectively, these patterns highlight the dynamic sensitivity of Kabir Lake's lentic ecosystem to seasonal hydro-meteorological drivers. The study provides essential baseline data for ecological assessment and supports the development of season-specific strategies for water resource management. Improved understanding of these physicochemical dynamics is vital for maintaining the ecological integrity and long-term sustainability of Kabir Lake.

Keywords: Kabir Lake, Water Quality, Seasonal Dynamics, Physicochemical Parameters, Lentic Ecosystem

FEED MANAGEMENT IN SHRIMP AQUACULTURE

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Feed management is very important in shrimp aquaculture. It helps shrimp grow faster, stay healthy, and survive better. Feed cost is about 50–60% of the total farming cost, so proper feeding is necessary to reduce expenses and increase profit. Good feed management means giving the right feed, in the right quantity, at the right time, with minimum waste. This topic explains different types of shrimp feed, protein requirements, feeding methods, feeding frequency, and feed calculation. It also focuses on scientific methods like the check tray system and Feed Conversion Ratio (FCR). Proper feed management improves water quality, reduces disease risk, and increases production. The aim of this presentation is to help farmers understand simple and practical feeding techniques for successful and profitable shrimp farming.

Keywords: Shrimp Farming, Feed Management, Shrimp Feed, Feeding Method, FCR, Water Quality, Shrimp Growth

THE EFFECT OF GUT MICROBIOTA AND PROBIOTICS ON SHRIMP

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Shrimp aquaculture is one of the fastest-growing sectors of global food production; however, its sustainability is threatened by frequent disease outbreaks, poor feed utilization, and environmental degradation. In recent years, increasing attention has been given to the role of gut microbiota in maintaining shrimp health and productivity. The shrimp gut microbiota comprises a complex community of beneficial and opportunistic microorganisms, including *Bacillus*, *Lactobacillus*, *Vibrio*, and *Pseudomonas* species, which significantly influence digestion, metabolism, immune responses, and disease resistance. A balanced gut microbial ecosystem enhances nutrient absorption and supports normal physiological functions, whereas microbial imbalance can increase susceptibility to pathogens and stress. Probiotics, defined as live beneficial microorganisms administered through feed or rearing water, have emerged as an effective and eco-friendly alternative to in shrimp farming. Common

probiotic strains such as *Bacillus subtilis*, *Lactobacillus* spp., *Saccharomyces cerevisiae*, and *Pseudomonas* spp. improve gut microbial composition by competitively excluding pathogenic bacteria, particularly *Vibrio* spp. Probiotics also enhance digestive enzyme activity, leading to improved feed conversion efficiency and growth performance. Additionally, they stimulate the shrimp immune system by increasing hemocyte count, phenoloxidase activity, and expression of immune-related genes, thereby enhancing resistance to infectious diseases. Beyond host-level benefits, probiotics contribute to improved pond water quality by degrading organic waste and reducing toxic metabolites such as ammonia and nitrite. This effect shrimp health and the culture environment promotes higher survival rates and better stress tolerance under intensive farming conditions. Numerous studies demonstrate probiotic supplementation leads to improved growth, immunity, and overall production efficiency.

Keywords: Gut microbiota, probiotics, shrimp health, immunity, growth

TUNA FISHERY IN INDIA: PRESENT STATUS, RESOURCE POTENTIAL AND MANAGEMENT IMPLICATIONS

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Tuna fisheries play a crucial role in India's marine capture fisheries due to their high economic, nutritional, and export significance. India exploits both coastal (neritic) and oceanic tuna resources across the Arabian Sea, Bay of Bengal, and island ecosystems of Lakshadweep and Andaman & Nicobar Islands. The present study reviews the current status of tuna fisheries in India, focusing on species composition, production trends, fishing methods, stock status, and management challenges. Indian tuna resources comprise five genera and nine commercially important species, with *Euthynnus affinis*, *Auxis* spp., *Thunnus albacares*, and *Katsuwonus pelamis* contributing significantly to total landings. Recent estimates indicate tuna landings of approximately 1.19 lakh tonnes, with a notable contribution from Lakshadweep through traditional pole-and-line fisheries. Export performance has shown a marked increase, reflecting growing global demand. However, issues such as overfishing, bycatch, data deficiencies, climate-driven stock shifts, and technological limitations pose serious sustainability concerns. Stock assessments indicate varying exploitation levels, emphasizing the need for precautionary management. Strengthening scientific monitoring, electronic surveillance, selective fishing gears, and compliance with Indian Ocean Tuna Commission (IOTC) measures is essential. Sustainable, value-based utilization rather than increased fishing effort is critical for ensuring the long-term resilience and economic viability of India's tuna fisheries.

Keyword: Tuna fisheries India, Marine capture fisheries, Pole-and-line fishery, Bycatch, IOTC management, Fisheries monitoring

EFFECT OF RED BELL PEPPER AND SHRIMP HEAD WASTE ON PIGMENTATION, GROWTH AND SURVIVAL IN KOI CARP (CYPRINUS CARPIO L.)

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The present study evaluated and contrasted the effects on koi carp (*Cyprinus carpio* L.) growth performance, feed utilisation, survival and colour pigmentation of a plant-derived pigment source, red pepper (*Capsicum annum*) and an animal-derived pigment source, shrimp head waste. At the Department of Aquaculture, College of Fisheries Science, Kamdhenu University, Veraval, a 60-day feeding experiment was carried out. In a fully randomised design, juvenile koi carp weighing 2.10 ± 0.013 g were randomly assigned to seven dietary treatments. In addition to a control diet, graded inclusion levels of both supplements (3%, 6% and 9%) were incorporated into isonitrogenous diets (30% crude protein). The findings showed that, in comparison to the control, both pigment sources considerably ($p < 0.05$) improved growth performance, feed conversion ratio, and colour pigmentation. While shrimp head waste showed a dose-dependent response, with 9% inclusion yielding superior growth and pigmentation, red bell peppers performed best at 3% inclusion. Across treatments, the survival rate remained high and non-significant ($p > 0.05$). Shrimp head waste worked better overall, but both sources can be used as affordable, natural substitutes for artificial pigments in koi carp culture.

**PRELIMINARY CHECKLIST OF SPIDER (ARANEAE) DIVERSITY
FROM THE CAMPUS OF D. K. V. ARTS AND SCIENCE COLLEGE,
JAMNAGAR, GUJARAT, INDIA**

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Among arthropods, spiders (Order: Araneae) are globally dominant predators that play a vital ecological role in regulating insect populations. Due to their high sensitivity to habitat alterations, they serve as excellent bioindicators of ecosystem health. Despite their ecological significance, the spider fauna of the Jamnagar region in Gujarat remains under-reported. The present study aims to document a preliminary checklist of spider fauna occurring within the campus of D. K. V. Arts and Science College, Jamnagar, Gujarat. Data were collected through direct visual observations and opportunistic sampling conducted over a five-month period from September 2025 to January 2026. A total of 135 spider observations were recorded during the study period, of which approximately 40% were identified up to the family level. The identified fauna represented seven distinct families: Pholcidae, Salticidae, Theridiidae, Thomisidae, Oxyopidae, Araneidae, and Sparassidae. Quantitative analysis revealed that Pholcidae (Cellar spiders) was the most dominant family, comprising 42.33% of the observations, followed by Salticidae (Jumping spiders) at 26.90%, and Araneidae (Orb-weavers) at 17.30%. Other families, including Theridiidae (5.8%), Oxyopidae (3.8%), Thomisidae (1.9%), and Sparassidae (1.9%), were present in lower frequencies. The presence of multiple spider families indicates considerable ecological heterogeneity within the campus environment. The diverse assemblage of these families reflects a healthy micro-habitat within the college campus. The significant proportion of unidentified specimens underscores the necessity for more intensive taxonomic studies using microscopic examination. This checklist serves as a fundamental baseline for future ecological and conservation-oriented research in the region.

Keywords: Spider diversity, Araneae Checklist, Jamnagar, Gujarat.

ARTIFICIAL REEFS: A TOOL TO RESTORE MARINE BIODIVERSITY

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Artificial reefs are increasingly recognized as effective tools for restoring degraded marine habitats, enhancing fishery resources, and supporting sustainable livelihoods of coastal communities. Defined as man-made structures deployed on the seabed to mimic the ecological functions of natural reefs, artificial reefs address critical challenges faced by global and Indian marine fisheries, including overexploitation, habitat degradation, climate change impacts, and declining fish stocks. This review synthesizes the concept, historical development, types, site selection criteria, construction materials, and ecological functioning of artificial reefs, with particular emphasis on Indian coastal waters. The process of biological colonization and ecological succession on artificial reefs—from initial microbial settlement to complex, mature reef communities—is discussed in detail. Case studies from Gujarat, the Gulf of Mannar, Tamil Nadu, Andhra Pradesh, and island ecosystems demonstrate significant improvements in fish biomass, coral recruitment, biodiversity enhancement, shoreline stabilization, and socio-economic benefits to fishing communities. The role of artificial reefs in fisheries enhancement, coral reef restoration, coastal protection, and ecosystem-based management is highlighted here. Indian initiatives led by institutions such as CMFRI, NIOT, and state governments illustrate the long-term ecological and economic potential of scientifically designed artificial reefs. When integrated with community participation and sustainable fisheries management, artificial reefs emerge as a vital strategy for marine conservation, climate resilience, and coastal resource sustainability.

Keywords: Artificial reefs; Fisheries enhancement; Marine habitat restoration; Ecological succession; Coastal ecosystem management

INTEGRATING ACTIVE STIMULATION AND ARTIFICIAL LIGHTS IN TRAWL NET TO REDUCE JUVENILE SHRIMPS AND BYCATCH FISHES FROM SHRIMP TRAWLS

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Unwanted bycatch and the retention of juvenile fishes remain major challenges in tropical shrimp trawl fisheries, where small mesh sizes and species-rich environments often result in high discard rates. Active mechanical devices such as shaking cod-end or fluttering panels can generate rhythmic motion that increases turbulence, enhances fish activity, and improves contact probability with mesh openings. Such motion has been shown to promote escapement of small fish by preventing cod-end mesh collapse and stimulating erratic swimming responses. Parallel studies on artificial illumination demonstrate that strategically placed LEDs can increase the visibility of escape routes, guide fish towards selective panels, or deter entry into specific trawl sections without compromising shrimp retention. Combining these approaches in shrimp trawls may create a multi-sensory stimulus field that both motivates fish to swim actively and directs them towards escape openings. This integrated system could be particularly valuable in tropical waters where diverse bycatch species exhibit varying light sensitivities and behavioural responses. This poster synthesizes current knowledge and proposes an integrated cod-end design that merges shaking mechanisms with targeted LED illumination to

enhance juvenile and bycatch reduction in shrimp trawls. The combined approach represents a promising step toward developing more selective, behaviour-based fishing gear suitable for sustainable shrimp trawl operations in the Indian Ocean and similar regions.

Keywords: Fisheries Management, bycatch, shaking cod-end, juvenile.

APPLICATION OF NANOTECHNOLOGY IN SEAFOOD PRESERVATION

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Nanotechnology has emerged as a transformative and interdisciplinary field with significant potential in food and seafood preservation. By manipulating materials at the nanoscale (1–100 nm), nanotechnology enables unique physicochemical, biological and antimicrobial properties that differ markedly from those of bulk materials. These nanoscale characteristics, including high surface area-to-volume ratio and quantum effects, enhance reactivity, stability and functional performance. In the seafood sector, nanotechnology offers innovative solutions to address rapid spoilage, microbial contamination and quality deterioration, which are major challenges due to the highly perishable nature of fish and fishery products. Applications such as nano-ice, nanochitosan coatings, nanoemulsions, nanoencapsulation, nanosensors and nanocomposite packaging systems have demonstrated significant improvements in shelf life, microbial safety, sensory quality and nutrient retention. Nano-enabled packaging materials enhance mechanical strength and barrier properties, while active and smart packaging systems provide real-time monitoring of freshness and spoilage through colorimetric indicators and nanosensors. Despite these advancements, concerns related to nanoparticle migration, toxicity and regulatory safety remain critical, necessitating thorough risk assessment and compliance with international standards. Overall, nanotechnology presents promising, sustainable and advanced approaches for improving seafood preservation, safety and quality and its continued development is expected to play a vital role in the future of the seafood processing and food packaging industries.

Keywords: Nanotechnology, Seafood preservation, Nanocomposite packaging, Shelf-life extension, Food safety

EFFECT OF DIETARY GARLIC (*Allium sativum*) POWDER ON GROWTH PERFORMANCE AND SURVIVAL RATE OF *Labeo catla*

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The present study evaluated the effects of dietary garlic (*Allium sativum*) powder on growth performance and survival rate in *Labeo catla*. A 60-day feeding trial was conducted using four experimental diets containing 0% (T0), 0.5% (T1), 1% (T2) and 1.5% (T3) garlic powder, each formulated with 30% protein. The results showed significant improvements ($p < 0.05$) in growth parameters in garlic-supplemented groups compared to the control group. The T2 group (1% garlic powder) demonstrated the highest performance across all measured parameters, recorded the highest mean weight (2.69 ± 0.081 g), mean weight gain (2.33 ± 0.067 g), Percentage weight gain ($648.08 \pm$

11.16%), SGR ($3.354 \pm 0.025\%$) and a better FCR (1.999 ± 0.023). The T2 group showed the highest survival rate ($96.67 \pm 3.33\%$) among all treatments. The study concluded that dietary supplementation of 1% garlic powder effectively enhances growth performance and survival rate in *L. catla*, indicating its potential as a natural feed additive in aquaculture.

Key words: Garlic powder, *Labeo catla*, growth, survival

REPRODUCTIVE BIOLOGY AND POPULATION DYNAMICS OF THE SPADENOSE SHARK, *SCOLIODON LATICAUDUS*, FROM THE VERAVAL COAST, GUJARAT: IMPLICATIONS FOR FISHERIES MANAGEMENT

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A total of 328 specimens (151 males, 177 females) were collected monthly from commercial landings from April, 2024 to March, 2025 at Veraval Fishing Harbour, Veraval coast, Gujarat, India to study the comprehensive analysis of the length-weight relationship (LWR) and reproductive biology of *S. laticaudus*. The spadenose shark, *Scoliodon laticaudus*, was a key component of elasmobranch landings in India, yet its region-specific biological data remained limited for sustainable management. The LWR revealed a negative allometric growth pattern for both sexes (pooled $b = 2.84$, $R^2 > 0.92$), consistent with findings from other Indian populations. The overall sex ratio (1:1.17 M: F) was not significantly different from 1:1, though significant monthly fluctuations were observed. Reproductive analysis indicated a seasonal cycle with peak gonadal activity (GSI) in November and March, suggesting an extended spawning period. The Hepatosomatic Index (HSI) showed a marked pre-spawning rise in females, indicating hepatic energy storage prior to reproduction, followed by a decline during peak GSI, demonstrating a clear energy trade-off. Uterine fecundity ranged from 6 to 9 embryos female⁻¹, with a progressive increase in embryo length indicating continuous gestation. The findings confirmed that *S. laticaudus* in Gujarat exhibited distinct regional growth and reproductive patterns. This baseline data was crucial for developing targeted conservation and fisheries management strategies for this prolific yet vulnerable shark species.

COMPARATIVE STUDY OF PROXIMATE ANALYSIS OF WATER HYACINTH (*EICHHORNIA CRASSIPES*) LEAVES FROM TWO DIFFERENT REGIONS IN JABALPUR (M.P.)

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This study investigates the proximate composition of water hyacinth (*Eichhornia crassipes*) leaves collected from two ecologically distinct aquatic habitats in Jabalpur, Madhya Pradesh: Karonda Nala (Site A), a lotic system with substantial anthropogenic nutrient input and Adhartal Pond (Site B), a lentic freshwater body with limited external nutrient influence. Triplicate samples were analyzed for

moisture, crude protein (CP), ether extract (EE), carbohydrate and total ash (TA) on a dry matter basis. Statistical analysis revealed a significant elevation ($P < 0.05$) of CP in Site A ($35.6 \pm 0.72\%$) compared to Site B ($32.4 \pm 0.64\%$), while differences in EE (5.7–5.9%), Carbohydrate (40.3–40.8%), Moisture (12.5–15.5%) and TA (5.4–5.9%) were not statistically significant ($P > 0.05$). The increased CP content at Site A is attributed to nitrogenous enrichment from sewage inflow enhancing protein biosynthesis. These findings support the potential use of nutrient-enriched water hyacinth leaves as a sustainable, high-protein feed ingredient in aquaculture and livestock nutrition.

Keywords: *Eichhornia crassipes*, Proximate Analysis

INFLUENCE OF SELECTED MICROALGAE ON GROWTH, FEED UTILIZATION AND HEALTH OF *LABEO ROHITA* (HAMILTON, 1822) FRY

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The present study investigated the influence of selected microalgae, *Chlorella* spp. and *Haematococcus* spp., as partial replacements for fish meal in the diet of *Labeo rohita* (Hamilton, 1822) fry. Five isonitrogenous experimental diets containing 30% crude protein were formulated with graded inclusion levels of *Chlorella* spp. and *Haematococcus* spp. at 0% (control), 5% (T0), 10% (T1), 15% (T2), and 20% (T3). The experiment was carried out for a period of 60 days. Fish were stocked at a density of 10 fry per aquarium across 20 aquaria and were fed twice daily at 10% of their body weight. Sampling was conducted at 15-day intervals to assess growth performance and adjust feeding rates accordingly. The results revealed that the diet containing 10% microalgal inclusion (T2) recorded the highest mean weight gain, specific growth rate (SGR), and protein efficiency ratio (PER), along with the lowest feed conversion ratio (FCR). Survival rate remained 100% across all dietary treatments. Proximate composition analysis revealed higher crude protein content in fish fed the T2 diet, while lipid content was highest in T3. Ash content was comparatively higher in T4, whereas moisture content was highest in the control diet (T0). The findings of the study demonstrate that partial replacement of fish meal with *Chlorella* spp. and *Haematococcus* spp., particularly at a 10% inclusion level, enhances growth performance, improves feed efficiency, and supports better nutritional quality in *L. rohita* fry.

Keywords: *Labeo rohita*; Microalgae; *Chlorella* spp.; *Haematococcus* spp.; Fish meal replacement; Growth performance

INTEGRATED MULTI-TROPHIC AQUACULTURE (IMTA): A SUSTAINABLE APPROACH FOR RESOURCE EFFICIENT AQUACULTURE

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Integrated Multi-Trophic Aquaculture (IMTA) is an ecosystem-based aquaculture strategy designed to enhance environmental sustainability and resource-use efficiency by co-culturing species from different trophic levels within a single production system. In IMTA systems, fed species such as finfish or shrimp generate organic and inorganic wastes through uneaten feed and metabolic excretions. These waste products are subsequently assimilated by extractive species, including filter feeders and deposit feeders (e.g., sea cucumbers) that utilize particulate organic matter, as well as

seaweeds that uptake dissolved inorganic nutrients such as nitrogen and phosphorus. This internal recycling of nutrients improves water quality, provides natural biofiltration, and significantly reduces nutrient loading and eutrophication relative to conventional monoculture systems. Moreover, IMTA enhances ecological stability, contributes to disease risk mitigation, and lowers dependence on chemical treatments and intensive water exchange. From an economic standpoint, the simultaneous production of multiple species diversifies income streams and improves overall system efficiency. Although IMTA adoption may be constrained by higher initial investment and increased management complexity, it represents a promising and scientifically robust approach for sustainable, economically viable, and climate-resilient aquaculture. Keyword: Integrated Multi-Trophic Aquaculture (IMTA), Ecosystem-based aquaculture, Nutrient recycling, Biofiltration, Sustainable aquaculture

MOLECULAR CONFIRMATION WITH REPRODUCTIVE OBSERVATION OF *STHENOTEUTHIS OUALANIENSIS* FROM THE NORTHWEST COAST OF INDIA

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The purpleback flying squid, *Sthenoteuthis oualaniensis* (Lesson, 1830), is an ecologically and commercially important oceanic cephalopod distributed widely across the Indo-Pacific. Despite its known presence in parts of the Indian Ocean and along the southwest coast of India, molecularly validated records from the northwest coast, including Gujarat waters, remain scarce. The present study provides an integrative account combining molecular confirmation and reproductive observation for this species in the region. Specimens were collected from commercial trawl landings along the Gujarat coast and initially identified based on standard morphological characters. Molecular validation was performed using DNA barcoding of the mitochondrial cytochrome c oxidase subunit I (COI) gene. A 684 bp COI sequence was generated and demonstrated >99.9% similarity with reference *S. oualaniensis* sequences (B2, E54, Q10, GS-1A) in the NCBI GenBank. Nucleotide composition analysis revealed A = 26.9%, C = 20.3%, G = 16.1%, and T = 36.7%. Maximum Likelihood phylogenetic reconstruction clustered the Gujarat specimen firmly within the *S. oualaniensis* clade, confirming its taxonomic identity. Specimens exhibited a marked accumulation of spermatophores in the buccal cavity, indicative of reproductive activity. Although full reproductive biology was not assessed, this observation provides valuable insight into the reproductive status of *S. oualaniensis* in northwest Indian waters. These results extend the known distribution of *S. oualaniensis* to Gujarat waters, demonstrate the utility of molecular tools in accurate species validation, and highlight the region's significance as a potential reproductive habitat. The study provides baseline data for future investigations on population genetics, reproductive ecology, and sustainable management of pelagic cephalopods in the Indian Ocean.

Keywords: Cephalopods; Squid; DNA barcoding; COI gene; Molecular identification; Buccal spermatophores; Northwest Indian Ocean; Range extension

MICROPLASTIC IN AQUATIC ECOSYSTEM: DISTRIBUTION, IMPACTS AND MITIGATION TOOLS

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Microplastics, defined as plastic particles smaller than 5 mm, have become a widespread contaminant in aquatic ecosystems worldwide. They originate from the degradation of larger plastic debris and from primary sources such as synthetic fibers, microbeads, and industrial pellets. Due to their persistence, small size, and buoyant nature, microplastics are widely distributed in marine, freshwater, and estuarine environments, accumulating in water columns, sediments, and aquatic organisms. These particles act as carriers for toxic chemicals, heavy metals, and pathogenic microorganisms, increasing ecological risks. Ingestion of microplastics by aquatic organisms can cause physical injury, oxidative stress, altered behavior, and reduced growth and reproductive performance, with potential implications for human health through trophic transfer. Effective mitigation tools include improved solid waste management, advanced wastewater treatment technologies, reduction of single-use plastics, development of biodegradable alternatives, and strengthened policy regulations. Integrated monitoring and public awareness are essential for controlling microplastic pollution and protecting aquatic ecosystem health.

Key words: Microplastic, Persistence, Mitigation, Ingestion, Biodegradable

TECHNOLOGY-ENABLED AQUACULTURE: A STEP TOWARDS BLUE ECONOMY

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The growing global population and increasing demand for fish protein are placing tremendous pressure on traditional aquaculture systems. Traditional fish farming practices often deal with problems like poor water quality control, disease outbreaks, over-reliance on labor, and inefficient resource use. In this sense, integrating Internet of Things (IoT) technology into fish farming has emerged as a practical means of enhancing production, sustainability, and profitability. In IoT-based fish farming, critical water quality parameters like temperature, dissolved oxygen, pH, turbidity, and ammonia levels are continuously monitored using smart sensors, wireless networks, and data analytics. Because these sensors continuously collect data and transmit it to cloud-based systems, farmers are able to make timely and informed management decisions. The blue economy framework aims to achieve economic growth while ensuring the long-term conservation of marine ecosystems and active social participation. It emphasizes the responsible and sustainable use of ocean resources by integrating sectors such as sustainable fisheries, aquaculture, marine biotechnology, ecotourism, and low-carbon maritime transport. Renewable energy sources, including offshore wind, tidal, wave, and ocean thermal energy conversion, play a vital role in reducing dependence on fossil fuels and minimizing carbon emissions.

Keywords: Sustainable fisheries, Artificial intelligence, blue economy, Aquaculture, Digital Monitoring

UNUSUAL LANDING OF TENUALOSA ILISHA (HAMILTON, 1822)
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Tenulosa ilisha (Hamilton, 1822) is a commercially important anadromous fish species, exhibiting peak spawning activity during the southwest monsoon season. Traditionally, fishing pressure on hilsa is expected to be minimal during this period due to breeding migrations and conservation regulations. However, the present observation highlights an unusual and significantly higher landing of hilsa about 1500-4500 tonnes about 1.4 – 5 million individuals at one site (Bharuch) and 140-1500 tonnes about 0.2 – 0.5 million individuals at second site (Dholai) during the single monsoon season for about 4 months June-September, 2025, which coincides with its peak breeding period. The catch composition was dominated by half of a million fully mature individuals, with a large proportion of females exhibiting ripe ovaries showing the fecundity about 0.8 million to 11 million egg per spawning indicating active spawning condition. Such unexpected landings may be attributed to alterations in riverine and coastal environmental conditions, changes in hydrological regimes, climate-driven shifts in migration patterns, or increased fishing effort and gear efficiency during monsoon months. This phenomenon raises serious concerns regarding the sustainability of hilsa stocks, as the removal of mature breeders during peak spawning can adversely affect recruitment and future population stability. The findings emphasize the need for strengthened monitoring of monsoon fisheries, strict enforcement of seasonal fishing bans, and adaptive management strategies to protect spawning stocks. Understanding the drivers behind this unusual landing pattern is significant for developing effective conservation and management measures for *T. ilisha* under changing environmental and anthropogenic pressures.

Keywords: *Tenulosa ilisha*, Unusual landing, Monsoon season, Peak breeding, Ripe ovary, Fisheries management

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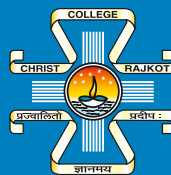
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