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ABSTRACT BOOK

Academic Research and Student Innovations in the Blue Economy

ACADEMIC RESEARCH ABSTRACTS

Microzooplankton Grazing and Carbon Biomass Dynamics in Indian Coastal Ecosystems: Insights into Trophic Transfer & Research Priorities

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ABSTRACT

The study of the trophodynamics of organic carbon in the planktonic food web is crucial for understanding the biogeochemical processes that regulate carbon cycling in coastal ecosystems, assessing ecosystem health, productivity, and resilience to anthropogenic and climate-induced changes. This review examines the studies on microzooplankton grazing through the dilution technique to gain a clear understanding of their critical role in sustaining higher standing stocks of carbon in the planktonic food web. Secondary data from 12 studies focusing on microzooplankton grazing and their ecology in the Indian coastal waters and estuarine ecosystems were analyzed. Notably, more studies have been conducted on the west coast compared to the east coast. However, these studies are mostly limited to estuarine ecosystems of the west coast of India (especially the Zuari estuary and Cochin backwaters). The highest grazing rate was observed in the Zuari estuary in the eastern Arabian Sea, ranging from 58 to 97%, highlighting the significance of microzooplankton as an important primary consumer. The review of the literature indicates that grazing rates in the coastal water of the west coast range from 26 to 80%, while the average rate on the east coast is higher at 83%. This study also elucidates the contribution of various size classes of plankton, such as picoplankton, nanoplankton, microzooplankton, and mesozooplankton, to the living carbon pool. Microzooplankton recorded the highest carbon biomass on the west coast (264.09 mg C m-3) while the east coast exhibited the lowest microzooplankton carbon biomass (0.48±0.18 mg C m-3). These findings suggest the higher consumption by micro- than mesozooplankton and the efficient transfer of energy to the next trophic levels through smaller plankton. This review highlights future research priorities on continuous monitoring of differing food-web structures and trophic transfer efficiency of planktonic food webs of the spatio-temporally understudied pockets of the Indian coast.

Keywords: Microzooplankton Grazing, Carbon Biomass

MARINE TRADE TECHNOLOGY AND SERVICES

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ABSTRACT

Marine trade has been a cornerstone of global economic development, facilitating the exchange of goods and services across continents for centuries. As the concept of the Blue Economy gains prominence, there is a growing need to integrate sustainable practices into marine trade technology and services. This study explores innovative advancements in marine trade technology and their implications for enhancing economic growth while minimizing environmental impacts. The primary objective of this research is to analyze cutting-edge technologies such as autonomous shipping, smart ports, and blockchain-enabled supply chain management. Additionally, it investigates the emerging field of marine bio-manufacturing, focusing on the utilization of marine organisms to create sustainable products and services. The methodology encompasses a comprehensive literature review, stakeholder interviews, and case studies of leading marine trade hubs. Quantitative data analysis tools are employed to assess the economic and environmental benefits of integrating these technologies into existing systems. Furthermore, the study examines policy frameworks and international cooperation essential for fostering sustainable marine trade. Preliminary outcomes indicate that the adoption of smart technologies in marine trade could significantly reduce carbon footprints, optimize logistics, and enhance global connectivity. Marine bio-manufacturing presents an untapped potential for creating biodegradable materials and sustainable bio-products, contributing to environmental conservation while fostering economic growth. In conclusion, the integration of advanced technologies and sustainable practices in marine trade and bio-manufacturing represents a pivotal step toward achieving the goals of the Blue Economy. This research highlights the transformative potential of these innovations, underscoring the importance of collaborative efforts among industries, governments, and academia.

Keywords: Marine trade, Marine bio-manufacturing, Biodegradable materials, Sustainable bio-products

The Blue Economy prospective of Odisha, India

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ABSTRACT

Spreading over 480 km coastline Odisha is the finest repository of marine and estuarine biodiversity. Six coastal districts such as Balasore (80 km), Bhadrak (50 km), Kendrapara (68 km), Jagatsinghpur (67 km), Puri (155 km) and Ganjam (60 km) are located in this maritime state. This state is possessing some unique ecosystems namely Chilika lagoon, Bhiterkanika, Gahirmatha, Balaramgadhi etc for different floral and faunal communities. Furthermore, Odisha is endowed with numerous estuaries, intertidal mudflats, creek, back waters, ports, lakes and lagoons etc. Phytal community is also highly promising that is comprised of mangrove vegetation, sea weeds, sea grass meadows, sand dune vegetation etc. Coupled with exploitable fisheries resources and ever increasing tourism sector Odisha becomes the nucleus of Blue Economy program of India. Shifitng from traditional agriculure practise to marine aquaculture the blue economy of Odisha broadly includes sustainable use of the marine resources for creating alternative livelihood, fostering job to impoverished sector as well as to promote inclusive economic growth for long term development by adopting climate resilience capabilities. The state's unique natural resources will bring up a new chapter in the blue economy aspect. There are couple emerging sectors that could contribute significantly to the blue economy such as fisheries & aquaculture, tourism, sea grass and sea weeds in terms of medicine and food from the sea etc. Resources obtaining from marine biotechnology and bio prospecting are meagerly explored areas along the Odisha coast which need immediate attention. Marine biodiversity augmentation could have been possible by implementing the artificial coral reef structures in the near shore region of some of the strategic locations. Indeed, Odisha coast provides vast potential in support of the blue economy, therefore more study is essential on conservation and management of marine biodiveristy.

Keywords: Carbon Biomass, Microzooplankton Grazing, Indian coast, Phytoplankton

COASTAL DISASTER MANAGEMENT

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ABSTRACT

The blue economy, which encompasses sustainable use of ocean resources for economic growth, improved livelihoods, and environmental health, is increasingly recognized as a critical paradigm in addressing coastal disaster management. Coastal regions, which are hubs of economic activity, biodiversity, and human settlement, are highly vulnerable to natural disasters such as cyclones, tsunamis, and rising sea levels due to climate change. This study explores the integration of blue economy principles into coastal disaster management to enhance resilience and sustainability. The primary objective of this research is to assess how sustainable practices in marine resource management, renewable energy, and ecosystem preservation can mitigate the impacts of coastal disasters. The methodology involves a multidisciplinary approach, combining geospatial analysis, economic modeling, and case studies from disaster-prone coastal regions worldwide. Stakeholder consultations and policy reviews were conducted to identify actionable strategies that align with both blue economy goals and disaster management frameworks. Results indicate that initiatives such as mangrove restoration, coral reef conservation, and development of offshore renewable energy systems significantly reduce the vulnerability of coastal communities. Enhanced ecosystem-based adaptation strategies, when integrated with early warning systems and climate-resilient infrastructure, not only minimize disaster risks but also promote socio-economic benefits like job creation and food security. In conclusion, the study demonstrates that adopting a blue economy approach provides a sustainable pathway for coastal disaster management. By prioritizing ecosystem health alongside economic growth, this paradigm fosters resilience and safeguards the livelihoods of coastal populations. Policymakers are urged to adopt these integrated strategies to build adaptive capacities in the face of increasing climatic and geological threats.

Keywords: Coastal regions disaster management, Sustainable practices, Socio-economic benefits

Phragmites Biomass Utilization: A Sustainable Strategy for Chilika Wetland Ecosystem Management and Conservation

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ABSTRACT

Chilika Lake, located on the eastern coast of Odisha, India, is renowned for its rich biodiversity. However, the super cyclone of 1999 led to rapid ecological degradation, primarily due to increased sedimentation and the widespread invasion of Phragmites karka. This invasive reed displaced native vegetation, disrupted nutrient cycling, and diminished biodiversity, causing significant deterioration of the wetlands and coastal areas. P. karka exhibits rapid growth and high biomass production, making it a renewable resource suitable for blue economy applications. Its lower lignin content compared to conventional wood pulp facilitates easier pulping and potentially reduces chemical usage during processing. Optimal cellulose extraction from P. karka involves alkali treatment, bleaching, and hydrolysis, with Fourier transform infrared spectroscopy confirming the removal of non-cellulosic components. Meanwhile, X-ray diffraction (XRD) analysis demonstrated that the crystallinity of cellulose increased following hydrolysis. The extracted fibers are directly used in the Kraft pulping process for papermaking. Additionally, P. karka biomass can be converted into polymer-based particleboards through mechanical size reduction, drying, adhesive application, pressing, and curing. These particleboards are suitable for applications in furniture, construction, and interior design. Despite its potential, challenges such as optimizing pulping processes, ensuring cost-effectiveness, and developing efficient conversion technologies remain. Utilizing P. karka for paper and particleboard production can aid in conserving Chilika lake by controlling the reed's spread and reducing reliance on tree-based resources. Furthermore, it contributes to carbon sequestration and climate change mitigation. In conclusion, P. karka holds promise as a sustainable feedstock, supporting a circular bioeconomy that integrates land and marine resources.

Keywords: Blue economy, marine bio-manufacturing, Chilika lake, Phragmites karka, sustainable resource

Harnessing UAV Technology for Sustainable Aquaculture in the Era of Blue Growth

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ABSTRACT

The sustainable growth of aquaculture constitutes a major role for the development of a blue economy to feed the global population without harmful effects on the environment. Unmanned Aerial Vehicles (UAVs) offer potential for improvement in efficiency of aquaculture through precision monitoring and optimization of resources in addition to sustainable methods. This review summarizes the latest developments in the use of UAV in aquaculture, with a focus on its use in feeding, water quality monitoring, biomass measurement, habitat survey, and disease detection. The critical analysis finds the existing gaps in application of UAVs in aquaculture, integration of data from UAVs with machine learning algorithms, and lack of standardization for widespread application. This paper analyses studies addressing these challenges, involving remote sensing, thermal imaging, and multispectral analysis to establish UAV's practicality. The findings revealed the numerous benefits of UAVs in terms of operational costs, decision-making, and sustainability. This review concludes by highlighting the future research potential, focusing on the requirement of interdisciplinary approaches and policy frameworks to maximize the harness of UAV technology for sustainable aquaculture in response to global blue growth initiatives.

Keywords: UAV Technology, Sustainable Aquaculture

Understanding Fisheries Dynamics: A Casy Study from East Coast of India

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ABSTRACT

The North-Western Bay of Bengal is a critical region for marine biodiversity and supports the livelihoods of coastal communities through capture fisheries. Understanding the long-term trends in fishery resources is essential to ensure sustainable management in the face of environmental changes and anthropogenic pressures. This study presents an analysis of decadal data on capture fishery landings at a selected coastal site (Paradeep) in the region, examining species composition, biomass fluctuations, and influencing factors such as climatic variability, overfishing, and habitat degradation. Coastal waters off Paradeep, a major capture fishery hotspot, is influenced by the Mahanadi estuary, major seaport, fishing harbour, and mangroves. Despite its ecological richness, the fishery potential and decadal trends influencing the regional biota remain largely unexplored. Critical information on species composition, feeding guilds, and the fishing crafts and gear employed in the area is still poorly reported. This study, conducted from 2019 to 2024, aimed to bridge these knowledge gaps by examining the structure of marine capture fisheries in relation to satellite and model-derived environmental parameters. Additionally, it sought to evaluate long-term trends influencing species distribution in this coastal system. Fish catch data from Paradeep were analyzed using a trophic guild approach to identify annual and seasonal trends. Seasonal variations were assessed with Bray-Curtis similarity indices and visualized using Non-Metric Multidimensional Scaling (NMDS). Results revealed minimal variability in annual trends, but seasonal patterns showed distinct differences in trophic guild abundance. Benthic omnivores were predominant, followed by benthopelagic mid-level carnivores and top predators across most seasons. The highest catches occurred in the post-monsoon of 2022 and the monsoon of 2023. These inter-seasonal variations highlight the impact of monsoon timing and intensity on functional guild abundance. Mechanized trawlers contributed significantly to total landings, while the motorized sector showed targeted operations, with limited representation of certain groups. Key environmental variables exhibited cyclic seasonal patterns. Chlorophyll-a, particulate organic carbon, and water column transparency positively correlated with catches, particularly for higher carnivores and top predators. Conversely, sea surface temperature negatively correlated with most groups. The dominance of benthic groups and top predators suggests a focus on higher trophic levels in fishing activities, despite an abundance of prey in the ecosystem. These findings underscore the necessity of implementing fisheries management strategies that alleviate pressure on higher trophic levels to ensure the long-term sustainability of fish resources in the region.

Keywords: Fisheries Management, Bay of Bengal, Mahanadi Estuary, Trophic Guild

The Blue Economy: A balancing act between Economic Growth and Marine Biodiversity Conservation

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ABSTRACT

The Blue Economy, a concept advocating for sustainable ocean resource utilization, presents a unique challenge: balancing economic growth with the preservation of marine biodiversity. This abstract explores the intricate relationship between these two facets, highlighting the critical role of marine biodiversity in sustaining a thriving Blue Economy.

Key Points:

- **The Interdependence of Economy and Biodiversity:** Marine biodiversity underpins numerous economic sectors, including fisheries, tourism, and renewable energy. A healthy ocean ecosystem is essential for long-term economic prosperity.
- **Threats to Marine Biodiversity:** Human activities such as overfishing, pollution, and climate change pose significant threats to marine biodiversity, jeopardizing the stability of the Blue Economy.
- **Conservation Strategies:** Effective conservation measures, including marine protected areas, sustainable fishing practices, and pollution reduction initiatives, are crucial for safeguarding marine biodiversity and ensuring the long-term viability of the Blue Economy.
- **Innovation and Technology:** Technological advancements and innovative approaches can play a vital role in promoting sustainable ocean resource management and mitigating the impacts of human activities on marine ecosystems.

The Blue Economy can only be successful if it prioritizes the conservation of marine biodiversity. By adopting sustainable practices and embracing innovative solutions, we can create a future where economic growth and environmental stewardship go hand in hand.

Keywords: Blue Economy, Marine biodiversity, Sustainable ocean resource utilization

Plastic degrading bacteria: A sustainable solution for mitigating marine pollution within the blue economy

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ABSTRACT

Plastic pollution is a significant environmental issue, especially in marine ecosystems, threatening wildlife, biodiversity, and coastal communities. An innovative solution within the blue economy is focused on sustainable ocean resource use which is the discovery of plastic degrading bacteria. These bacteria naturally possess enzymes capable of breaking down synthetic polymers like polyethylene and polystyrene into simpler, less harmful substances, offering a promising way to mitigate plastic waste in oceans. Recent research has highlighted the genetic and enzymatic mechanisms behind plastic degradation, with bacteria such as Ideonella sakaiensis and Pseudomonas species being able to break down plastics. These bacteria offer the potential to accelerate the biodegradation process, contributing to cleaner oceans and healthier ecosystems. However, challenges remain, including optimizing the degradation efficiency, addressing bacterial toxicity, and scaling the process for widespread application. Integrating plastic-degrading bacteria into blue economy strategies could enhance waste management and foster sustainable resource use in marine industries, such as fisheries and tourism. This bioremediation approach and traditional recycling methods hold promise for reducing ocean plastic pollution. By advancing research and developing scalable applications, we could create new opportunities for innovation, job creation, and sustainable economic development in coastal regions. Ultimately, combining biotechnology and the blue economy could help protect marine ecosystems and support the economies that depend on them, contributing to a cleaner, more sustainable planet. Further research is needed to optimize the use of plastic-degrading bacteria in real-world conditions.

Keywords: Blue economy, Ideonella sakaiensis, Pseudomonas, bioremediation, sustainable

Formulation of biopolymer-based aerogels for efficient removal of microplastics and oil spill from seawater

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ABSTRACT

Background: Cleanup technologies for petrochemical spill treatment include dispersants and in situ remediation additives. Commonly used biobased raw materials are surface-modified with polydopamine, fluorides, and epoxy resin to increase their oleophilic and floating properties, which have toxic effects on the overall marine microbiota in the long run.
Objective: The present study aims to design oleophilic aerogels made from biopolymers modified using a hydrophobic coating to increase petrochemical and microplastic absorption from water with a potential application in seawater cleanup.
Methodology: Composite hydrogel made from cellulose derivatives and other plant-based biopolymers was prepared by physical and chemical crosslinking methods. To achieve high porosity and floating properties these hydrogels were freeze-dried and transformed into aerogels. The stability of aerogel at different pH and salinity levels was tested. Microplastic binding was monitored using fluorescence microscopy and RAMAN spectroscopy. Oil sorption was tested after functionalization with organosilanes as per ASTM F726-12 guidelines.
Outcome: The resulting hydrogel showed excellent water holding capacity at pH and salinity range between 6-9 and 0-40 ppt respectively. The transformed aerogel could bind PET microplastic of particle size <300 µm. The OTS and TMES functionalized aerogels have the potential to absorb oil of various viscosity from a water-oil mixture. The overall finding of the study shows the potential of biopolymer-based composite materials for seawater treatment and control of marine pollution.

Keywords: Oleophilic aerogels, Biopolymers, Microplastic absorption, Seawater cleanup

Microplastic contamination in agricultural soil along NH66 highway in Goa-India

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ABSTRACT

Soil is a crucial natural resource for sustaining life on Earth, especially in countries like India where agriculture plays a vital role. Soil quality and fertility are important factors that can be managed to ensure sustainable agricultural practices. One emerging issue in soil contamination is the presence of Microplastics (MP), which are plastic particles smaller than 5mm. The current study aims to identify, classify, and quantify MP in agricultural soil. A methodology was established to achieve these objectives, starting with pre-field planning to select sampling locations in Goa based on potential contamination sources. The extraction of microplastics from soil samples followed modified NOAA methods to isolate and identify MP particles. Sample collection was carried out during the dry season, with 10 samples collected along Highway locations in Goa. Analysis of soil samples revealed the presence of microplastics in all samples, with fragments being the most common type. The highest observed MP abundance is 3640 particles/kg and the lowest is 240 particles/kg with an average of 768 particles/kg. The research aims to provide insights into the distribution and concentration of microplastics in agricultural soil contamination in Goa. By identifying areas requiring attention and implementing effective measures. Overall, the study on microplastic contamination in agricultural soil in Goa serves as a significant step towards addressing environmental concerns and ensuring sustainable agricultural practices in the region. Through thorough analysis and research, the findings are expected to provide valuable information for policymakers and stakeholders to take necessary actions towards conserving soil quality and protecting the environment.

Keywords: Microplastics, Soil, Highway, Raman

Isolation of culturable bacteria from the gut of Penaeus indicus and Metapenaeus monoceros from Chilika Lake, Odisha

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ABSTRACT

'Chilika', the largest brackish water lake in eastern India, harbors diverse flora and fauna in its estuarine environment. Many local farmers depend on this Lake for their livelihood. The cultivation of prawns in these regions occurs within pristine marine ecosystems. Thus, exploring the microbes from these wild prawn species may significantly contribute to the blue economy through their potential bioprospecting. The present study focuses on the isolation, culture and characterization of gut-associated microbes from two commonly found prawn species of Chilika Lake- Penaeus indicus (Indian white prawn) and Metapenaeus monoceros (Indian tiger prawn). Intestinal tissue collected from prawn samples were subjected to routine bacterial isolation procedures. The homogenized tissue suspensions were plated on nutrient agar, Zobell marine agar, and De Man–Rogosa–Sharpe agar media. After incubation, distinct bacterial colonies were observed and selected for sub-culturing to obtain pure cultures. Out of the 52 selected bacterial colonies, 16s rRNA gene sequencing confirmed the presence of 16 different genera and 27 different species. Further, Gram's staining and hemolytic test of these isolates indicated their differential characteristics. Phylogenetic analysis using 16s rRNA gene sequences for certain selected isolates showed very low similarity to other reported bacterial sequences of the same genus and species, indicating their potential unique features. Moreover, the data showed a difference in the type of culturable bacteria inhabiting the gut of these two prawn species. Literature search suggest the potential of these microbes for various commercial uses. Our ongoing study aimed to unravel the Whole Genome Sequence of these microbes, which will aid our efforts for potential bioprospecting of these bacteria in the future.

Keywords: Chilika Lake, Marine ecosystem, blue economy, Prawn, Penaeus indicus, Metapenaeus monoceros

A Model to Control Dengue Fever in Bhubaneswar, Odisha Using Gambusia affinis

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ABSTRACT

Dengue fever, caused by the Aedes aegypti and Aedes albopictus mosquitoes, is a significant public health concern in Bhubaneswar, Odisha. This model proposes the use of Gambusia affinis (mosquitofish) as an eco-friendly, biological control agent to combat mosquito populations. The model emphasizes an integrated approach combining scientific interventions, community engagement, and policy support.The first step involves identifying dengue-prone areas through a comprehensive survey and mapping of mosquito breeding sites, including stagnant water bodies, drains, and ditches. Following site suitability assessments, Gambusia affinis are introduced at optimal densities into these habitats. Community awareness campaigns educate residents on the benefits of this biological control method, fostering public participation. Regular monitoring ensures fish survival, reduction in mosquito larvae density, and the program's impact on dengue incidence. Stakeholders, including municipal authorities, NGOs, and local communities, are actively engaged to ensure the program's sustainability. Adaptive management strategies address challenges such as fish mortality or re-contamination of water bodies.The model integrates with Bhubaneswar's existing vector control programs, promoting scalability and long-term impact. This eco-friendly approach minimizes dependence on chemical insecticides, reducing environmental harm and associated costs.This model provides a sustainable, community-driven solution to dengue control, potentially transforming public health outcomes in Bhubaneswar and serving as a replicable framework for other regions.

Key Words: Dengue fever, Aedes aegypti, and Aedes albopictus control in Bhubaneswar, Odisha

Metagenomic analysis of epiphytic bacteria of Ulva sp., obtained from Chilika, Odisha

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ABSTRACT

The brackish marine ecosystem of Chilika lagoon, Odisha is reported to be rich in seaweed biodiversity, but the microbial diversity yet remains unexplored. The epiphytic bacteria of seaweeds have been found to be a great source of various bioactive compounds. This study explores the bacterial diversity associated with Ulva spp. obtained from Chilika. Metagenomic analysis was performed using the Illumina NovaSeq 6000 sequencing platform, producing 53.5 Mb of high-quality bases and 779 assembled contigs. Taxonomic analysis revealed that Proteobacteria and Firmicutes were the most dominant phyla in the seaweed sample. Among the genera, Vibrio, Pseudomonas, Lachnoclostridium, and Ruminococcus were predominant, with Vibrio fluvialis (phylum: Proteobacteria) identified as the most abundant species, followed by Escherichia coli and Ethanoligenens harbinense. The observed diversity index and Shannon–Wiener diversity index was measured at 211.0 and 4.560, respectively. Few epiphytic bacteria were cultivated on the growth medium. The isolates were characterized by Gram staining and antibiotic susceptibility and antimicrobial compound screening using agar well diffusion method. The isolates were found to have resistance against different antibiotics like Kanamycin, Vancomycin, Ampicillin, Chloramphenicol, Rifamycin and Streptomycin. Molecular characterization of isolate G-1B by 16S rRNA gene sequence analysis using BLAST showed 99.92 % sequence homology with Salinicoccus roseus SK42 16S rRNA partial sequence in the reference database. Salinicoccus roseus is reported to possess bioactive compounds with antimicrobial, antifungal and anticancer properties. Results indicate that diverse bacterial spp. are associated with the seaweeds and further studies needs to be conducted to understand their role and interactions in the marine ecosystem. Metagenomic studies on bacterial diversity has significant potential in understanding the microbial ecosystems. Understanding the bacterial diversity can facilitate comprehension of the status of critical resources in the Chilika ecosystem and their significance in health, economics, and environmental contexts.

Keywords: Seaweeds, Ulva spp., epiphytic bacteria, bioactive compounds, metagenomics, Salinicoccus roseus

Harnessing Ulva lactuca for Sustainable Antidiabetic Interventions: In Vitro and In Vivo Insights Using Drosophila melanogaster

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ABSTRACT

Background:
The rising prevalence of type 2 diabetes (T2DM) demands sustainable therapeutic solutions that address global health and economic priorities. Edible seaweeds like Ulva lactuca offer promise within the blue economy due to their bioactive compounds and health benefits. This study investigates the antidiabetic potential of Ulva lactuca through In Vitro and In Vivo analyses.
Objectives:
To perform phytochemical profiling in Ulva lactuca and assess its antidiabetic effects on glucose regulation using In Vitro assays and Drosophila melanogaster as a genetic model.
Methodology:
Ulva lactuca crude extracts were prepared using solvent extraction and analyzed for bioactive compounds by GCMS/LCMS and biochemical characterization. In Vitro assays included MTT, yeast and L6 cell glucose uptake, and α-amylase inhibition to assess antidiabetic potential. In Vivo studies in Drosophila melanogaster evaluated extract toxicity, glucose regulation, climbing ability, and survival under high-sugar diets.
Results:
Ulva lactuca ethanol extract (ULE) showed significant glucose uptake in yeast and L6 cells, with 250 µg/ml identified as the IC50 value for glucose uptake and set as the maximum test dosage. It exhibited α-amylase inhibition, indicating potential for carbohydrate metabolism modulation. In Vivo toxicity of ULE extract was checked in Drosophila melanogaster & ULE intervention improved glucose metabolism, muscular function, locomotion, and survival in high-sugar-fed Drosophila melanogaster.
Conclusion:
This study identifies Ulva lactuca as a sustainable, marine-derived antidiabetic resource that aligns with the principles of the blue economy. It emphasizes its potential to support human health while promoting environmental sustainability. These findings encourage further exploration of marine bioresources to address global health challenges and economic growth.

Keywords: Edible marine seaweed, Ulva lactuca, antidiabetic potential, glucose uptake, Drosophila melanogaster, Diabetic model system

Genomic Insights and Taguchi-Based Optimization of Culture Conditions for Enhanced Alkaline Protease Production by Streptomyces barkulensis RC1831

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ABSTRACT

This study presents the whole genome sequencing (WGS) analysis of Streptomyces barkulensis RC1831 to identify genes involved in alkaline protease (AP) production. Using bioinformatics tools such as RAST, KEGG, KAAS, and BLASTx, we identified 10 genes potentially responsible for AP synthesis. Multiple Sequence alignment revealed high homology with M24 family serine proteases and subtilisin-like serine proteases. Optimization of culture conditions for enhanced AP production identified the following optimal parameters: 37°C, pH 11, 1% (W/V) casein (Substrate), 0.5% (W/V) dextrose as carbon Source, 0.5% (W/V) urea as nitrogen source, 1% (W/V) tryptophan amino acid , 1 mM MnCl2, and 1% (V/V) Tween-80 in LB medium, with a 72-hour incubation period. Among the 10 identified genes, two encoding a Mn^{2+}-dependent metalloprotease and a Ca^{2+}-dependent subtilisin-like serine protease showed significant expression and activity during optimization. Additionally, structural and docking studies using SWISS-MODEL and AutoDock Vina indicated strong affinity for casein, suggesting potential industrial applications. The AP enzyme exhibited remarkable stability in the presence of various metal ions and surfactants, underscoring its potential for diverse industrial applications. These findings highlight Streptomyces barkulensis RC1831 as a promising source of alkaline protease for commercial use under varied conditions.

Keywords: Streptomyces RC1831, Alkaline protease, Industries, Whole genome, Optimization, Taguchi Method

Microplastic contamination in agricultural soil along NH66 highway in Goa-India

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ABSTRACT

Soil is a crucial natural resource for sustaining life on Earth, especially in countries like India where agriculture plays a vital role. Soil quality and fertility are important factors that can be managed to ensure sustainable agricultural practices. One emerging issue in soil contamination is the presence of Microplastics (MP), which are plastic particles smaller than 5mm. The current study aims to identify, classify, and quantify MP in agricultural soil. A methodology was established to achieve these objectives, starting with pre-field planning to select sampling locations in Goa based on potential contamination sources. The extraction of microplastics from soil samples followed modified NOAA methods to isolate and identify MP particles. Sample collection was carried out during the dry season, with 10 samples collected along Highway locations in Goa. Analysis of soil samples revealed the presence of microplastics in all samples, with fragments being the most common type. The highest observed MP abundance is 3640 particles/kg and the lowest is 240 particles/kg with an average of 768 particles/kg. The research aims to provide insights into the distribution and concentration of microplastics in agricultural soil contamination in Goa. By identifying areas requiring attention and implementing effective measures. Overall, the study on microplastic contamination in agricultural soil in Goa serves as a significant step towards addressing environmental concerns and ensuring sustainable agricultural practices in the region. Through thorough analysis and research, the findings are expected to provide valuable information for policymakers and stakeholders to take necessary actions towards conserving soil quality and protecting the environment.

Keywords: Microplastics, Soil, Highway, Raman

Oceanographic Value Chain Services vis-à-vis Indian Blue Economy

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ABSTRACT

The Indian National Centre for Ocean Information Services (INCOIS) plays a transformative role in advancing India's blue economy through its comprehensive suite of operational oceanographic services. By providing real-time forecasts, advisories, and early warnings, INCOIS empowers key sectors such as fisheries, maritime transport, offshore energy, and coastal management, driving economic growth while ensuring sustainable resource utilization and disaster-resilient coastal communities. This review highlights the major contributions of INCOIS in supporting India's blue economy. Services such as Ocean State Forecasts (OSF), Tsunami Early Warning (TEW), and Potential Fishing Zone (PFZ) advisories directly enhance productivity and safety. For instance, PFZ advisories, based on satellite data, optimize fishing operations and reduce fuel consumption and environmental impact. INCOIS' TEW ensures disaster preparedness, safeguarding millions of lives and assets along India's coastline. Advanced tools such as the Small Vessel Advisory Services and Oil Spill Trajectory Advisory Service enhance safety and environmental protection, addressing critical challenges in coastal and offshore operations. Looking ahead, INCOIS is expanding its capabilities to address emerging needs, such as site selection for renewable energy and mariculture, species-specific fishery advisories, deep-sea fisheries potential, climate-resilient coastal management, and long term sea-level rise projections. This effort is underpinned by robust R&D, using high-resolution numerical models and extensive ocean observation networks. Aligned with the UN Sustainable Development Goals (SDGs), INCOIS is focusing on clean energy, sustainable communities, responsible production, climate action, and life below water. These efforts also strongly support the UN Ocean Decade mission of advancing transformative ocean science for sustainable development and fostering connections between people and the ocean. This review underscores INCOIS's pivotal role as a knowledge and service hub, enabling sustainable and inclusive blue economy development in India. By integrating science, technology, and policy, INCOIS demonstrates the transformative potential of operational oceanography in addressing contemporary challenges and opportunities in the maritime domain.

Keywords: INCOIS, Blue Economy, Operational Oceanography, Fisheries, Sustainable Development

Marine Trade Technology And Services

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ABSTRACT

Marine trade has been a cornerstone of global economic development, facilitating the exchange of goods and services across continents for centuries. As the concept of the Blue Economy gains prominence, there is a growing need to integrate sustainable practices into marine trade technology and services. This study explores innovative advancements in marine trade technology and their implications for enhancing economic growth while minimizing environmental impacts. The primary objective of this research is to analyze cutting-edge technologies such as autonomous shipping, smart ports, and blockchain-enabled supply chain management. Additionally, it investigates the emerging field of marine bio-manufacturing, focusing on the utilization of marine organisms to create sustainable products and services. The methodology encompasses a comprehensive literature review, stakeholder interviews, and case studies of leading marine trade hubs. Quantitative data analysis tools are employed to assess the economic and environmental benefits of integrating these technologies into existing systems. Furthermore, the study examines policy frameworks and international cooperation essential for fostering sustainable marine trade. Preliminary outcomes indicate that the adoption of smart technologies in marine trade could significantly reduce carbon footprints, optimize logistics, and enhance global connectivity. Marine bio-manufacturing presents an untapped potential for creating biodegradable materials and sustainable bio-products, contributing to environmental conservation while fostering economic growth. In conclusion, the integration of advanced technologies and sustainable practices in marine trade and bio-manufacturing represents a pivotal step toward achieving the goals of the Blue Economy. This research highlights the transformative potential of these innovations, underscoring the importance of collaborative efforts among industries, governments, and academia.

Keywords: Marine trade technology, Global economic development, Sustainable practices

Unveiling the PHA Production Potential of Streptomyces Species: Screening, Optimization, and Molecular Characterization

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ABSTRACT

Polyhydroxyalkanoates (PHAs) are a group of biodegradable polymers synthesized by various microorganisms to serve as intracellular energy storage compounds. Due to rising environmental concerns associated with petroleum-based plastics, PHAs have attracted significant attention as a sustainable alternative. Bacteria such as Ralstonia eutropha and Pseudomonas species are well-studied and commercially utilized for PHA production. However, the genus Streptomyces, traditionally recognized for its extensive production of antibiotics and other secondary metabolites, has recently emerged as a promising but relatively underexplored candidate for PHA biosynthesis. In this study, 20 Streptomyces isolates were obtained from soil sediments collected from Chilika Lake in Odisha, India, and were qualitatively screened for polyhydroxybutyrate (PHB) production using a medium containing Sudan Black B stain. Among the 20 isolates, Streptomyces chitinivorans (RC1832), identified through 16S rRNA sequencing, was the highest PHB producer, outperforming other positive isolates. The optimized conditions such as temp(37℃), pH(7), carbon(Sucrose), and nitrogen source(wheat bran) significantly influence PHA yield as simple carbon sources are easily metabolized by Streptomyces, leading to higher PHA yields, and also nitrogen limitation triggers the redirection of carbon flux towards storage compounds like PHAs whereas complex substrates require specific enzymatic breakdown before utilization. Under optimized conditions, the RC1832 strain produced 2.408 g/L of PHA. The purity and molecular weight of the extracted PHAs were typically assessed using Fourier-transform infrared (FTIR) spectroscopy and the structural analysis is assessed by XRD and SEM techniques.

Keywords: Biodegradable polymers, Characterization, Microbial biosynthesis, Optimization, Polyhydroxyalkanoates (PHAs), Streptomyces.

Streptomyces mediated synthesis of silver chitosan nanocomposite for antibiofilm applications

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ABSTRACT

The green synthesis of chitosan-silver nanocomposites (CS-AgNC) represents a promising approach in nanobiotechnology, emphasizing eco-friendly production and multifunctional applications. This study details the green synthesis of silver nanoparticles (AgNp) using a sustainable method with Streptomyces griseoincarnatus RB7AG. These AgNp were subsequently integrated with chitosan to create a chitosan-silver nanocomposite (CS-AgNp), with its properties characterized by UV-visible spectroscopy and dynamic light scattering (DLS). UV-visible spectroscopy confirmed the successful synthesis of the nanocomposite, while DLS provided insights into its size distribution and stability. The antibiofilm potential of CS-AgNp was assessed against mixed bacterial biofilms of Staphylococcus aureus and Escherichia coli. Notably, at the highest concentration tested (300 µL/mL), CS-AgNp exhibited significant antibiofilm activity, markedly reducing biofilm metabolic activity. This was further validated by fluorescence imaging, which visually confirmed the diminished biofilm formation. These results highlight the potential of CS-AgNp as a potent antimicrobial agent against mixed bacterial biofilms, with important implications for treating biofilm associated infections. Additionally, the mechanistic insights into its antibiofilm action lay the foundation for future research on innovative antimicrobial strategies.

Keywords: Antimicrobial, Biofilm, E. coli, Green synthesis, Silver-chitosan nanocomposite

Blue-Col: Marine Microalgae Pigments for Functional Foods

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ABSTRACT

Blue-Col represents a breakthrough in sustainable nutrition by utilizing bioactive pigments extracted from marine microalgae. These pigments act as natural colorants while offering profound functional benefits.
Utilizing resource-efficient marine microalgae, requiring minimal land, water, and energy, Blue-Col aligns with the blue economy to drive sustainable growth and eco-friendly food innovations.By leveraging marine bioresources, Blue-Col uplifts the blue economy, transforming underutilized algae into high-value, market-ready solutions.

What Makes Blue-Col Unique?

Blue-Col represents a breakthrough in sustainable nutrition by utilizing bioactive pigments extracted from marine microalgae. These pigments act as natural colorants while offering profound functional benefits.
Blue-Col: Marine Microalgae Pigments for Functional Foods

• Extracted from marine microalgae, pigments like chlorophylls, carotenoids, and phycobiliproteins offer a sustainable, plant-based alternative to synthetic food dyes.

• Perfect for the clean-label movement, delivering beautiful, natural colors for a variety of food applications.

FunctionalHealth Benefits

Microalgal oligosaccharides enhance digestion, promote a balanced gut microbiota, and fortify the gut lining, while bioactive pigments, such as chlorophylls and carotenoids, combat oxidative stress and inflammation, reducing the risk of non-communicable diseases (NCDs).

Keywords: Blue-Col, Sustainable nutrition, Bioactive pigments

Sustaining the Blue Economy: Marine Fisheries Management in Odisha

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ABSTRACT

Odisha, with its 480 km coastline and vast Exclusive Economic Zone (EEZ), is home to a thriving fishing community that plays a crucial role in the state's economy, employment, and food security. Major fish species, including sardines, mackerel, sciaenids, and prawns, contribute significantly to the landings. However, the marine fisheries sector faces challenges such as overfishing, habitat degradation, climate change, and rising conflicts over resource use. The overall trend in marine fish landings from 2007-2023 indicates a decline in fishery health. Rapid Stock analysis methods, including RSA and CMSY++ and BSM, show that most major finfish stocks are in a healthy state, except for hilsa (Tenualosa ilisha) and False travelly (Lactarius lactarius), which are showing signs of decline and collapse respectively. To ensure sustainable fisheries, ICAR-CMFRI has developed Fisheries Management Plans (FMPs) integrating modern approaches such as stock assesment, marine resource mapping, effort zoning, and stakeholder involvement. These efforts aim to regulate fishing practices and support resource sustainability. Odisha has also pioneered marine conservation initiatives, including Marine Fisheries Regulation Acts (MFRAs) and the protection of critical habitats for species like olive ridley turtles. ICAR CMFRI has identified key habitats, such as the Gahirmatha Sanctuary and Devi River mouth, as critical areas for threatened species like whale sharks, sawfishes, giant freshwater whiprays, and marine guitarfish (Rhinobatos lionotus and Glaucostegus obtusus). This emphasis on protecting vulnerable species will inform and shape future fisheries management strategies. Furthermore, estimated minimum legal sizes for vulnerable elasmobranchs and finfish stocks would help in size regulation. Emerging technologies like artificial intelligence (AI), geospatial tools, and remote sensing would be beneficial in enhancing fisheries monitoring, while livelihood diversification and capacity building help reduce pressure on overexploited resources. Investing in research, innovation, and multi-stakeholder collaboration will be essential to address challenges and ensure a sustainable future for Odisha's marine fisheries.

Keywords: East coast, FMPs, Habitat conservation, Integrated approaches, Livelihood

Metagenomic analysis of epiphytic bacteria of Ulva sp., obtained from Chilika, Odisha

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ABSTRACT

The brackish marine ecosystem of Chilika lagoon, Odisha is reported to be rich in seaweed biodiversity, but the microbial diversity yet remains unexplored. The epiphytic bacteria of seaweeds have been found to be a great source of various bioactive compounds. This study explores the bacterial diversity associated with Ulva spp. obtained from Chilika. Metagenomic analysis was performed using the Illumina NovaSeq 6000 sequencing platform, producing 53.5 Mb of high-quality bases and 779 assembled contigs. Taxonomic analysis revealed that Proteobacteria and Firmicutes were the most dominant phyla in the seaweed sample. Among the genera, Vibrio, Pseudomonas, Lachnoclostridium, and Ruminococcus were predominant, with Vibrio fluvialis (phylum: Proteobacteria) identified as the most abundant species, followed by Escherichia coli and Ethanoligenens harbinense. The observed diversity index and Shannon–Wiener diversity index was measured at 211.0 and 4.560, respectively. Few epiphytic bacteria were cultivated on the growth medium. The isolates were characterized by Gram staining and antibiotic susceptibility and antimicrobial compound screening using agar well diffusion method. The isolates were found to have resistance against different antibiotics like Kanamycin, Vancomycin, Ampicillin, Chloramphenicol, Rifamycin and Streptomycin. Molecular characterization of isolate G-1B by 16S rRNA gene sequence analysis using BLAST showed 99.92 % sequence homology with Salinicoccus roseus SK42 16S rRNA partial sequence in the reference database. Salinicoccus roseus is reported to possess bioactive compounds with antimicrobial, antifungal and anticancer properties. Results indicate that diverse bacterial spp. are associated with the seaweeds and further studies needs to be conducted to understand their role and interactions in the marine ecosystem.
Metagenomic studies on bacterial diversity has significant potential in understanding the microbial ecosystems. Understanding the bacterial diversity can facilitate comprehension of the status of critical resources in the Chilika ecosystem and their significance in health, economics, and environmental contexts.

Keywords: Seaweeds, Ulva spp., epiphytic bacteria, bioactive compounds, metagenomics, Salinicoccus roseus

Purification and functional characterization of a novel alkaline protease from Streptomyces RC1831: Harnessing it's potential detergent compatibility and antibacterial activity

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ABSTRACT

A novel Alkaline Protease enzyme was isolated from Streptomyces barkulensis RC1831. Optimal enzyme production was seen in Luria Bertani (LB) medium supplemented with 0.5% (w/v) dextrose ,0.5% (w/v) casein, 0.1% (v/v) Tween 80, 1 mM MnCl2 and 1 gL-1 alkali-soluble casein. The enzyme was purified by ammonium sulphate precipitation followed by anion exchange chromatography using DEAE sephacel . To assess its molecular weight and activity,SDS-PAGE and zymography were conducted. The enzyme's kinetic parameters were measured,the Michaelis Menten constant (Km) was found to be 0.165 mg/mL and the maximum velocity (Vmax)was determined to be 973.2 mM/min.This indicates significant proteolytic activity and stability, highlighting its utility in industrial applications. The enzyme exhibited stability from pH 8-11, optimal activity at 11.0, and temperature stability between 25-45°C, optimal activity at 37°C. The AP from S. barkulensis RC1831 exhibited remarkable stability with cofactors and surfactants, showing potential for various industrial applications. Its compatibility with commercial detergents and antibacterial activity were also confirmed.

Keywords: Streptomyces RC1831, Alkaline protease, Industries, Purification

Assessing the Economic Impacts of Water Resource Degradation in Loktak Lake: Challenges and Sustainable Solutions

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ABSTRACT

Loktak Lake, a Wetland of International Importance under the Ramsar Convention, which is also under the Montreux record, represents the largest freshwater lake in Northeast India, and is distinguished by its floating mass of vegetation, known as Phumdis. The lake serves as a vital source of water for domestic purposes, hydroelectric power generation, and irrigation, and as a habitat for various plants used for food, and, supports biodiversity and recreational activities. The objective of this study was to evaluate the physicochemical parameters of water and calculate the Water Quality Index (WQI). Water samples were collected monthly from selected sites of Loktak Lake over one year, from February 2022 to January 2023. The parameters measured included salinity, temperature, pH, total dissolved solids (TDS), conductivity, and turbidity (NTU), which were recorded on-site using a Systronic Water Analyser 371 Sr. No. 106g. Dissolved Oxygen (DO) levels were estimated by following Winkler's method, as outlined by the American Public Health Association (APHA, 1998). The Water Quality Index (WQI) was employed to evaluate the quality of the wetland water. The WQI ranged from 51.76 at site L-3 to 62.79 at site L-2, indicating poor water quality. Loktak Lake is the lifeline of the people of Manipur, playing a significant role in their social, cultural, and economic lives. It is imperative to address pollution resulting from various anthropogenic activities and to enhance awareness regarding the importance of conserving the lake. Promoting the lake as an ecotourism destination could further intensify these activities, potentially leading to a decline in water quality and biodiversity.

Keywords: Blue Economy, Montreux Record, Livelihood, Loktak Lake, Sustainable Development, WQI

Conversion of waste PET Bottle into Terephthalic Acid Based Metal-Organic Framework for Removal of Nanoplastic from Water

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ABSTRACT

Micro- and nanoparticles of plastic wastes are considered emerging pollutants with significant environmental and health impacts at high concentrations or prolonged exposure time. Here we report the synthesis and characterization of a metal-organic framework (MOF) using terephthalic acid (TPA) recovered from plastic waste bottles. The fully characterized zinc-terephthalic acid MOF (Zn-TPA MOF) was used to extract and remove polyvinyl chloride (PVC) and polymethyl methacrylate (PMMA) nanoparticles from water with an efficiency of 97 % and 95 %, respectively. Kinetic and isotherms models for adsorption of all polymer nanoparticles (PNPs) on the MOF surface were investigated to understand the mechanism. Zn-TPA MOF before and after adsorption of PNPs were characterized using scanning electron microscopy (SEM), elemental analysis, thermal analysis, Brunauer-Emmett-Teller (BET), dynamic light scattering (DLS), fluorescence, UV-Vis, and FTIR spectroscopy. After extraction, the Zn-TPA MOF was successfully regenerated, reused for the adsorption and removal of polymer nanoparticles, showing consistent results for five consecutive extraction cycles. Such methods and materials are needed to deal with the emerging micro- and nanoplastic pollutants in the environment.

Keywords: Microplastics, nanoplastics, environmental pollution, metal-organic framework, water purification, emerging pollutants.

Preliminary Habitat Risk Assessment of endemic Lilium mackliniae (Sealy) in Shirui Kashong Hill, Manipur, India

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ABSTRACT

Shirui Lily, or Lilium mackliniae, is a rare species endemic to Manipur and Nagaland state. The study aims to assessed the habitat risk associated with Lilium mackliniae in one of its natural habitats, i.e., Shirui Kashong Hill of Ukhrul District, Manipur, India located at 25° 06' 52.1" N latitude and 94° 26' 52.2" E longitude during the year 2023. The study was conducted during the altitudinal ranges of 2000 to 2590 m asl with the altitudinal stratification into four study zones. During the study, a total of 20 herbaceous plants were observed to be closely associated with the L. mackliniae. During the population analysis in the stratified zones, the highest population of L. mackliniae was recorded from the uppermost study area i.e., zone I (2442.5 to 2590 m asl) and the lowest density in zone III (2147.5- 2295 m asl). The species were found to be closely associated with Sinarundinaria rolloana, Cyperus sp., Aconitum sp. and Paris polyphylla. The study suggest that the species prefer low temperature and high altitudinal range. There was risk of habitat destruction lead by natural causes such as erosion, invasion and competition and man-made destruction like intermittent forest fire, tourism, uprooting of plants, deforestation in the peripheries. Current status shows limited natural regeneration. Therefore, a thorough scientific study with the requirement of comprehensive life cycle research. Since, there was relatively low natural regeneration in the areas under study. The endemic lily may face unfavourable outcomes in the future if there were no satisfactory scientific steps taken up for the conservation. Furthermore, because of the area's delicate and fragile ecosystem, there is utmost necessity to conserve this lily and a few other important associate species. The study emphasizes the urgent need for scientific intervention to prevent potential adverse outcomes for this endemic species and its habitat.

Keywords: Endemic, Habitat, Lilium mackliniae, Regeneration

IoT Enabled Precision Solution for Mass Phyco Spirulina Protein Fortified Foods As A Circular Blue Economy Innovation

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ABSTRACT

Our project is dedicated to enhancing the growth and utilization of Spirulina algae through innovative R&D and mass cultivation using IoT-enabled precision solutions. This initiative is aimed at developing phyco spirulina protein-fortified foods as a circular blue economy innovation. The hypothesis objectives of the project include extending the distribution of spirulina protein component IoT enabled Precision Solution for phyco spirulina protein for fortification in foods with Vitamin D and circular blue economy innovation nutrient to the local mass or the NE region, optimizing the biomass mass production through our patentable innovation R&D vertical bioreactor IoT enabled technology for it will address the need of protein need of the large sector of population, extraction of the phycocyanin and purification of spirulina fortification with Vitamin D, nutrients to product loaded form and filling the gap in NE region for mass cultivation, as there are less major player in the region. Our methodology incorporates IoT-Enabled Precision Farming with smart sensors, automated controls, and data analytics, emphasizing Sustainable Practices like closed-loop systems, renewable energy and Circular Economy Model like waste utilization and local partnerships. The results include Spirulina-fortified foods such as Vitamin D supplements, protein bars, pasta, beverages and nutritional products like powders, capsules and tablets, along with customized solutions for food manufacturers. This initiative promotes improved public health through better nutritional intake, environmental benefits by reducing water usage, waste generation, carbon emissions and economic growth through market development and job creation. Spirulina, a nutrient-dense blue-green algae rich in high-quality protein, vitamins, and antioxidants, holds great potential to enhance the nutritional profile of food products. However, traditional cultivation methods face challenges such as inefficiency, high resource consumption, and inconsistent yields.

Keywords: IoT, Phyco, Protein, food, Innovation

Ecological structure and diversity indices of the phumdi ecosystem

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ABSTRACT

The phumdi ecosystems are a vital component of the Loktak Lake ecosystem. Takmu pat is one such wetland in the lake where anthropogenic activities and environmental stressors have impacted biological diversity. This study aimed to assess the vegetation composition and diversity of the phumdi ecosystem by applying key ecological indices, to evaluate the Importance Value Index (IVI) and diversity indices such as Shannon Wiener Index for species diversity, Margalef's Index for species richness, Pielou Evenness Index for species evenness and Simpson's Index for Species dominance. The quadrat method was adopted in this study to collect data on plant species composition and to determine diversity indices. A total of 27 Phumdi Species from 14 families were identified. The dominant species, determined through IVI calculations, included Isachne globosa (IVI = 51.93), Leersia hexandra (IVI = 48.99), and Cyperus rotundus (IVI = 25.71). The diversity indices calculated indicate a moderate level of species diversity (Shannon-Wiener Index = 1.19), low species richness (Margalef's Index = 0.91), high evenness (Pielou Evenness Index = 0.83), and low dominance (Simpson's Index = 0.09). The result suggests that Takmu Pat, being a disturbed area within the Loktak Lake, may contribute to the observed low species richness results, with anthropogenic activities and environmental changes likely affecting species composition. These findings provide a better understanding of the ecological structure and diversity patterns within the phumdi ecosystem, providing essential information to support future conservation strategies aimed at preserving biodiversity in this unique wetland habitat.

Keywords: Phumdi ecosystem, Loktak lake, Wetland ecology, Species composition, Biodiversity, Conservation.

Assessing Human Impacts in a Protected Tropical Wetland

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ABSTRACT

Lake Loktak, the largest lake in Northeast India, is vitally important to the surrounding communities, providing food, drinking water and livelihoods for over 250,000 people. It also hosts a wide range of unique and rare biodiversity, including the critically endangered Sangai deer (260 of which remain in the wild). Despite its ecological and socioeconomic significance, the lake faces threats from human and climatic stressors including pollution, overfishing and hydrological regime change. As such, local people have become increasingly worried regarding the health of the lake. A stakeholder meeting was organised at the lake to hear concerns of local fishermen, business owners, academics, and politicians. The meeting provided invaluable insight into the most pressing concerns surrounding the wetland, which then went to inform the research design of this project. 210Pb/137Cs dated sediment cores are used to provide a robust timeline of human impact and environmental change. δ13C and δ15N isotopic analysis of organic matter is used in combination with C/N ratios, XRF, algal pigments and diatoms to reconstruct pollution inputs, nutrient cycling and ecological status of the lake over the last ~150 years. Water samples are analysed for nutrients, δ18O and δ15NO−3 isotopes, chlorophyll-a, and algal pigments to provide modern context and investigate seasonal/spatial variation. Baseline conditions prior to major human impact are reconstructed. This represents the first comprehensive, multi-proxy palaeolimnological study in the region to assess anthropogenic and climatic stressors through the analysis of both paleoenvironmental and contemporary material.

Keywords: Palaeolimnology, Geochemistry, Lake Loktak, Environmental Change, Freshwater Ecology

Essential Elements and Chemical Metabolites content in the Edible Freshwater Snails of Manipur, India: A Potential Multifunctional Food and Mini-Livestock of the Future.

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ABSTRACT

Background: Snails are distributed in various habitats including freshwater and marine. Freshwater snails, locally known as "Tharoi" are consumed as an authentic cuisine by the natives of Manipur, India. It is necessary to characterize its chemical composition and contaminants as they act as bio-indicators of the aquatic ecosystem.
Objectives: In the present study, the main aim is to characterize essential elements content and metabolite profile in the edible freshwater snails of Manipur. Snail market survey in Waithou and Khwairamband, Manipur was conducted.
Methodology: Essential elements were analyzed in the four snails, namely Filopaludina bengalensis, Brotia costula, Cipangopaludina lecythis and Paludomus pustulosa using ICP-OES while LC-ESI-QTOF-MS was used to identify the metabolites present. Further, primary data were collected through structured questionnaire on snail farming, profitability and constraints to snail marketing.
Outcomes: A notable concentration of P (137.68 ± 6.06 mg/100g) in F. bengalensis, K (324.01±10.94 mg/100g) in P. pustulosa; Mg (477.42 ± 8.58 mg/100g) in B. costula (spineless) and Zn (19.78 ± 0.91 mg/100g) in C. lecythis were recorded. A total of 370, 368, 318 and 185 compounds were identified in F. bengalensis, B. costula, C. lecythis and P. pustulosa respectively. Market survey results revealed that snail sellers were dominated by the female gender and also reported that snail marketing is profitable. The major constraints faced were limited marketing and supply, poor storage and transport facilities.
Conclusion: Essential elements and bioactive compounds with therapeutic potential which plays a crucial role in the human health were abundantly present in the snail flesh. There is no detection of heavy metals such as lead, arsenic and cadmium in the study. Snail farming and marketing should be encouraged for all year-round supply thereby increasing the socio-economic status. The overall findings provide an insight that freshwater snails are nutraceutical food and a mini-livestock for the future.

Keyword: Nutraceutical food, Aquatic Snails, Snail Farming, Snail market.

A Key to Sustainable Economy: Harnessing the Potentials of Water Fox Nut

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ABSTRACT

'Sustainable Economic Development' is the term that has been popularised in recent years. The pursuit of Sustainable Economic Development has led to exploring underutilized resources with significant potential. A promising solution that can enhance local economies and contribute to the economic growth is water fox nut (makhana), an aquatic crop, which is often termed as organic wafers or superfood due to its nutritional value. However, there is a need to develop a holistic approach of farmers, agricultural entrepreneurs and all the stakeholders to create better opportunity by promoting backward and forward linkages related to production, marketing and distribution. The paper discusses both the modern and traditional farming practices and their role in assessing the potentials of water fox nuts. The multifaceted benefits including environmental sustainability, economic viability, nutritional value and possible strategies etc. are highlighted in this paper. A comprehensive literature review and systematic analysis of secondary data is carried out to harness the underutilized resource. Special focus is given to the state of Manipur, where water fox nut is cultivated mainly using traditional practices and sell the nuts without much value addition. It is also observed that development in techniques and farming practices of this crop backed by value addition methods will undoubtedly catalyse the economic growth. The paper will further delve into how integration of water fox nut to the local economy along with modern techniques synergise to sustain and drive sustainable economic growth, highlighting the chain reaction on the production, productivity, enhancement of innovation and the contribution to overall economic resilience. The study provides recommendations to sustainably improve rural livelihoods and to enormously contribute to a blue economy.

Keywords: Sustainable Economic Development, Local Economy, Aquatic Crop, Agricultural Entrepreneurs, Economic Growth, Blue Economy

Utilizing Insects as a Cost-Effective Alternative Feed in Aquaculture

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ABSTRACT

Maiyon Agro LLP has been working on the cost cutting as well as saving the small fish for human consumption and to maintain the ecosystem of the nature. The present study has designed a fish feed with insect as an alternative to the fish meal. The insect Tenebrio Molitor has 50%-75 % dried protein and 20 amino acids are present out of 23 essential amino acid.The company is aiming to reduce the small fish/fingerling/trash fish harvest by 10%-20% which will directly impact the marine ecosystem since globally the fish for feed came from ocean/seas/big fresh water areas. The objective of the study is to used insect (Tenebrio Molitor) for the fish feed production as an replacement of fish meal. Due to the increased demand for the fish feed globally there is tremendous pressure on the marine ecosystem to harvest, to meet the demand. The rising feed cost make the fish farming a nightmare for the farmers due to increase cost and decrease demand. The pressure is not only for fishery, but any forms of feed be it animal feed or poultry.The finished product when tasted is giving Cost Benefit ration of 2.7 when compare to commercial fish feed of 1.7. Digestibility is 90% and the feed conversion ratio is 2.04 which interpretes that it gives the growth equivalent to broiler chicken. The methodology used is the developemet of commercial production technology, of the worm Tenebrio Molitor by acclimatizing in the local environment. The process of acclimatizing is important as it will stabilize the protein content of the worm. The second process is the standardization of the harvesting process so as to save the protein from denaturation using several technique which will be suited for the commercial production and low cost ie Microwave and Hot air oven technique . The temperature tranges from 80 degree to 200 degree centigrade for the optimal production. We have has completed the pre production , post production of the designed feed and found to be a stable alternative to fish meal. The product has been tried in fiels condition and as well as OFT is done in collaboration with KVK churachandpur. All the required parameters to replaced the fish meal with Insect meal for the feed production and found that Insect Tenebrio Molitor is the answer to the rising cost of the feed. The insect will not only help in reducing the feed cost but will also help in reducing the stress on the marine ecosystem. The model of using insects will also help the farmers add more revenue indirectly in the form of fertilizer which is again polluting the environment because of the inorganic fertilizer.

Keywords: Insect, fish feed, Tenebrio molitor, fertilizer, amino acids, pollution

Determination of N,N-Diethyl-meta-toluamide (DEET) in Sediment and Water by GC-EI-MS: An Analytical Approach for an Emerging Contaminant

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ABSTRACT

The insect repellent N,N-Diethyl-meta-toluamide (DEET) is one of the most frequently detected emerging chemical contaminant in water and sediment globally in recent years. Analytical methods involving solid-phase extraction and ultrasonic extraction with gas chromatograph-electron impact-mass spectrometer has been developed for the determination of DEET in water and sediment samples, respectively. The developed methods are simple without any clean-up, highly selective, repeatable and reliable with good relative recovery of 93 ±2.3% and 108 ±1.4% for water and sediment, respectively. The intraday precision of analytical method was 1.29% RSD whereas, the interday precision was 1.54% RSD. The method detection limit obtained for water (5.86 ng/L) and sediment (4.44 ng/g) are good with best recovery compared with the existing mass spectrometric methods. The methods were successfully applied for monitoring DEET contamination from the surface water and sediment from the Kaveri River in India. The water and sediment extraction methods developed in this study are one of the first comprehensive methods to use solid phase extraction and ultrasonication, respectively with gas chromatograph-electron impact-mass spectrometer analyses. The methods are simple, sensitive, reliable and validated through different quality assurance and quality control parameters. These analytical methods can effectively assess DEET contamination and identify hotspots in marine environments. This information is essential for is essential for assessing its potential ecological risks.

Keywords: DEET, insect repellent, GC-EI-MS, solid phase extraction, ultrasonication

Sustainable Blue Economy Practices for Loktak Lake: Balancing Conservation, Livelihoods, and Ecotourism

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ABSTRACT

Loktak Lake, the largest freshwater lake in Northeast India, is not only a cradle of biodiversity but also a vital socio-economic asset. Its unique Phumdi (floating biomass) ecosystem supports globally significant flora and fauna, including the critically endangered Sangai deer (Rucervus eldii eldii) in the only floating national park in the world, the Keibul Lamjao National Park. The lake provides sustenance to nearly 8% of the total population of Manipur through fishing, aquaculture, agriculture and ecotourism. However, the lake faces critical challenges from anthropogenic pressures, including pollution, overfishing, climate change, and unregulated land-use practices. These issues necessitate integrated scientific intervention and community-centric policies to restore its ecological balance and unlock its potential for the Blue Economy. Initiatives such as freshwater pearl farming, ecotourism development, and Phumdi management offer promising pathways for sustainable livelihood generation while preserving the lake's ecological integrity. The present study explores sustainable blue economy practices for Loktak Lake, aiming to balance conservation imperatives with economic opportunities and community well-being. It examines the lake's provisioning (food, fresh water, fibre and fuel, biochemical, genetic material), regulating (climate, water, purification, erosion, hazard, pollination), cultural ecosystem services (spiritual, recreational, Aesthetic, educational), and supporting (soil formation, nutrient, energy) emphasizing strategies for sustainable fisheries, ecotourism, and renewable energy initiatives. The result from the study identified that people from the state are directly and indirectly depending on the lake mostly for food including, fishes, agricultural products, wild vegetables plants, climate, water purification and ecotourism. As the ecological pressure is increasing on the lake, there is an urgent need to enhance resilience for sustainable development and management of the lake. The finding from the present study will help policy makers, government in proper implementation of development project and provide a comprehensive roadmap to transform Loktak Lake into a model for sustainable blue economy practices, ensuring long-term ecological integrity and socio-economic benefits for future generations.

Keywords: Loktak Lake, Blue Economy, sustainable development, biodiversity conservation, freshwater ecosystems, Northeast India.

Evaluation of Phytochemical, Antioxidant and Mineral Content in Euryale ferox Salisb. of Manipur, India: A Potential Superfood of the Future

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ABSTRACT

Background: Euryale ferox Salisb. popularly known as "Foxnut" and locally named "Thangjing" in Manipur, is a spiny aquatic plant of the family Nymphaeaceae. It is one of the most highly consumed aquatic crops in Manipur, a northeastern state of India. Various parts of the plant are regarded as delicacies in the traditional cuisine of Manipur. Objectives: This study was carried out to examine the phytochemical content, Total Phenolic Content (TPC), Total Flavonoid Content (TFC), in vitro antioxidant potential and mineral content in the seeds, arils and petioles/pedicels of E. ferox. Methodology: Phytochemical, TPC, TFC analysis was done following standard protocols, in vitro antioxidant potential by DPPH and ABTS assays while ICP-OES was used for mineral content analysis. Outcomes: The selected three plant parts are rich in a variety of phytochemicals and contain a good amount of TPC and TFC. In case of DPPH and ABTS assays, the lowest IC50 value was recorded in seeds having 16.99 ± 0.49 µg/mL and 70.69 ± 1.83 µg/mL respectively. Among the three edible parts, arils showed the highest K (138.71 ± 3.28 mg/kg), Mg (28.64 ± 2.33 mg/kg), P (43.31 ± 2.05 mg/kg), S (7.18 ± 0.68 mg/kg), Cu (0.17 ± 0.03 mg/kg), and Zn (1.25 ± 0.11 mg/kg), whereas petioles/pedicels had the highest content of Ca (53.64 ± 1.61 mg/kg), Mn (1.83 ± 0.30 mg/kg), and Fe (2.28 ± 0.34 mg/kg). Conclusion: The findings of this study provide a scientific insight that Euryale ferox Salisb. as a traditional food ingredient with high nutritional value and various health benefits, has the potential to be considered as one of the future superfoods and can help in improving food security. It is one of the most promising income generators for the natives of Manipur and also has a very good prospects for market development that will ultimately improve their socio-economic status.

Keywords: Foxnut, Superfood, Antioxidant, ICP-OES, Natural products, Northeast India.

Assessment of Water Poverty Index (WPI) of Imphal River Basin: A Tool to Assess the Climate-Induced Vulnerability on Water Resources

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ABSTRACT

Water, essential for life and human development, is facing severe stress worldwide due to human activities and climate change, despite its crucial role in health, well-being, and sustainable development. The present phenomenon of climate variability and change is significantly affecting the global distribution leading to water scarcity in terms of their availability and accessibility. The Himalayan region has already witnessed various threats to water resources and security issues. A similar trend has been observed in Manipur also, as it falls under the greater GBM (Ganga- Brahmaputra-Meghna) catchment and belongs to the same Himalayan orogeny. Water security in the region faces mounting challenges due to climate variability, changing rainfall patterns, and human activities like deforestation, population growth, and unplanned land use changes, all of which exacerbate existing water scarcity issues. The present study analyses water poverty index (WPI) which is an interdisciplinary tool or indicator to assess water stress and scarcity, linking physical estimates of water availability with the socioeconomic drivers of poverty. It emphasizes the significance of water availability, accessibility, quality, environment and capacity of society to cope with the water scarcity challenges of the region. This index-based analysis is an important method for identifying the factors influencing poverty, ranking the extent of stress, and developing an appropriate intervention in needy areas. According to equal weight analysis, Imphal West is the least vulnerable district, followed by Senapati, Imphal East and Thoubal. Unequal weighted analysis shows that Imphal West is the least vulnerable district, followed by Thoubal, Senapati, and Imphal East. The majority of the households depend on natural water resources for consumptive uses, which are far from the residence and sensitive to climate variability. The water scarcity issues have affected both hilly and valley districts of Manipur which requires immediate attention for adapting to the emerging situation.

Keywords: Water Poverty Index, Climate, Vulnerability, Adaptation

Microplastics: Affecting India's Blue Economy

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ABSTRACT

Microplastic pollution poses a significant threat to India's blue economy, which heavily depends on fisheries. Microplastics, defined as polymeric particles ≤5 mm in diameter, have been detected in various environmental matrices along the Indian coastline. Their presence raises serious concerns regarding ecosystem health, food safety, and the sustainability of marine-based industries. Their pervasive presence raises concerns about ecological health, seafood safety, and the sustainability of marine-based industries. Studies have documented the widespread distribution of microplastics along the eastern coast of India in different environmental matrixes. Microplastics are ingested by all organisms from plankton to higher species like marine mammals, either directly from the surrounding environment or through the food chain, this may cause physical injury to organisms or potentially transfer the toxic compounds which raises safety concerns for consumers. A study estimated that local populations may ingest between 731 to 781 microplastic particles annually through fish consumption and as many as 2,809 particles through shellfish, posing potential health risks. Using scientific qualitative and quantitative techniques, bioremediation methods and adopting effective mitigation strategies, such as implementing robust waste management practices, reducing plastic usage, and raising public awareness are essential steps to combat this growing problem and to establish a sustainable blue economy. The impact on the blue economy along the Indian coastline still remains understudied. Highlighting this area will urge Indian policymakers to establish essential guidelines and strictly enforce laws, ensuring the protection of the environment, preservation of marine ecology, and safeguarding of human life.

Keywords: Blue Economy, Microplastics, Environmental matrixes, Laws and Policy.

Fermentation of Seaweed processing waste to value added products

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ABSTRACT

Seaweed a safe, affordable, and easily accessible macroalgae, Saccharina (Laminaria) japonica, can serve as a substrate for a variety of microbial fermentations. In addition, processing industries release a huge amount of sugar-rich seaweed residues, which can be a rich source for the cost-effective production of pigments by microbial fermentation techniques. This study investigated the feasibility to utilize water-soluble extract from the macroalgae Saccharina japonica as a substrate for the production of pigments by a fungal isolate. Based on morphological characters, enzyme profile, and genotyping, the culture is identified as Talaromyces amestolkiae GT11. It produced extracellular pigments, such as Monascus-like pigment and PP-V (homologue of monascorubramine) and extracellular enzymes, like phosphatase, α-chymotrypsinase, arylamidase, naphthol-AS-BI-phosphohydrolase, and various sugar-degrading enzymes. T. amestolkiae GT11 used Water Extract Basal Medium (WEBM) prepared from S. japonica particles produced higher amounts of extracellular pigments than intracellular in. Significantly, higher amount of red (609.68 ± 29 AU410/100 mL) and yellow (627.18 ± 24 AU510/100 mL) pigments were produced in 3% WEBM. The optimum temperature for the production of yellow and red pigments was found to be 28℃ and 30℃, respectively. The optimal pH for red pigment production was noted to be pH 5.0, while yellow colour at low pH. The highest pigment production for yellow and red pigments was observed with 1% spore inoculum (4.5 X 104 spores mL-1). This study shows that the culture T. amestolkiae GT11 could be used to utilize seaweed residues from marine seaweed industry with a target of remedying environmental pollution for natural pigments production for application in food, cosmetics, and pharmaceuticals.

Keywords: Submerged fermentation, Seaweed, Fungal pigments

Revolutionizing Coral Reef Restoration: Sustainable Solutions with 3D-Printed Bio-Compatible Materials

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ABSTRACT

Coral reefs, often referred to as the "rainforests of the sea," are essential ecosystems that support biodiversity, protect coastlines, and sustain economic activities like fisheries and tourism. However, these ecosystems face severe threats from climate change, pollution, overfishing, and coastal development, with over 75% of global reefs at risk. Traditional restoration methods, such as concrete artificial reefs, are expensive, labor-intensive, and lack the complexity of natural reef structures. This project proposes an innovative solution utilizing 3D printing technology to create bio-compatible coral reef structures from calcium carbonate and polyhydroxyalkanoate (PHA) composites. These materials mimic natural coral skeletons, promoting coral growth and environmental integration. The 3D-printed structures replicate the intricate geometry and porosity of natural reefs, fostering biodiversity and enhancing ecosystem functionality. The eco-friendly composite material is biodegradable and sustainable, supporting scalability and cost-effective deployment. Advanced sensors integrated into the design enable real-time monitoring of reef health, ensuring adaptive management and long-term success. Beyond ecological restoration, the technology holds potential in tourism and aquariums, offering decorative reef structures that combine ecological benefits with aesthetic appeal. This scalable solution addresses the limitations of traditional methods, providing a sustainable approach to restoring marine biodiversity, protecting coastal livelihoods, and combating climate change impacts. By collaborating with environmental organizations, government agencies, and private entities, the initiative aims to create a significant global impact, positioning itself as a leader in marine conservation and sustainable innovation.

Keywords: Artificial Reef, Additive Manufacturing, Marine Conservation.

Bio-engineered micro-algae for sustainable production of bio-energy and value added products

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ABSTRACT

With a growing population every day, there's a huge global demand for energy to meet the necessary needs of every individual. The energy supply today hugely depends on fossil fuel production, which not only creates pressure on this energy source but is also responsible for the immense production of detrimental greenhouse gases. The accumulation of these gases in the atmospheric ozone layer has led the human race to face the most serious threat of climate change. To address all these issues, we've devised an innovative idea of harnessing green energy production using natural resources like algae and phytoplankton. We propose to use bio-engineered algae as bio-factories for the production of renewable sources of energy like methane and hydrogen and for producing value-added byproducts that can substitute the present sources of marine pollutants like plastics, fertilizers etc. We plan to isolate and integrate the genes of aerobic methanogens and photosynthetic bacteria in compatible algal strains that are responsible for the production of methane(in an aerobic environment) and hydrogen and enhancing the lipid bio-synthesis pathway through synthetic biology. Together this creates a versatile energy platform competent for the synthesis of methane, hydrogen and lipid-based byproducts like bio-plastics and bio-fertilizers. To address the possibilities of bio-contamination, we'll aim to introduce genetic kill switches and nutrient dependency strategies to prevent uncontrolled gene transfer and risks of algal bloom. We'll also incorporate a real-time monitoring system to track the growth and overall environmental impact. Thus the strategy aligns with the principles of the blue economy and offers a scalable approach to mitigate climate change and contribute towards marine conservation.

Keywords: Fossil fuel, green energy, bio-engineered algae,, value-added byproducts, climate change, marine conservation.

EcoRestore: Microbial Medley for Marine Ecosystem Revival

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ABSTRACT

Marine ecosystem pollution imperils 70% of global fisheries, threatening food security, biodiversity, and the $2.5 trillion blue economy. Current remediation methods are costly, inefficient, and environmentally hazardous. EcoRestore proposes a precision-engineered microbial consortium to degrade pollutants, promote nutrient cycling, and enhance ecosystem resilience. EcoRestore's technical framework integrates a proprietary blend of marine microorganisms, carefully selected for their pollutant-degrading capabilities, which are engineered to work in synergy within a patented, biodegradable encapsulation matrix. This encapsulated microbial consortium is optimized using machine learning algorithms, which analyze real-time data from advanced sensors and IoT technologies to inform consortium composition, application rates, and monitoring protocols. A systems biology approach is employed to model the complex interactions between microorganisms, pollutants, and the marine ecosystem, enabling predictive analytics and adaptive management. By harnessing the power of marine microorganisms and AI-driven optimization, EcoRestore offers a revolutionary solution for promoting a healthy and sustainable blue economy. EcoRestore's innovative approach has far-reaching implications for marine conservation, climate change mitigation, and sustainable coastal development, ensuring a resilient and thriving marine ecosystem for future generations. The proposed solution also addresses the United Nations' Sustainable Development Goals (SDGs), specifically SDG 14 (Life Below Water), by providing a cutting-edge technology for marine ecosystem restoration.

Keywords: Sustainable, Microbial Consortium, Artificial Intelligence, IoT, Algorithm

Advancing the Blue Economy of Chilka Lagoon: Seaweed Applications and Monitoring Using Innovative Imaging Techniques

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ABSTRACT

The blue economy has become an essential sector within the global economy, emphasizing the sustainable utilization of ocean resources. Among these, seaweeds are recognized as vital contributors due to their versatility in producing food, fodder, and other valuable products. Chilika, a prominent brackish water lagoon on India's east coast, hosts a diverse array of seaweed species, offering potential to enhance the blue economy through ecosystem services such as shoreline protection, water purification, and habitat formation for marine organisms. To fully exploit the economic and ecological benefits of Chilika's seaweeds, robust detection and monitoring methods are crucial. Advanced imaging techniques have emerged as valuable tools in this regard. Specifically, multispectral imaging has shown promise in identifying and classifying seaweed species across varied environments, using specialized cameras to capture images at different wavelengths, thus enabling growth pattern assessment. Beyond multispectral imaging, hyperspectral imaging and satellite remote sensing have also demonstrated efficacy in large-scale seaweed monitoring, offering high spatial resolution and broad area coverage. Furthermore, innovative approaches using unmanned aerial vehicles (UAVs) and autonomous underwater vehicles (AUVs) have enhanced the efficiency and cost-effectiveness of seaweed detection. Adopting these imaging technologies can significantly benefit seaweed detection efforts in Chilika. Techniques like multispectral and hyperspectral imaging allow precise species identification and growth monitoring, aiding in the formulation of effective management and conservation strategies. Meanwhile, UAVs and AUVs offer high-resolution imagery, facilitating extensive monitoring and tracking of seaweed population dynamics over time. The present work aims for Chilika Lagoon, India, by highlighting the potential of seaweeds to enhance the blue economy through ecological, economic, and conservation-driven initiatives. Chilika's diverse seaweed species can provide sustainable livelihoods for local communities through aquaculture and value-added products like biofertilizers and nutraceuticals, reducing dependency on overexploited marine resources. Advanced monitoring techniques such as multispectral and hyperspectral imaging, along with UAVs and AUVs, can support precise mapping and sustainable management of seaweed beds, guiding conservation strategies and mitigating environmental impacts. By integrating seaweed aquaculture into Chilika's economic framework, the region can contribute to India's blue economy goals, fostering eco-friendly industries and enhancing local livelihoods. The proposed approach envisages to realize the full potential of the blue economy in Chilika Lagoon and similar ecosystems worldwide.

Keywords: Sustainable, Seaweeds, biofertilizers

Strategic Development of a Sustainable Seaweed Industry in Vizhinjam, Kerala: Harnessing the Nutritional and Bioactive Potential of Seaweeds

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ABSTRACT

Seaweeds are rich in essential nutrients, including vitamins (A, B1, B12, C, D, E), minerals (calcium, phosphorus, potassium), dietary fibers, and bioactive compounds like polysaccharides (Fucoidan), polyphenols (Phlorotannins), and terpenoids. These compounds possess anti-inflammatory, antioxidant, antiviral, and anticancer properties, making seaweed valuable for the food, pharmaceutical, and fertilizer industries. This abstract outlines a strategic plan to develop a seaweed industry in Vizhinjam, Kerala, focusing on optimizing harvesting, processing, and extraction processes, while increasing production and diversifying value-added products for various industries. Three seaweed species—Kappaphycus alvarezii, Turbinaria spp., and Ulva spp.—are cultivated using floating rafts and the IMTA technique to maximize yield and minimize environmental impact. The DST project on cultivating Kappaphycus alvarezii has emphasized Kerala's potential due to its favorable climate and coastline. Kappaphycus thrives in temperatures of 27–30°C and salinity of 30–35 PSU, particularly during the pre- and post-monsoon seasons. Turbinaria spp. and Ulva spp. also have optimal temperature and light conditions. Kappaphycus alvarezii yields better with a longer harvest period of 135 days. Turbinaria spp. should be harvested avoiding intense sunlight, while trimming brown algae enhances yield. Ulva spp. harvests in early or late spring help reduce biofouling. UAVs, utilizing RGB and multispectral data, improve species classification and monitoring accuracy using algorithms like Random Forest and Support Vector Machines. Bioactive compound extraction utilizes sequential solvent extraction, with spray drying for encapsulation and contamination removal. A photobioreactor promotes hybrid growth to boost bioactive production. Quality control is ensured via FT-IR spectroscopy, HPLC, and GC-MS for microbial analysis and compound quantification. Wastewater from the system is valorized using RAS technology to produce sustainable fertilizers. By leveraging optimized cultivation techniques, bioactive compound extraction, and waste valorization, this initiative aims to maximize both environmental and economic benefits, positioning Kerala as a key player in the global seaweed industry.

Keywords: Seaweed cultivation, Kappaphycus alvarezii, bioactive compounds, IMTA technique, sustainable agriculture, wastewater valorization

Fabrication of Bioactive Wound Healing Nanocomposite Hydrogels from Hydroxyapatite and Collagen Extracted from Fish Scale Wastes

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ABSTRACT

Fish scales, often regarded as waste in the fishing and aquaculture industries, present significant opportunities for sustainable utilization and waste management. Fish scales, primarily composed of type-I collagen and hydroxyapatite, play a significant role in wound healing due to their unique structural properties, bioactivity, biocompatibility and abundance. Here an alginate-based nanocomposite hydrogel containing type-I collagen and hydroxyapatite was engineered to enhance wound healing and support tissue regeneration. Fish scales are a good source of type-I collagen, a primary structural protein in the extracellular matrix. Collagen enhances the wound healing process by promoting fibroblast proliferation and facilitating the migration of keratinocytes, leading to faster wound closure and tissue regeneration. Hydroxyapatite extracted from fish scales provides a scaffold for cell attachment and proliferation, enhancing tissue repair and regeneration. Sodium alginate, a natural polysaccharide from brown algae, forms gels through ionic cross-linking with calcium, creating a network that encapsulates water and bioactive compounds. Its properties like moisture retention, biocompatibility, and hemostatic effects make it ideal for ointments and wound care, enhancing healing and supporting advanced biomedical formulations. We're using ionic cross-linking to form a nanocomposite hydrogel of alginate, collagen, and
hydroxyapatite. This method uses the interaction of alginate with divalent cations like calcium ions to form a stable three-dimensional network, which allows collagen and hydroxyapatite to be incorporated into the hydrogel matrix. Using fish scale waste decreases seafood industry waste and offers a cost-effective source of valuable biomaterials. This nanocomposite hydrogel, synthesized from fish scales, has the potential to significantly enhance the healing and cellular regeneration of diverse wound types, including cuts and burns. The expanding wound care market sees bio-based materials like fish-derived hydroxyapatite and collagen as sustainable alternatives to synthetic options. Nanocomposite hydrogels from fish scale waste offers a promising, eco-friendly solution for advanced wound healing, with ongoing research driving innovations in regenerative medicine and bioengineering.

Keywords: Fish scales, Type-I Collagen, Hydroxyapatite, Alginate, Ionic cross-linking, Nanocomposite
Hydrogel

Kelp&Kettle: Transforming nutrient-rich seaweed into an extraordinary wellness tea that delights your senses

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ABSTRACT

This study investigates the possibility of capitalizing on the functional properties of green seaweed Ulva lactuca that goes beyond basic nutrition. The seaweed was subjected to optimized processing like drying and grinding techniques before it was combined with traditional tea ingredients.Chemical assays have revealed a consortium of bioactive compounds in seaweeds including major players of the polyphenol family like catechin, epicatechin and epigallocatechin, making them a suitable attraction for herbal tea formulation. The beverage demonstrated notable antioxidant activity with an IC50 value of 45.3 µg/mL. The tea was evaluated for organoleptic sensory attributes by conducting experiment with 120 participants and secured a score of 7.2 out of 9 for taste and 6.8 out of 9 for aroma. Blending with peppermint and ginger was shown to notably enhance the sensory scores. Further quantitative nutritional analysis studies revealed seaweeds contain 14.8-72mg/g of iron, 38.8- 72.2mg/g of iodine and 410-870mg/g of calcium, making them promising candidates for fulfilling health claims that traditional herbal teas fall short of. Seaweed is also a storehouse of essential fatty acids like omega-6 and omega-3 fatty acids as well as contains all essential amino acids that bridges the gap created in a nutritionally compromised vegetarian diet. Seaweed contains considerable amount of both water and fat soluble vitamins that make their integration into food matrices convenient and cater bioavailability. This research is focused on a constructive approach towards developing functional beverages that aim exploitation of seaweed's nutritional profile while meeting consumer preferences.

Keywords: Blue Economy, seaweeds & value chain, bioavailability, polyphenol

Strategic Development of a Sustainable Seaweed Industry in Vizhinjam, Kerala: Harnessing the Nutritional and Bioactive Potential of Seaweeds

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ABSTRACT

Seaweeds are rich in essential nutrients, including vitamins (A, B1, B12, C, D, E), minerals (calcium, phosphorus, potassium), dietary fibers, and bioactive compounds like polysaccharides (Fucoidan), polyphenols (Phlorotannins), and terpenoids. These compounds possess anti-inflammatory, antioxidant, antiviral, and anticancer properties, making seaweed valuable for the food, pharmaceutical, and fertilizer industries. This abstract outlines a strategic plan to develop a seaweed industry in Vizhinjam, Kerala, focusing on optimizing harvesting, processing, and extraction processes, while increasing production and diversifying value-added products for various industries. Three seaweed species—Kappaphycus alvarezii, Turbinaria spp., and Ulva spp.—are cultivated using floating rafts and the IMTA technique to maximize yield and minimize environmental impact. The DST project on cultivating Kappaphycus alvarezii has emphasized Kerala's potential due to its favorable climate and coastline. Kappaphycus thrives in temperatures of 27–30°C and salinity of 30–35 PSU, particularly during the pre- and post-monsoon seasons. Turbinaria spp. and Ulva spp. also have optimal temperature and light conditions. Kappaphycus alvarezii yields better with a longer harvest period of 135 days. Turbinaria spp. should be harvested avoiding intense sunlight, while trimming brown algae enhances yield. Ulva spp. harvests in early or late spring help reduce biofouling. UAVs, utilizing RGB and multispectral data, improve species classification and monitoring accuracy using algorithms like Random Forest and Support Vector Machines. Bioactive compound extraction utilizes sequential solvent extraction, with spray drying for encapsulation and contamination removal. A photobioreactor promotes hybrid growth to boost bioactive production. Quality control is ensured via FT-IR spectroscopy, HPLC, and GC-MS for microbial analysis and compound quantification. Wastewater from the system is valorized using RAS technology to produce sustainable fertilizers. By leveraging optimized cultivation techniques, bioactive compound extraction, and waste valorization, this initiative aims to maximize both environmental and economic benefits, positioning Kerala as a key player in the global seaweed industry.

Keywords: Seaweed cultivation, Kappaphycus alvarezii, bioactive compounds, IMTA technique, sustainable agriculture, wastewater valorization

Marine Biomanufacturing: Analyzing the Potential of Algal Drugs and Nutraceuticals for Human Health

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ABSTRACT

Oceans cover more than 70% of Earth's surface that provides a challenging environment for the growth of marine organisms. This enables them to synthesize highly effective metabolites for their survival in such extreme situations. These metabolites are found to have exceptional pharmaceutical and nutraceutical values. Among all the marine resources, high value compound derived from algae have emerged to have immense potential for serving mankind. The main objective of this study is to explore the potential of marine algae in producing multiple active molecules or bio actives that can be used as valuable drugs and nutraceuticals. Using a systematic review methodology, we examined recently published peer reviewed articles and books on marine biotechnology and microbiology, highlighting breakthroughs in algal drug development and nutraceutical applications. Compounds like sulphated polysaccharides, carotenoids, alkaloids, flavonoids and phenolic compounds were identified for their anti-oxidant, anti-inflammatory, anti-microbial, anti-coagulant and anti-cancer properties. The outcomes emphasize on the importance of the application of algal derived compounds, like active substances from seaweed are capable of affecting many pathways related to insulin production, glucose metabolism, and insulin sensitivity, providing a comprehensive approach to the management of diabetes. Also, daily consumption of fucoidan, an active compound of brown algae, helps in reducing post-menopausal breast cancer in women and also plays role in reducing toxicity associated with colon cancer patients. Similarly, there are numerous other applications of a variety of algal derivatives. In conclusion, algal biomanufacturing presents a sustainable way for developing nutraceuticals and pharmaceuticals promoting overall human wellbeing. On the other hand, through the utilization of marine resources also contribute towards blue economy.

Keywords: Blue Economy, Marine Bio-manufacturing, Algal drugs, Algal Nutraceuticals, Bioactive Compounds

Blue approach to green lands

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ABSTRACT

Pesticides play a huge role in increasing production in agriculture but this overabundance has a major cost pertaining to loss of biodiversity due to the toxic leaching of chemicals, which can both permeate food chain and products consumed by humans. This followed by loss of farmlands becoming 'dead ecological' zones poses major threat to biodiversity in general. Biopesticides, derived from organisms and their pre-present mechanisms for determining pest is environment friendly and sustainable. Due to being organic, it doesn't interfere with the ecosystem, naturally degrade in the soil and most importantly doesn't effect humans due to being easy to wash away or presenting no ill-health effects after consumption. The red algae, Asparagopsis armata is a major threat to Blue economy due to its invasive nature effecting major marine ecosystems. Thus the goal of this study is to involve Marine Bio-manufacturing to derive the use of extracellular polymeric substances secreted from Asparagopsis armata to use a biopesticides. Asparagopsis armata is an invasive sea weed which constricts lot of coral ecosystems due to it's prolific growth rate, but because of it's biotechnological application, it presents a unique niche of its high growth rate making it ideal as harvest for materials.

Keywords: Biopesticides, Extracellular polymeric substance, Algae, Blue economy

STUDENT INNOVATION ABSTRACTS

SUSTAINABLE SEAWEED-BASED HYDROCOLLOID FORMULATIONS FOR PROLONGING THE SHELF-LIFE OF CLIMACTERIC FRUITS

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ABSTRACT

Climacteric fruits, including bananas, mangoes, papayas, and tomatoes, are among the major staple agricultural products globally and in India. They have a significant role in agricultural economies due to their economic value and widespread consumption. However, these fruits are highly perishable, with ethylene-induced ripening leading to considerable post-harvest losses during transportation and storage. Chemical solutions such as 1-methylcyclopropene have been used to delay ripening, their application demands advanced infrastructure and trained personnel, raising concerns about safety, regulatory approval, and potential impacts on fruit texture and taste. In response, eco-friendly alternatives such as biofilm-based materials and food-grade ethylene inhibitors have gained attention. Despite this progress, a major gap exists in developing biodegradable, macroalgal-based materials for ethylene sequestration and ripening delay. The successful adoption of such biodegradable, macroalgal-based materials could significantly reduce post-harvest losses and address the growing demand for sustainable agricultural practices. By integrating these advancements into post-harvest management systems, the agricultural sector can transition towards eco-friendly solutions, ultimately promoting sustainability and enhancing the economic value of climacteric fruits in global and Indian markets. Also, our studies on tomato fruits can demonstrate the potential of semi-refined hydrocolloids derived from macroalgae, such as Kappaphycus and Gracilaria species, blended with ethylene sequesters and modifiers in creating coatings that extend fruit shelf life. These hydrocolloid-based sprays have proven effective in delaying ripening and maintaining fruit firmness, offering an innovative, sustainable, and cost-effective solution to post-harvest challenges. Despite these promising results, further research is necessary to scale these technologies for broader applications and evaluate their efficacy across a wider range of climacteric fruits.

Keywords: Agricultural sustainability, Blue Economy, Hydrocolloid, Marine Bio-manufacturing, Shelf-life extension.

FROM LITTER TO LIVELIHOOD: UNLOCKING BLUE ECONOMY POTENTIAL IN EASTERN INDIA'S COASTAL RESOURCES

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ABSTRACT

The eastern coast of India, characterized by its rich coastal biodiversity and natural resources, faces escalating challenges from plastic pollution, which significantly impacts marine ecosystems and coastal habitats. Plastic waste, coupled with discarded molluscan shells, disrupts ecological processes, threatens marine biodiversity, and undermines the ecological and aesthetic integrity of the coastline. Despite these challenges, this study identifies an untapped opportunity to repurpose these waste materials into valuable products that align with the principles of a sustainable blue economy. Discarded Crassostrea sp. shells, predominantly composed of calcium carbonate ($CaCO_3$), exhibit properties highly desirable for enhancing the performance of construction materials, including improved strength, durability, thermal insulation, and cost-efficiency. Simultaneously, waste plastics, known for their structural resilience, offer significant potential for reuse in engineered composites. This study explores the synergistic utilization of these materials to produce lightweight and high-performance construction products, such as bricks, tiles, and structural panels. The integration of these materials adheres to circular economy principles, addressing key environmental challenges by reducing coastal pollution while maximizing resource efficiency. This approach not only minimizes environmental impacts but also fosters socio-economic benefits, including job creation and the promotion of sustainable livelihoods for coastal communities. The proposed methodology demonstrates a transformative pathway for sustainable waste management by contributing to cleaner coastlines and a robust blue economy in eastern India.

Keywords: Blue economy, Plastic waste, Molluscan shell, Sustainability.

APPLICATION OF UNMANNED SURFACE VESSEL (USV) IN MARINE CAGE FARMING

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ABSTRACT

Marine cage farming is emerging as a sustainable solution for high-yield aquaculture, yet traditional feeding and monitoring methods remain labor-intensive, costly, and inefficient. The integration of Unmanned Surface Vessel (USV) technology transforms these operations by automating precision feeding, real-time monitoring, and environmental data collection. Equipped with a dual crank-type feed thrower, GPS-guided navigation, and flexible pipe conveyors, the USV ensures even feed distribution, reducing labor dependency and feed wastage. Onboard sensors monitor vital water parameters such as temperature, salinity, and oxygen, enabling proactive farm management. Additionally, the system enhances surveillance by tracking fish activity and detecting threats, supporting efficient, sustainable, and scalable offshore farming operations. This innovation fosters precision aquaculture, improves productivity, and minimizes environmental impact, setting a new standard for technological integration in marine farming.

Keywords: Unmanned Surface Vessel (USV), Marine Cage Farming, Precision Aquaculture, Automated Feeding, Real-Time Monitoring, Environmental Data Collection.

SEAWEED BASED PRAWN FARMING EFFLUENT REMEDIATION: A MULTIDIMENSIONAL OPPORTUNITY TO BLUE ECONOMY

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ABSTRACT

Seaweed-based remediation of prawn farming effluents offers a multifaceted opportunity to enhance the Blue Economy by providing sustainable solutions to both environmental and economic challenges in aquaculture. Prawn farming, especially in coastal areas of Odisha, typically generates effluents rich in nutrients, leading to water quality degradation, eutrophication, and the loss of biodiversity. The integration of seaweed as a natural biofilter in these systems presents an innovative and environmentally friendly method to mitigate these adverse effects. Different native and exotic seaweed like Gracilaria spp., Chaetomorpha spp., Ulva spp. and Kappaphycus spp. are known for their high bioremediation capacity, can effectively absorb excess nutrients such as nitrogen and phosphorus, thereby reducing pollution and improving water quality, which in turn promotes ecosystem health. Moreover, combining seaweed farming with prawn aquaculture fosters a circular, symbiotic relationship, enhancing overall productivity. This strategy not only addresses environmental challenges but also provides economic advantages through the commercialization of seaweed for diverse applications such as food, pharmaceuticals, biofertilizers and biofuel production, contributing to the sustainable development of coastal economies. Additionally, seaweed-based effluent remediation supports the principles of the Blue Economy by emphasizing resource conservation, sustainability, and the development of value-added industries. Consequently, the integration of prawn farming and seaweed cultivation represents a comprehensive approach to fostering both environmental sustainability and economic prosperity in coastal regions.

Keywords: Blue economy; Bioremediation; Coastal sustainability; Circular aquaculture systems; Prawn farming effluents; Seaweed based remediation

MARINE PLASTIC DEBRIS: CHALLENGES AND THE PROMISE OF MICROBIAL SOLUTION THROUGH BIODEGRADATION

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ABSTRACT

The marine ecosystem hosts a diverse array of novel bacteria that have adapted to its conditions, developing unique genetic capabilities. As the ocean serves as the ultimate sink receiving these pollutants, bacteria able to metabolize plastic biodegradation evolve and pave way for a promising solution to remove these compounds specifically for the elimination of plastics like Polyethylene Terephthalate (PET), Polyethylene (PE) and, Polypropylene (PP), a robust bacterial consortium capable of biodegrading multiple plastic types will be developed. Key enzymes involved in the biotransformation process, along with their corresponding genes, will be identified from potential bacterium. Novel enzymes will be harnessed for the enzymatic conversion of plasticizers such as Dibutyl phthalate (DBP), Dimethyl phthalate (DMP), Monohydroxyethyl Terephthalate (MHET), and Bis-hydroxyethyl terephthalate (BHET). Furthermore, robust enzymes like hydrolases, esterases, MHETase, and PETase, along with specific bacterial strains, will be utilized for the industrial synthesis of novel molecules and monomers, including glycols, phthalates, terephthalates, and other precursor compounds. A whole genome sequencing will be done for a selected bacterium that is best, robust and substrate versatile in biodegrading plastics/plasticizers. The insights from genome sequencing will also be exploited for managing the plastic menace on a larger scale-organised approach.

Keywords: Polyethylene Terephthalate (PET), Bacterial consortium, Biodegradation, Plasticizers, Pollution reduction.

EXTRACTION OF CHITOSAN NANOPARTICLES FROM MARINE BIO-WASTE AND ITS ANTIMICROBIAL APPLICATIONS

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ABSTRACT

Chitosan nanoparticles which are mainly derived from marine bio-waste, such as shrimp and crab shells, have immense potential in food packaging applications, as they are versatile and eco-friendly with potent antimicrobial applications. Chitosan is mainly derived by the deacetylation process of chitin, which is further processed into nanoparticles through methods like ionic gelation and emulsion crosslinking. The nanoparticles formed by this process, exhibit enhanced surface area and antimicrobial activity due to the polycationic nature of the nanoparticles causing plasma membrane disruption and disturbance in the intracellular functions. Chitosan nanoparticles serve as broad-spectrum antimicrobial agents, which are effectively known to inhibit the growth of Escherichia coli and Staphylococcus aureus by damaging the cellular components. Chitosan nanoparticles serve as good antimicrobial agents to protect crops from pathogens and also extend the shelf-life of fresh commodities by reducing microbial contamination. Chitosan nanoparticles serve as active compounds that can be encapsulated in a nanofiber matrix which offers promising applications in the field of active food packaging. The utilization of extracted chitosan from marine biowaste provides a sustainable and effective strategy for addressing environmental and microbial challenges in the field of agriculture and food packaging.

Keywords: Chitosan Nanoparticles, Marine Bio-Waste, Antimicrobial Applications, Food Packaging, Sustainable Agriculture.

A NOVEL, SMART, USER-FRIENDLY WHEELCHAIR FOR MEDICAL DIAGNOSTICS

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ABSTRACT

In medical emergencies, rapid access to vital health data is crucial. This invention—a " Wheelchair"—incorporates portable diagnostic equipment to deliver real-time data on patient health, enabling timely decisions even before arrival at the hospital. The wheelchair is equipped with essential medical devices to monitor parameters such as complete blood count (CBC), body temperature, blood pressure, ECG, X-rays, blood sugar, and blood oxygen levels, among others. These results are transmitted via mobile app for immediate doctor review, supporting timely interventions. Enhanced by a motorized design, adjustable seating, and remote control, the Wheelchair is a comprehensive, portable healthcare solution ideal for emergencies.

Keywords: Smart Wheelchair, Medical Diagnostics, Portable Healthcare, Emergency Medical Devices, Real-Time Health Monitoring.

FABRICATION OF MARINE FUNGAL BIOFILM-BASED BIOCOMPOSITES FOR SUSTAINABLE APPLICATION IN PYRENE REMEDIATION

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ABSTRACT

Marine filamentous fungi are ecologically important microbes renowned for their unique adaptations and metabolic versatility under challenging environments. These fungi hold substantial biotechnological significance as prolific producers of extracellular enzymes and secondary metabolites. The fungal mycelium rapidly develops biofilm over the organic substrate by enzymatically solubilizing and penetrating the surface for nutrient acquisition. Furthermore, the synthesized extracellular matrix serves as a natural binding agent, forming distinct substrate-mycelium biomass, often referred to as mycelium-based composite. In the present study, the marine fungus Aspergillus falvus JKSC-7 was explored for its ability to colonize the agro-wastes to develop a mycelium-based biocomposite (MBC) and determine its role in pyrene remediation. MBCs are sustainable and innovative functional biomaterials that utilize the metabolic ability of fungi to remove organic pollutants such as polycyclic aromatic hydrocarbons from contaminated environments. Aspergillus falvus JKSC-7 effectively colonized rice husk, wheat bran, and sugarcane bagasse, forming a biocomposite over 30 days of incubation. The scanning electron micrographs revealed a rough surface with low composite porosity, indicating dense fungal colonization. A higher dry density and low moisture retention capacity of biocomposite indicated their high stability under an aqueous environment. In addition, x-ray diffraction analysis revealed a crystalline structure with major peaks aligning with cellobiose, dextrose, and mannitol. The MBC showed 80.3 % pyrene removal efficiency over 24 h of incubation, significantly higher than the removal efficiency of routinely used polyurethane carriers. The properties of MBC render it an environment-friendly, biodegradable biomaterial for application in large-scale bioremediation processes. MBC's development process integrates by-product generation with organic waste management, aligning with sustainable developmental goals and promoting a circular blue economy.

Keywords: Marine filamentous fungi, Aspergillus flavus JKSC-7, Agrowastes, Biofilm-based biocomposite, Bioremediation, Blue Economy.

HARNESSING THE METABOLIC POTENTIAL OF MARINE STREPTOMYCES IN THE BLUE ECONOMY PARADIGM FOR THE SUSTAINABLE PRODUCTION OF BIOPLASTIC

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ABSTRACT

The untapped potential of marine environments offers a vast reservoir of unique microorganisms with novel metabolic pathways, paving the way for innovative biotechnological applications. Streptomyces strains isolated from the marine environment of the Bay of Bengal, Odisha, India, were screened for polyhydroxybutyrate (PHB) synthesis where S. nigra KDS4 showed the highest PHB accumulation. PHB is a bioplastic synthesized by microorganisms and it offers a sustainable, versatile, and eco-friendly alternative to traditional plastics, addressing both environmental and functional challenges across various industries. Optimized conditions (pH 7.5, salinity 2.5%, temperature 30.6˚C, and 6-day incubation) and a starch-to-KNO_3 ratio of 20:1 enhanced the biomass (3.95 g/L) and PHB accumulation (2.63 g/L), as determined via response surface methodology (RSM). The elemental composition and surface morphology of PHB were determined using field emission scanning electron microscopy and energy dispersive X-ray spectroscopy (FESEM-EDX). The biophysical characterization identified the major functional groups (carbonyl, methyl, methylene), and the chemical profiling through GC-MS revealed different compounds (2,4-di-tert-butylphenol, n-hexadecanoic acid, octadecenoic acid) present in the polymer. PHB exhibited a tensile strength of 0.61 Kg/mm2, and elongation at break of 15%. The biodegradability of the PHB film was assessed, showing 92.3% degradation within 30 days. Further, the biocompatibility of the PHB was confirmed using HaCaT cell line showing 82.40 to 72.84% cell viability, demonstrating its potential for various applications. The utilization of marine Streptomyces for bioplastic production, and other high-value applications represents a promising avenue for addressing global sustainability challenges while advancing the principles of the blue economy.

Keywords: Marine bacteria, Streptomyces nigra KDS4, PHB synthesis, Bioplastic, Blue Economy, Sustainability.

TURNING SPIRULINA STRESS INTO SUCCESS: A CIRCULAR ECONOMY BLUEPRINT

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ABSTRACT

The rapid growth of the global population is placing immense pressure on food production systems, leading to resource depletion and environmental degradation. Traditional agriculture, being resource-intensive, is unsustainable to meet growing food demands. At the same time, food insecurity remains a pressing challenge, requiring innovative and sustainable approaches to ensure adequate nutrition while protecting natural resources. Spirulina sp. provides a promising solution by producing high-value bioactive compounds and nutrient-rich biomass while being cultivable in marine or brackish water, reducing reliance on freshwater and arable land. The present work explores the potential of Spirulina sp. in establishing a circular economy through an integrated, zero-waste biorefinery model. Spirulina sp. cultivated under stress-induced conditions enhances the production of high-value bioactive compounds such as phycocyanin and exopolysaccharides (EPS). Phycocyanin, a blue-green pigment, functions as a bioactive ingredient in functional foods and nutraceuticals. The residual biomass, rich in proteins and essential nutrients, will be utilized as a food supplement. Additionally, exopolysaccharides secreted into the culture medium will be recovered from the spent solution and repurposed as plant biostimulants, providing an eco-friendly alternative to fertilizers. This approach boosts resource efficiency, reduces emissions, and transforms waste into valuable products, offering scalable, sustainable solutions for food and environmental conservation.

Keywords: Spirulina sp., Circular economy, Phycocyanin, Exopolysaccharides, Nutrient-rich biomass, Food security.

EXTRACTION AND CHARACTERIZATION OF BIOACTIVE POLYSACCHARIDES FROM SEA WEEDS: INNOVATIONS AND APPLICATIONS IN FOOD AND MEDICINE

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ABSTRACT

Fucoidan, a bioactive sulfated polysaccharide predominantly found in the cell walls of brown seaweeds (Sargassum ilicifolium), is gaining significant attention for its diverse health benefits and functional properties. Structurally, fucoidan consists of a backbone of sulfated α-L-fucose with occasional branching and substitutions of sulfate, galactose, xylose, or uronic acid, contributing to its unique bioactivities. Fucoidan has demonstrated potent antioxidant, anti-inflammatory, anticoagulant, antiviral, and anticancer properties, making it a valuable compound for functional food, pharmaceutical, and nutraceutical applications. This study compares the efficiency of conventional stirring and ultrasound-assisted extraction (UAE) methods for isolating fucoidan from Sargassum ilicifolium. A detailed characterization was performed, including yield, proximate composition, sulfate and fucose content, phenolic concentration, antioxidant activity, and functional properties. The results showed that UAE not only achieved significantly higher yields but also enhanced the bioactivity and functional properties of fucoidan compared to conventional methods. These improvements are attributed to the structural integrity and preservation of active moieties facilitated by the UAE. The integration of UAE introduces a sustainable, innovative approach to fucoidan extraction, addressing the growing demand for high-quality bioactive compounds. This study highlights the immense potential of fucoidan as a high-value bioactive polysaccharide, offering significant health benefits and broadening its applicability in food, pharmaceutical, and biotechnological industries. Furthermore, it underscores the role of advanced extraction technologies in unlocking the value of marine bioresources, contributing to the development of a sustainable blue economy.

Keywords: Fucoidan, Bioactive Polysaccharides, Ultrasound-Assisted Extraction, Antioxidant Activity, Marine Bioresources.

MARINEBIOPREDICT: REVOLUTIONIZING PHARMACEUTICALS WITH MARINE BIOPRODUCT INNOVATION

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ABSTRACT

Marine ecosystems hold immense potential for pharmaceutical innovation, offering a rich diversity of bioactive compounds. However, the development of marine-derived drugs is hindered by challenges such as variable bioactivity, toxicity risks, complex regulations, and a lack of predictive tools. These barriers lead to delays, high R&D costs, and suboptimal formulations. MarineBioPredict is a data-driven platform designed to revolutionize marine-based drug development. By integrating diverse datasets, it enables predictive toxicology, structure-activity relationship (SAR) analysis, efficacy modeling, and pharmacokinetics assessments. Advanced computational models identify safe and effective compounds, focusing on antimicrobial and anticancer agents with novel mechanisms of action to address global challenges like antimicrobial resistance. Promoting sustainability through eco-friendly marine sourcing, MarineBioPredict optimizes formulations for safety, efficacy, and regulatory compliance while reducing costs. This innovative approach accelerates the transition from discovery to market-ready pharmaceuticals, bridging the gap between marine biodiversity and healthcare innovation. Redefining the future of drug discovery, delivering safer, more effective, and sustainable treatments to meet the needs of modern medicine.

Keywords: Marine bioactive compounds, drug discovery, predictive toxicology, antimicrobial resistance, sustainability, pharmaceutical innovation.

MARINE TOXIN DETECTION AND RISK ASSESSMENT USING COMPUTATIONAL FLUID DYNAMICS (CFD) MODELS

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ABSTRACT

Marine toxins, including harmful algal blooms (HABs), biotoxins, and waterborne pathogens, represent significant risks to human health, marine ecosystems, and the fishing industry. These toxins accumulate in seafood, leading to poisoning when consumed, and affect marine life. Traditional detection methods are time-consuming and unsuitable for real-time monitoring while existing risk assessment tools are limited under dynamic environmental conditions. This study proposes the integration of Computational Fluid Dynamics (CFD), molecular dynamics (MD) simulations, molecular docking, and Quantitative Structure-Activity Relationship (QSAR) models to assess marine toxin risks. CFD will be employed to simulate ocean currents, temperature, and toxin dispersion, providing insights into how toxins will spread and accumulate under varying environmental conditions. MD simulations will explore the molecular behaviour of toxins, while molecular docking will evaluate their interactions with marine organism receptors to assess bioaccumulation and toxicity. QSAR models will be used to predict the toxicological properties of emerging toxins based on chemical structure, allowing for faster detection and proactive risk management. By combining these methods, the model will offer a comprehensive, real-time risk assessment tool that accounts for both environmental dynamics and molecular interactions, enhancing the ability to predict and mitigate the impact of marine toxins on ecosystems and human health.

Keywords: Marine toxins, Computational Fluid Dynamics (CFD), Molecular Dynamics (MD), QSAR models, Risk assessment

OCEAN'S SECRET CODE: AI-DRIVEN DISCOVERY OF IMMUNE-BOOSTING MARINE TREASURES

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ABSTRACT

Marine biodiversity has a wealth of untapped potential for the discovery of emerging bioactive compounds, including those with immune-boosting properties. However, the process of identifying these compounds has been slow and inefficient due to the complex nature of marine ecosystems and the challenges of screening vast chemical libraries. Despite advances in natural product discovery, there remains a significant gap in leveraging the full potential of marine organisms for therapeutic applications. To achieve this aim, current approaches are not scalable. The opportunity lies in utilizing cutting-edge technologies like artificial intelligence (AI), quantum computing, and molecular docking to accelerate the identification and development of these compounds. This research proposes the development of an AI-driven computational platform that decodes the "secret code" of marine biodiversity, using machine learning to predict the bioactivity, safety, and efficacy of marine-derived compounds. By integrating quantum chemistry and AI-driven metabolic pathway analysis, this platform will enhance the efficiency and scalability of bioactive compound discovery and biomanufacturing. A centralized marine bioactive database will further support these efforts, streamlining access to valuable data and accelerating the research and development of immune-boosting therapies derived from the ocean's diverse organisms.

Keywords: Marine Biodiversity, Immune-Boosting Compounds, AI-Driven Discovery, Biomanufacturing, Drug Discovery.

CULTIVATING, EXTRACTING AND UTILIZING SEAWEED-DERIVED COLORANTS FOR SUSTAINABLE AND POTENTIAL NOVEL APPLICATION IN FOOD INDUSTRY

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ABSTRACT

Freshness is crucial in consumer food purchases, emphasizing the need for effective quality monitoring in the food supply chain. This study developed a pH-sensitive film to monitor food freshness, using biopolymers and phycocyanin, a pH-sensitive pigment with antioxidant and antimicrobial properties extracted from Spirulina sp. Colorimetric analysis showed a range of colour variations from purple to greyish-red across pH ranging from 2 to 12. Incorporating phycocyanin at 25%, 50%, 75% and 100 % resulted in significant colour change, whereas higher concentrations enhanced the film's colour. FTIR analysis revealed distinct phycocyanin peaks at 1649 cm^{-1}, 1328 cm^{-1}, and 1151 cm^{-1} corresponding to C=O, C-H, and -OH bonds, respectively, in phycocyanin-incorporated film. XRD showed crystallinity of 91.8% with broader peak at 21.6◦ for the phycocyanin-incorporated film, indicating the crystalline nature of the polymers. SEM results indicated phycocyanin incorporation leading to a more heterogeneous surface at higher concentrations. This film shows potential as a visual indicator for monitoring food freshness during storage.

Keywords: Phycocyanin, pH-sensitive film, Food wastage, Packaging system.

SMART PH-SENSITIVE FILM: A STEP TOWARDS REDUCING FOOD WASTE

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ABSTRACT

Marine algae play a crucial role in the food chain and contribute to more than 70% of the world's total biomass. The Indian coastline, stretching over 7516.6 km, is rich in biodiversity (green seaweed: 216 species, red seaweed: 434 species, and brown seaweed: 194 species). A total of 865 seaweed taxa have been documented in Indian waters (Maharashtra: 240 species, Tamil Nadu: 282 species, Gujarat: 198 species, and other coastal states). Seaweed is an excellent source of natural food colours (chlorophyll, carotenoids, and xanthophylls), and imparts sensorial and health properties (anticancer, antioxidant, antidiabetic, and anti-inflammatory). The market for food colorants is steadily growing, with projections indicating it will reach US$5.58 billion by 2027. Generally, the food, cosmetics, and pharmaceutical sectors use artificial colorants. More and more people are paying attention to the growing trend of using natural pigments instead of synthetic ones. This is because people want natural products and natural products are safer and better for your health. Artificial or synthetic pigment application has its limits, as it causes health risks and is very sensitive to light, temperature, and pH. They are highly toxic for human consumption. Permitted synthetic colorants upon prolonged consumption may still pose serious health defects in the long run. Seaweed pigment has the potential to replace synthetic colour for use as a food colorant and needs to be focused on the development of novel extraction techniques that meet the requirements of being environmentally friendly, cost-effective, sustainable, food-compatible, and feasible for industrial scale-up. Using seaweed in this way also helps marine farming and encourages a circular economy, which fits with the growing need for eco-friendly and plant-based solutions. As research advances, these colorants could find novel applications in a wide range of food products, from beverages to confectioneries, aligning with consumer preferences for clean-label and eco-conscious products.

Keywords: Seaweed; Food colorant; Pigment extraction; Health benefits.

EXAMINING THE ROLE OF THE BLUE ECONOMY IN ECONOMIC GROWTH: EVIDENCE FROM BRICS COUNTRIES

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ABSTRACT

Background of the Study: In general, a country's growth cannot be possible without a significant contribution from the marine sector. This present study, it explores the relationship between the blue economy on economic growth in BRICS countries. This study provides a clear path for understanding how the blue economy contributes the economic growth in the BRICS countries. To fulfill this objective the study used secondary data from World Development Indicators, the World Bank, Food and Agriculture Organization (FAO), and the Organization for Economic Co-operation and Development (OECD). In addition, this study also examines how increasing the availability of seafood in the BRICS nations might help stimulate economic growth in the BRICS and address issues related to food security through effective management and use of water resources.

Objectives of the Study: Examining how the blue economy impacts economic growth in the BRICS countries between 2006 and 2022.

Methodology: To empirically test the objective, the study used various panel regression analyses like the Fixed Effect Model, Random effect model, and PCSE model to investigate the impact of the Blue Economy on Economic Growth in BRICS.

Outcomes: The empirical finding of the study depicts that Blue Economy has a positive impact on Economic growth in BRICS. Also, the study reveals that Fishing and aquaculture have always been an essential tool for contributing to many avenues for employment opportunities and economic growth in BRICS.

Keywords: Blue Economy, Economic Growth, Fixed Effect Model, Random effect model, PCSE.

BLUE FISH FEED LABELLING AND CERTIFICATION

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ABSTRACT

The rapid growth of aquaculture has amplified the demand for high-quality fish feed, placing immense pressure on marine resources and the environment. The Blue Fish Feed Labelling and Certification initiative proposes a standardized framework to ensure sustainability, transparency, and accountability in aquaculture feed production. This system aims to certify fish feeds based on their environmental impact, ingredient sourcing, carbon footprint, and nutritional adequacy. By promoting alternative feed ingredients such as algae, insect meal, and agricultural by-products, this certification reduces reliance on wild-caught fishmeal and fish oil, thus supporting marine biodiversity. Clear eco-labeling empowers fish farmers and consumers to make informed choices, fostering trust in the aquaculture industry. Additionally, this initiative aligns with the principles of the blue economy by driving innovation, enhancing resource efficiency, and contributing to carbon-neutral practices. The implementation of this idea could stimulate a shift toward sustainable aquaculture, benefitting ecosystems, economies, and communities. Through partnerships with policymakers, researchers, and industry stakeholders, the Blue Fish Feed Labelling and Certification framework has the potential to set global standards for responsible aquaculture practices, ensuring a balance between economic growth and marine conservation.

Keywords: Sustainable Aquaculture, Blue Fish Feed, Eco-Labelling, Marine Conservation, Alternative Feed Ingredients.

SEAWEEDS – A SUSTAINABLE SOLUTION FOR THE BLUE ECONOMY

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ABSTRACT

Seaweeds are emerging as a significant solution in the Blue Economy, addressing critical environmental and economic challenges through their numerous applications. As a natural and renewable marine resource, seaweeds play an important role in carbon sequestration, absorbing significant amounts of CO_2 and contributing to the fight against climate change. Additionally, they improve marine ecosystems by reducing nutrient pollution, combating harmful algal blooms, and enhancing water quality. Beyond their ecological benefits, seaweeds offer innovative solutions to pressing global issues. They are a key raw material for bioplastics, presenting a biodegradable and eco-friendly alternative to conventional plastics, and for biofuels, contributing to the global transition to renewable energy with a reduced environmental footprint. Here the root cause of pollution is synthetic plastic. Burying plastic in soil will adsorb and transport contaminants, such as heavy metals and other pollutants, in the soil environment resulting in a series of toxic effects to soil health, fauna and flora through complex interactions. Burning plastic will release toxic gases which are not good for the environment. Sometimes animals like cows eat plastics and eventually end their lives but there will be no effect to the plastic. If we attack on the root, the whole plant will vanish i.e., just eradicate synthetic plastic and bring an eco-friendly alternative and then most of the environmental problems will get over. For Blue Economy, the most effective alternative is bioplastic (made from seaweed). One easy, cheap, and unique product that I have thought is creating a multifunctional bioplastic processing unit that will carry out all the operations of production like extraction, filtration, concentration, molding etc. in one single machine. This machine will use less area which will be utilized for other important processes. It will also cut the cost of buying separate heavy machinery which are used for separate processes in the current scenario. This machine will increase the production of bioplastic as the processes carried out will be continuous.

Keywords: Seaweeds, Blue Economy, Bioplastics, Sustainable Solutions, Carbon Sequestration.

AhR JAYANTI ROHUTM: REDEFINING SUSTAINABLE AQUACULTURE

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ABSTRACT

Indian Major Carps (IMCs) represent 87% of India's freshwater aquaculture production, with Labeo rohita (rohu) being exceptionally popular due to its taste and exorbitant market demand. However, the rising seed demand and intensified aquaculture practices have led to disease outbreaks, adversely affecting farmers and the economy. Bacterial infection, particularly from Aeromonas hydrophila, poses significant threats and is associated with small surface lesions, dropsy, hemorrhages and septicemia, ulcers, and fin, and tail rot in carp. Selective breeding has emerged as a reliable strategy to combat high mortality rates and production loss, offering promising long-term protection by enhancing disease resistance traits in subsequent generations. ICAR-CIFA has initiated the selection program on rohu since 1992 with a mandate for improved growth and has achieved an average of 18% genetic gain after eight generations of selection using six different diverse stocks as founder populations. Later, in 2004, disease resistance against A. hydrophila was added as a second trait. The challenge test results revealed 58% higher survivability in the resistant line with a significant positive correlation among the growth and disease-resistant traits. This technology opens new research avenues and horizons for the improvement of survival rates against aeromoniasis through Marker Assisted Selection (MAS), Proteomics, Metagenomics and Genome Editing (GE) approaches leading to the identification of genetic markers linked to disease resistance trait, proteins that are differentially expressed, comparative microbial diversity study and elucidation of immune-related pathways with disrupted target genes. Identifying novel candidate genes that impart resilience and selection of the broodstock with improved disease resistance will pave the way to ensuring healthier and more resilient populations in the era of climate change. Adopting these genetically improved strains could significantly boost production, reduce prices, and enhance sustainability and the livelihoods of fish farmers while mitigating financial and nutritional risks through integrated cultivation systems.

Keywords: Selective breeding, Disease resistance, Jayanti rohu, Aeromonas hydrophila, Aquaculture.

SEAVITA : SUSTAINABLE FISH FEED FOR ENHANCED HEALTH, DISEASE RESISTANCE, AND WATER QUALITY

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ABSTRACT

Traditional fish feed relies heavily on fish meal thus depleting marine resources and harming ecosystems. It causes several problems in fish such as protein imbalance, gastrointestinal issues, parasite infestations, and disease susceptibility. It forms excess ammonia as a byproduct and degrades water quality. We have come up with an all-in-one fish feed to address the critical issues faced in the present aquaculture practices by incorporating plant-based components into our fish feed to match a complete protein profile, enhance fish immunity, and also help to sequester ammonia to improve water quality. This paves the way for sustainable aquaculture practices. Our unique feed formulation includes duckweed and other plant proteins in place of fishmeal, lipid sources such as linseed oil, other necessary minerals and omega-3 fatty acids components. This mixture is ground into a fine powder along with binders such as alginate to hold the pellet together. Water is gradually added to the mixture to form a dough-like mixture due to the activation of binders. The mixture is fed into an extrusion machine at a low temperature. The pellets formed should be around 1-2 mm to fit according to the fry's small mouth and digestive system. The pellets are further dried for stability. Seavita is not just an alternative, it's a game-changing solution to adverse problems faced during aquaculture. Plant-based charcoal binds ammonia in the digestive tract, reducing its excretion. Moringa seed extract boosts immunity, while probiotics enhance gut health. Together, they provide a complete protein profile, strengthen immunity, and lower disease susceptibility in fish. This ensures robust and disease-resistant fish development. Our fish feed can be tweaked to fit the requirements of other species.

Keywords: Blue Economy, Marine Bio-manufacturing, Marine Fisheries & Mariculture, , Marine Pollution and Marine Biodiversity & Conservation.

TURNING THE TIDE: RESILIENT FISH FOR CLIMATE CHALLENGE

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ABSTRACT

Climate change-induced salinity intrusion has impacted 25% of the global freshwater supply, with salinity levels ranging from 2 to 8 ppt within 20 km of the Indian coastline. This poses a significant threat to freshwater aquaculture, necessitating the development of sustainable practices for low-salinity environments. Experiment results support the fact that freshwater carp can endure low-saline habitats. The spawn stage of Catla exhibited survival rates of 81.25%, 53.33%, and 25.83% at 0ppt, 2.5ppt, and 5ppt salinity, respectively. Similarly, the survival rates of Jayanti Rohu fingerlings were 100%, 100%, 95%, 80% & 75% at 0ppt, 2ppt, 4ppt, 6ppt, and 8ppt, respectively. Thus, developing climate-resilient species would help sustain the production of Indian Major Carps (IMCs) in a low-saline environment. The improved varieties of CIFA, CIFA- AMRIT Catla, and Jayanti Rohu pose the possibility of greater adaptability and resilience to climate change. Conducting salinity challenge experiments across the life stages of the IMCs would guide aqua farmers to stock and rear the fish an appropriate saline environment. Supplementing feed with dietary additives would help mitigate the stress induced by salinity, thus paving the way for increased growth and survival rates of IMCs in low-saline habitats. Exploring the muscle composition of IMCs cultivated in a low-saline environment can provide fresh insights into their nutritional profiles. By bridging the research gaps and empowering aqua farmers with actionable insights, it is possible to secure the production of Indian Major Carps, thereby bolstering food security and resilience in vulnerable coastal regions. This research underscores the potential for adaptive aquaculture practices to ensure food security and climate resilience.

Keywords: Carps, Climate-resilience, Stress mitigation, Aquaculture.

RAPID BACTERIAL LOAD ASSESSMENT KIT FOR ON-SITE MONITORING

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ABSTRACT

Aquaculture plays a crucial role in India's economy, with the nation ranking second globally in aquaculture production. However, bacterial diseases pose a significant threat to this industry, causing substantial economic losses. Fluctuations in water parameters like temperature, salinity, pH, and dissolved oxygen exacerbate bacterial infections. Hence, regular monitoring of the bacterial load is essential for maintaining the pond health. To address this challenge, we propose the development of a portable kit for rapid and on-site quantification of live bacterial load in aquaculture water samples. This kit utilizes the principle of the MTT (3-(4,5-Dimethylthiazol-2-yl)-2,5-Diphenyltetrazolium Bromide) assay, a colorimetric method that measures metabolic activity as an indicator of viable bacteria. A key innovation is the inclusion of a modified solution designed to enhance formazan crystal solubility and color intensity, enabling direct correlation with bacterial concentration. The kit's simplified workflow eliminates the need for laboratory assistance or specialized skills. Bacterial load is assessed by observing the color intensity of the formazan dissolving solution, which can be compared against a color gradient strip or quantified using a portable colorimeter. The accompanying datasheet will provide an immediate assessment of bacterial load and pond health. This cost-effective and time-saving solution will empower cooperatives and farmers with a critical tool for proactive disease management in aquaculture, and ultimately contribute to the sustainable growth of India's Blue Economy.

Keywords: Aquaculture, Pond health, Bacterial load, Blue Economy.

GENOME-BASED IDENTIFICATION AND COMPARATIVE ANALYSIS OF ENZYMES FOR CAROTENOID BIOSYNTHESIS IN MICROALGAE

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ABSTRACT

Carotenoids are vital pigments in microalgae, serving critical roles in photosynthesis, and photoprotection, and as precursors for bioactive compounds with commercial value. Despite their importance, the genomic basis of carotenoid biosynthesis and the evolutionary dynamics of the associated enzymes in microalgae remain underexplored. This study employed a genome-based approach to identify and comparatively analyze key enzymes involved in carotenoid biosynthesis across diverse microalgal species. Using annotated genomes and transcriptomic data, we mapped the carotenoid biosynthetic pathways, uncovering species-specific variations in enzyme gene structure, copy number, and regulatory sequences. Phylogenetic analysis revealed distinct evolutionary trajectories for enzymes such as phytoene synthase (PSY), lycopene cyclases (LCYB and LCYE), and carotenoid hydroxylases, shedding light on adaptive modifications to environmental pressures. Functional validation through heterologous expression of selected genes in *Escherichia coli* demonstrated activity variations linked to amino acid substitutions in catalytic domains. Furthermore, comparative transcriptomic analysis under varying light and nutrient conditions highlighted differential gene expression patterns, correlating with carotenoid accumulation profiles. Integrative metabolic modeling identified potential bottlenecks in the biosynthetic pathway, providing targets for genetic engineering aimed at boosting carotenoid yields. Our findings not only enhance the understanding of carotenoid biosynthesis in microalgae but also lay the foundation for optimizing their production through synthetic biology and metabolic engineering. This research underscores the potential of microalgae as sustainable biofactories for high-value carotenoids, contributing to advancements in biotechnology, nutrition, and renewable resources.

Keywords: Carotenoids, Microalgae, Biosynthesis, Genomic Analysis, Metabolic Engineering.

UTILIZING COASTAL MACROALGAE FOR ECO-FRIENDLY AGRO-INDUSTRIAL WASTEWATER TREATMENT AND RESOURCE RECOVERY

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ABSTRACT

Agro-industrial wastewater is a significant environmental concern, containing pollutants such as heavy metals, organic compounds, and excess nutrients that threaten aquatic ecosystems and biodiversity. This study explores the potential of utilizing macroalgae isolated from coastal areas as a sustainable solution for agro-industrial wastewater treatment and biomass valorization. Macroalgae serve as natural biofilters, effectively removing pollutants through biosorption and nutrient uptake, offering an eco-friendly and cost-effective alternative to conventional methods. The harvested macroalgae biomass can be valorized into valuable products such as biofuels, biofertilizers, bioplastics, and animal feed, promoting resource recovery and contributing to the circular economy. This dual-function approach enhances agro-industrial wastewater treatment efficiency and supports industries in reducing their environmental footprint while creating economic opportunities. By integrating macroalgae-based systems into agro-industrial wastewater management, this study demonstrates an innovative strategy for addressing pollution and fostering sustainability in line with global environmental goals.

Keywords: Agro-Industrial wastewater, Macroalgae, biomass valorization, Cost effective

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INFECTIOUS PATHOGENS AND ANTIBIOTIC REMEDIATION FROM WASTEWATER BY FORMULATED ALGAE

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ABSTRACT

Clean water is vital to human health, agriculture animal husbandry, etc. Water pollution is a global concern; it could change ecosystem dynamics and endanger human health and other living organisms. Wastewater from hospitals, municipalities, pharmaceutical establishments, and agriculture are the leading causes of the recent rise in the levels of primary water contaminants, which include detergents, personal care products, microplastics, polyfluorinated compounds, pharmaceuticals, and household and agricultural wastes. Through natural methods, such as running off, erosion, weathering, atmospheric deposition, etc., inorganic and biological contaminants can find their way into the total environment. Approximately 80% of municipal wastewater released into aquatic bodies is untreated. The most current technological advancements in removing waterborne diseases aim to enhance environmental safety and public health by illuminating the frequent aquatic bacteria that cause catastrophic diseases. Indeed, antibiotic resistance has been linked to 58,000 decimations in India, apart from antibiotics administered to animals in the estimated amount of 63,151 tonnes in 2010 in field waters. This would cause a projected increase of 67% in additional antibiotics by 2030. Thus, the algae-mediated antibiotic degradation product is the priority in this method with the techniques often seen with blue-green algae and some microalgae. Indeed, algae afford a more sustainable remedial system than the higher plants.

Keywords: Blue economy, algae, infectious disease, and antibiotics.

NANOPARTICLES COATED PAPER STRIPS FOR THE VISUAL AND COLORIMETRIC SENSING OF HEAVY METALS

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ABSTRACT

Heavy metal contamination creates significant risks to human and environmental health, demanding accessible and efficient detection methods. Conventional techniques, such as atomic absorption spectroscopy (AAS), inductively coupled plasma mass spectrometry (ICP-MS), and X-ray fluorescence (XRF) offer high precision but are expensive, time-consuming, and impractical for on-site use. Nanotechnology offers a promising solution through the development of paper-based sensors functionalized with nanomaterials such as gold nanoparticles, carbon nanotubes, and quantum dots. These sensors have the unique physicochemical properties of nanomaterials to enable rapid, cost-effective, and on-site detection of heavy metal ions via colorimetric or electrochemical signals. Despite advancements, challenges persist in achieving reproducibility, stability, and sensitivity in complex environmental matrices. This research presents a novel nano based paper strip sensor that addresses these limitations by incorporating higher reduction potential metal nanoparticles for detecting a broad range of heavy metals. This approach enhances the sensor's selectivity and sensitivity, enabling rapid detection and reliable detection of heavy metal ions at trace concentrations. The proposed nanobased paper strips are inexpensive, user-friendly, and capable of producing results in under 10 minutes, making them ideal for field applications. With the heavy metal testing market expected to grow at a compound annual growth rate (CAGR) of 6.8%, driven by stringent regulations and rising awareness of contamination risks, this technology addresses an urgent market demand. Furthermore, the technology's compatibility with IoT integration facilitates real-time data analysis, remote monitoring, and timely intervention strategies. This advancement in nano based sensing holds significant potential to revolutionize heavy metal contamination monitoring and contribute to global health and environmental sustainability.

Keywords: Atomic Absorption Spectroscopy (AAS), Inductively Coupled Plasma Mass Spectrometry (ICP-MS), X-ray Fluorescence (XRF), Nanoparticle coated paper strips, Heavy Metals.

SYNERGISTIC ANTIMICROBIAL ACTION: BACTERIOCINS AND THERMALLY STABLE PROTEASE INHIBITORS AS NOVEL SEAFOOD PRESERVATIVES

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ABSTRACT

As concerns grow over the harmful effects of chemical preservatives on human health, there is a pressing need for safer and more sustainable solutions for seafood preservation. This presentation introduces a novel approach that combines the power of bacteriocins and thermally stable protease inhibitors. Bacteriocins, natural proteins produced by bacteria, help prevent spoilage by stopping harmful microbial growth, while protease inhibitors protect the quality of seafood by preventing enzyme-related degradation. Thanks to their stability across various temperatures and pH levels, these agents work effectively in diverse conditions. Together, they offer a healthier, eco-friendly alternative to chemical preservatives, meeting the demand for cleaner, safer food preservation methods.

Keywords: Bacteriocins, thermally stable protease inhibitors, seafood preservation, antimicrobial synergy, food preservatives, enzyme inhibition, sustainable solutions, FDA approval, EFSA standards, reduced toxicity.

GREENCRISP (ALGAE-BASED BACON STRIPS) AN ECO-FRIENDLY ALTERNATIVE TO BACON

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ABSTRACT

The growing demand for sustainable, healthier meat alternatives underscores the need for innovative solutions to tackle the environmental and health challenges of conventional pork bacon. While plant-based options offer a step forward, they often struggle to match the taste, texture, and nutrition of traditional bacon. Additionally, the WHO classifies bacon as a Group 1 carcinogen, and many plant-based versions, with added sugars and refined oils, can impact blood sugar levels. This study introduces Vegan Bacon, a novel microalgae-based alternative that addresses these challenges through an innovative approach. Microalgae, recognized for their high protein content, essential fatty acids, and bioactive compounds, serve as the primary ingredient in Vegan Bacon. The literature survey highlights that microalgae offers a nutritionally superior profile, featuring lower fat content, zero cholesterol, and an abundant supply of omega-3 fatty acids. Vegan Bacon not only addresses the environmental challenges posed by livestock farming but also promotes better health outcomes by reducing dietary cholesterol and saturated fats. This formulation leverages a unique combination of microalgal biomass and natural flavouring agents to replicate the savoury umami profile, fibrous texture, and visual appeal of pork bacon. This innovative idea aims to address the nutritional deficiencies prevalent in the Indian diet, specifically in iron, protein, and vitamin B12 by utilizing microalgae-based bacon products. All raw materials will be sourced in food-safe grade, as certified by the FSSAI, and processed into powdered forms for appropriate blending. This formulation enables to achieve the desired bacon strip shape. Following the completion of product development, rigorous food safety trials and shelf-life evaluations will be conducted to ensure quality and compliance. This approach not only promotes healthier dietary choices but also supports sustainability in food production. This innovation bridges the gap between plant-based and traditional meat products, offering a viable and scalable solution that supports sustainability, health, and food security. Vegan Bacon represents a transformative step forward in the development of future food systems, catering to both consumer demand and global sustainability goals.

Keywords: Microalgae, Sustainable food innovation, Omega-3 fatty acids, Umami flavour.

BLUE ECONOMY SOLUTIONS: DEVELOPING COST-EFFECTIVE MICROBIAL FUEL CELLS FOR A SUSTAINABLE FUTURE

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ABSTRACT

The multi-faceted problems of the blue economy concomitant with environmental pollution and global warming have drawn attention to the exploration of renewable energy sources. As an alternative wastewater treatment and energy generation option, microbial fuel cells (MFCs) have garnered attention wherein the organic matter in wastewater is utilized as a substrate to stimulate microbial metabolism that could be explored in the form of bioelectricity. Over past years there have been tremendous research advances linked with MFCs in the form of the mechanisms involved, reactor configurations, electrode materials like Pt-based air cathode, carbon cloth/paper, carbon nanotubes, etc., and proton exchange membranes to partition the anodic and cathodic chambers, however, the process is difficult to scale-up and expensive. With intrinsic properties of high surface-area-to-volume ratio, porosity, and electrical conductivity, biochar (carbonaceous-rich matter) could be utilized as an alternative electrode material and proton exchange barrier. Simultaneously cultivation of microalgae in wastewater treats the contaminated water and aids in biomass and bioenergy production. The proposed project aims to optimize the production and modification of biochar from lignocellulosic biomass, for better electrical conductivity. Further, the design and operational aspects of MFCs including the distance between electrodes, nutritive properties of wastewater, algal cultivation, and operation time will be optimized to improve the power density in MFCs. This waste-to-wealth transition method utilizes agro-residues, and wastewater, where decentralized wastewater treatment with additional revenues from bioenergy and value-added bioproducts will be achieved leading to less eutrophication and resource recovery from wastewater and sustainable carbon sequestration.

Keywords: Algae; biochar; sustainable; value-added product; water.

SEAWEED : NATURE'S SHIELD AGAINST ALLERGIES

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ABSTRACT

Problem Statement
According to Global Allergy & Airways Patient Platform, allergic conditions affect 30-40% of the global population with the prevalence increasing in children. Conventional treatment options such as antihistamines, or steroids, possess certain risk factors even though they are effective.

Solution
Brown Seaweed has great nutritional and therapeutic value with bioactive compounds like fucoidans and phlorotannins, which can serve as anti-allergens. Fucoidans not only suppress histamine release from mast cells but also aid with maintaining TH1/TH2 balance, and inhibiting IgE expression and IgE-secreting B cells. Phlorotannins prevent IgE antibodies from binding to FcεRI receptors on mast cells, thus blocking degranulation and histamine release.

Methodology
These compounds can be purified from the raw seaweed by traditional methods like maceration, infusion, percolation or by advanced methods such as enzyme treatments, microwave treatment, ultrasonication. Advanced methods ensure sustainable use of solvents and energy. The purified extracts would be further processed for safe and effective human consumption. In line with SDGs 3, 12 and 14, our solution is versatile and eco-friendly.

Outcomes
1) Seaweed Gummies - Contains phlorotannins which helps reduce the effects of allergic reactions. It is safe and easy to consume with the target consumers being children especially.

2) Seaweed Ointment - Contains fucoidans which can be used to reduce inflammation and skin irritation including hydrating properties.

Summary
With an increase in allergic sensitivity in the population, our product can be scaled to cater to a large group of consumers. The availability of seaweed along the Indian coastline helps in the sustainable extraction processes. The bioactive compounds of seaweed acting as anti-allergens is an untapped market which can compete with well-established medications.

Keywords: Seaweed, Anti-Allergens, Sustainable and Accessible, Economical.

MANGROVE LITTER AND INTEGRATED MANGROVE AQUACULTURE (IMA) SYSTEMS- IMPLICATIONS TOWARDS SUSTAINABLE COASTAL AQUACULTURE IN SUNDARBANS

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ABSTRACT

Coastal mangroves serve various ecological and socio-economic functions, including in the blue economy; hence, they are crucial to achieving the United Nations Sustainable Development Goals (SDGs) 2030. Sundarbans, the world's largest contiguous mangrove forest, a UNESCO World Heritage Site, and a RAMSAR Site formed on the delta of Ganga-Brahmaputra-Meghna, faces the northeast coastal Bay of Bengal (BoB). The fringes of Sundarbans are reeling from unsustainable coastal aquaculture practices and leading towards a multifaceted negative impact on the ecosystem. A new approach, integrated mangrove aquaculture (IMA), offers new hope for sustainable aquaculture through mangrove leaf litterfall that can drive growth, provide disease resistance to shrimp, and flourish better livelihood opportunities for fisher folks. During the present study, 12 aquaculture ponds, which comprise 9 IMA ponds and 3 control ponds (non-IMA), were monitored for a period of 14 months to understand the dynamicity of mangrove leaf litter-derived phenolic groups (tannic and gallic acids). Based on key important hydro-ecological parameters and eDNA metagenome sequencing using Nanopore sequencing chemistry, it has been found that groups such as Actinobacteria, Bacteriodetes, and Clostridia tend to thrive in terms of number in IMA ponds that have mangrove vegetation compared to non-IMA ponds. The presence of these bacterial groups indicates that the labile forms of carbon and nitrogen in the IMA ponds may originate from microbial decomposition of mangrove litter. No hypoxic condition in any of these ponds, and pH ranged between 7.21 – 8.46 and higher concentrations of phenolics were observed in the IMA ponds, and dissolved nutrients DIN (50-365 μM), DOC (37 mg/L – 110 mg/L), o-phosphate (5 – 15 μM) and reactive silicate (10 – 80 μM). The result indicates the positive influence of mangroves in maintaining nutrient stoichiometry, providing niche-specific adaptation of primary producers, and enhancing the total bioresource yields (shrimp and fish).

Keywords: Sundarbans, Blue Economy, Bioresources, Phenolics and Hypoxic.

SUSTAINABILITY IN INDIAN MARITIME OPERATIONS: ADDRESSING GREENWASHING AND LEGAL GAPS

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ABSTRACT

The sea is the most significant front of any international trade. Today, as businesses extend everywhere, no single country can do business alone, and shipping is a real illustration of global connectivity. However, the nature and extent of the greenwashing cases are being seen, in which the businesses of the day are cheating and taking advantage of differing governmental regulation gaps to show their businesses as being environmentally responsible, which is totally false. India has faced the disadvantage of its misplaced and weak regulatory framework, allowing greenwashing to take place where enforcement tools are weak and global standards for sustainability are not being followed. The absence of an effective system for measuring and verifying emission data complicates the issues, resulting in a lack of transparency and accountability in maritime operations. The research, because it defines the characteristics of greenwashing within the framework of maritime industry in India, appraises existing policy and legal frameworks, poses the identified necessary additional legal and policy reforms that would facilitate improved compliance and broader adoption of sustainability measures. More pointedly, after identifying the existing frameworks, this study strives to draft desired actionable reforms to make the legal-scape of the industry more stringent and responsible. This particular attempt is, with the help of the guidance, to manage, structure for the provision of a clean, responsible, and sustainable industry. Moreover, this study benefits the shipbuilding field by giving an angle on what could be done to plan, steer, and make provisions of them.

Keywords: Sustainability, Indian Maritime Industry, Greenwashing, Legal Framework, Regulatory Compliance

LEVERAGING ORGANIC MATERIALS IN RENEWABLE ENERGY FOR A SUSTAINABLE BLUE ECONOMY

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ABSTRACT

Organic materials present transformative opportunities for advancing renewable energy technologies within the blue economy. From algae-based biofuels to biodegradable solar panels, these innovations align sustainability with economic development while preserving marine ecosystems. This concept highlights the potential of organic materials to contribute to decarbonization, resource efficiency, and waste reduction in maritime industries. By utilizing algae and marine biomass as feedstocks for biofuels, coastal communities can establish localized energy systems, reducing dependency on fossil fuels while promoting economic resilience. Additionally, the development of biodegradable photovoltaic materials and organic batteries can minimize environmental impact, ensuring marine biodiversity protection in alignment with SDG 14 (Life Below Water). The circular economy principles can be integrated by repurposing organic waste from aquaculture and fisheries into renewable energy sources, creating a closed-loop system that fosters both energy and food security. Collaboration among researchers, policymakers, and industry stakeholders is critical to scaling these innovations and overcoming technological and logistical challenges. This approach underpins the role of organic materials in transitioning to sustainable energy systems, ensuring climate resilience, and driving the blue economy toward a future where economic growth harmonizes with environmental stewardship.

Keywords: Organic materials, renewable energy, algae-based biofuels, sustainable development, blue economy.

ENHANCING SUSTAINABLE FISHERIES THROUGH NANOBUBBLE TECHNOLOGY AND FLUORIDE REMOVAL SYSTEMS: ADDRESSING WATER QUALITY AND ENVIRONMENTAL CHALLENGES

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ABSTRACT

The fisheries industry is confronted with critical challenges that threaten its sustainability and productivity, including water quality degradation, hypoxia, disease outbreaks, and unsustainable management practices. Fluoride contamination, resulting from industrial and agricultural pollutants, significantly impairs fish health and growth. Concurrently, low oxygen levels in aquaculture systems exacerbate fish stress and mortality rates. High-density farming amplifies disease risks, driving excessive antibiotic use that compromises aquatic ecosystems and product safety. Additionally, reliance on frequent water replacement and chemical treatments imposes high operational costs and environmental burdens. This study explores the integration of nanobubble technology and fluoride removal systems as sustainable solutions to address these challenges. Nanobubble technology enhances dissolved oxygen levels, creating optimal conditions for fish health and growth while reducing the need for water exchange. Fluoride removal systems effectively mitigate toxic contamination, ensuring a healthier aquatic environment. Together, these eco-friendly innovations promise to improve fish productivity, minimize economic losses, and promote long-term environmental sustainability in fisheries. This approach aligns with the principles of the blue economy, ensuring the viability of aquaculture systems in a rapidly changing environmental landscape.

Keywords: sustainable fisheries, nanobubble technology, fluoride removal, water quality.

Harnessing the potential of the Blue Economy: A Pathway to Sustainable Development

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ABSTRACT

The Blue Economy has emerged as a sustainable framework for utilizing ocean resources to promote economic growth, environmental preservation, and societal well-being. Covering over 70% of the Earth's surface, oceans play a pivotal role in livelihoods, food security, and climate regulation. Historically, marine resources were exploited with little regard for ecological limits or socio-economic disparities. Rooted in sustainability and equity, the Blue Economy emphasizes responsible resource utilization across sectors like fisheries, renewable energy, maritime transport, and tourism, aligning with global objectives such as the United Nations Sustainable Development Goal 14 ("Life Below Water").

This study explores the transformative potential of the Blue Economy through multidisciplinary methods, combining case studies, policy analyses, stakeholder interviews, and advanced geospatial and oceanographic tools. It focuses on four objectives: evaluating socio-economic benefits, identifying governance and technological gaps, proposing actionable policies, and developing multi-objective optimization models to balance economic growth, environmental sustainability, and social equity. Participatory frameworks incorporate perspectives from coastal communities, policymakers, and industry stakeholders, while advanced technologies like AI and IoT are employed for real-time monitoring and management.

Preliminary findings demonstrate the Blue Economy's capacity to foster resilient coastal economies, enhance biodiversity conservation, and reduce carbon footprints through ocean-based renewable energy. Sustainable fisheries, aquaculture, and marine biotechnology hold significant promise for food security, livelihoods, and innovation. However, challenges such as inadequate policy coordination, limited financial investments, and technological barriers persist, necessitating international collaboration, capacity-building, and policy reforms.

The study underscores the Blue Economy as a paradigm shift for sustainable ocean governance, offering actionable insights for policymakers and stakeholders. With commitment to ecosystem-based management, innovative technologies, and unified global efforts, the Blue Economy can address critical challenges while fostering inclusive growth and ensuring the oceans' long-term health and productivity.

Keywords: Blue Economy, Marine Resources, Ecosystem-Based Management, Multi-objective Optimization.

Salt marsh Vegetation and Carbon Stocks: A Synergistic Relationship in the United Kingdom

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ABSTRACT

The salt marsh community is one the important ecosystems that plays a vital role towards the soil stabilization, soil erosion, sea level change and climate change. The vegetation of the salt marsh is having a special characterization to prevent soil from losing and carbon storage. It has the fastest pace rate to store carbon in the ecosystem. It can have the ability to take the carbon out from the environment and store it away. There are many studies around the world about the blue carbon and vegetation community observation. The study showed the positive relationship between the carbon stocks and vegetation community of the salt marshes. There are a lot positive results for the biomass and carbon accumulation rates and its impact towards the ecosystem. Here the study is going to analyse the relation between the carbon stock and association of vegetation communities in the salt marshes of Great Britain, Wales. The study is going to analyse the relation between carbon with the plant height, plant richness, plant composition and biomass. The sample will collect by quadrates and cores. The data of vegetation variable were recorded and analysed with the soil/carbon samples by SPSS (One-Way-ANOVA & ANCOVA) to establish the relationship of vegetation variables with carbon for each salt marsh. The result will be significantly positive towards as the samples of vegetation are taking along the elevation of marsh, which have definitely some differences in data.

Keywords: Saltmarsh, Blue carbon, carbon analysis, plant community, ANCOVA.

Integrated Cultivation of Spirulina and Tiger Prawns: A Sustainable Approach for Blue Economy Development in Chilika Lagoon

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ABSTRACT

Chilika Lagoon, Asia's largest brackish water ecosystem, provides an ideal environment for sustainable aquaculture innovation under the Blue Economy framework. This study proposes an integrated farming system combining Spirulina (Arthrospira platensis), a nutrient-dense blue-green algae, and tiger prawn (Penaeus monodon), one of the region's most economically valuable crustaceans.

The cultivation model employs net-based floating cages designed to contain both Spirulina and tiger prawns effectively. These cages allow for nutrient exchange, ensuring Spirulina can utilize waste nutrients from prawn cultivation while improving water quality. Spirulina thrives in these nutrient-rich conditions, while tiger prawns benefit from the enhanced ecosystem. IoT-enabled sensors can monitor critical parameters such as water quality, nutrient levels, temperature, and dissolved oxygen, ensuring real-time optimization and minimizing risks.

This system directly aligns with multiple SDGs, including SDG 2 (Zero Hunger) by contributing to food security, SDG 8 (Decent Work and Economic Growth) by generating income for local fishers, and SDG 14 (Life Below Water) by promoting sustainable aquaculture practices and reducing pressure on wild stocks.

The proposed model offers substantial economic and ecological benefits. Spirulina, harvested as a high-value product for nutraceuticals, cosmetics, and animal feed, complements the premium revenue from tiger prawns. Preliminary estimates indicate an annual revenue boost of 35-45% per unit area. Additionally, Spirulina cultivation reduces nutrient waste, enhances water quality, and contributes to a balanced ecosystem.

By integrating IoT technology and aligning with SDGs, this innovative approach fosters sustainable livelihoods, supports marine bio-manufacturing, and promotes circular economy practices. It establishes Chilika Lagoon as a model for scalable, technology-driven blue growth that balances economic development and environmental conservation.

Keywords: Blue Economy, Spirulina, Penaeus monodon, Net-based Cage Farming, IoT, SDGs, Chilika Lagoon

Innovating the Blue Economy: A Data-Driven Approach to Sustainable Marine Resource Management and Renewable Energy Integration

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ABSTRACT

The Blue Economy is an emerging paradigm that leverages marine resources for economic growth while ensuring environmental sustainability and social equity**.** With oceans covering over 70% of the Earth's surface, they play a crucial role in climate regulation, biodiversity, global trade, and food security**.** However, unsustainable exploitation, climate change, and governance gaps pose severe threats to marine ecosystems. This paper presents a comprehensive framework for integrating technological innovations, policy mechanisms, and ecosystem-based strategies to foster a resilient Blue Economy.

The primary objectives of this study include: (i) assessing the potential of offshore renewable energy (floating solar, tidal, and wave power) in reducing carbon footprints, (ii) evaluating the role of digital transformation (AI-driven ocean monitoring, blockchain-based marine resource tracking) in strengthening governance, and (iii) analyzing the socio-economic impacts of sustainable fisheries**,** marine biotechnology**,** and blue carbon sequestration on coastal communities.

A multidisciplinary methodology is employed, combining geospatial analytics**,** machine learning models, and case study evaluations from global coastal economies. Participatory approaches involving policy stakeholders**,** local communities**,** and industry leaders ensure holistic and scalable solutions. Real-time data monitoring and predictive modeling aid in designing smart ocean zoning policies for efficient marine spatial planning.

The outcomes demonstrate that an integrated Blue Economy approach can enhance marine biodiversity conservation, improve coastal resilience, and generate sustainable employment opportunities**.** However, challenges such as policy fragmentation, limited financial investments, and technological barriers require innovative policy frameworks and international cooperation.

In conclusion, the paper advocates for adaptive governance, cross-sectoral partnerships, and sustainable financing models to transition toward a climate-resilient and technologically advanced Blue Economy, ensuring long-term economic and environmental benefits for future generations.

Keywords: Blue Economy, Offshore Renewable Energy, Sustainable Marine Management, AI-driven Ocean Monitoring, Smart Ocean Zoning, Circular Economy

Leveraging AI and IoT to Mitigate Coral Reef Mortality

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ABSTRACT

The Gulf of Mannar and the Gulf of Kutch in India host diverse coral reefs that support rich marine life, including fish, turtles, and sharks. Coral reefs, supporting nearly 25% of marine species, are essential for biodiversity, food security, coastal protection, and economic stability. However, bleaching events, driven by rising sea surface temperatures, ocean acidification, pollution, overfishing, and climate change, have disrupted ecosystems, threatened fisheries, and heightened vulnerability to climate impacts. Major bleaching events in 1998, 2010, 2016, and 2024, coupled with slow coral growth, have left the reefs in poor condition due to persistent human activities.

This study proposes integrating Artificial Intelligence (AI) and the Internet of Things (IoT) to monitor, protect, and restore coral reefs effectively. IoT-enabled environmental sensors monitor critical parameters such as temperature, pH, salinity, and dissolved oxygen in Indian coastal waters. Smart buoys, underwater sensor networks, and drones equipped with cameras and sensors collect real-time data for analysis. AI-driven image recognition systems analyze underwater imagery to detect bleaching events, classify coral species, and assess reef health.

Machine learning models predict reef responses to climate change, aiding in the identification of optimal restoration strategies, such as resilient coral transplantation sites. Automated technologies like underwater robots enhance restoration efforts by streamlining coral planting.

The outcomes highlight the potential of these technologies to deliver actionable insights for policymakers, enabling targeted conservation strategies and real-time interventions. This approach directly supports SDG 13 (Climate Action), SDG 14 (Life Below Water), SDG 12 (Responsible Consumption and Production), and SDG 9 (Industry, Innovation, and Infrastructure). By addressing immediate threats and fostering resilience, this framework ensures scalable and cost-effective solutions for coral reef conservation in India, contributing to sustainable development and the Blue Economy.

In conclusion, integrating AI and IoT with traditional methods offers a transformative pathway to preserving these vital ecosystems for future generations.

Keywords: Blue Economy, Marine Bio-manufacturing, Coral Reefs, Artificial Intelligence & Machine Learning, Internet of Things, Marine Conservation, Biodiversity

Comparative studies on the physicochemical and haemolytic properties of hydroxyapatite extracted from red seaweeds *Amphiroa rigida* and *Amphiroa foliacea*

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ABSTRACT

Calcifying red seaweeds combine calcium and carbon dioxide in seawater to make calcium carbonate which is a resource for the production of hydroxyapatite which finds numerous applications in biomedical field, especially in bone regeneration and dental implants. The objectives of this work are to extract hydroxyapatite from red seaweeds of North Andaman and to study its thermal, structural, morphological and haemolytic properties. Red seaweeds *Amphiroa rigida* and *Amphiroa foliacea* were collected from Lamiya Bay, North Andaman, India. Hydroxyapatite was extracted from the cell walls of *Amphiroa rigida* and *Amphiroa foliacea* using chemical treatment with hydrochloric acid to convert into calcium chloride. Upon treatment with potassium hydroxide, calcium chloride is converted into calcium hydroxide suspension which in addition with phosphoric acid, produced hydroxyapatite. From fourier transform-infrared (FTIR) spectroscopy, the functional groups were identified. The vibrational bands for O-P-O and P-O bonding were observed using FT-Raman spectroscopy. From x-ray diffraction (XRD) analysis, the extracted hydroxyapatite is found to be highly crystalline. The particle sizes from dynamic light scattering (DLS) studies were found to be 121 nm and 106 nm for *Amphiroa rigida* and *Amphiroa foliacea* derived hydroxyapatites. Thermal studies using thermogravimetric analsysis (TGA), differential thermogravimetric analysis (DTG), and differential scanning calorimeter (DSC) proved the thermal stability of hydroxyapatites. From scanning electron microscopic (SEM) analysis, the surface of hydroxyapatites were rough with slight agglomeration. High resoulution transmission electron microscopy (HTREM) studies proved the morphology of the hydroxyapatites to be rod shaped. Selected area electron diffraction (SAED) patterns depicted concentric circles with bright spots denoting high crystalline nature of hydroxyapatites. The haemolysis ratios for *Amphiroa rigida* and *Amphiroa foliacea* derived hydroxyapatites at 500 µg/mL were 8.94 % and 9.89 %, respectively, confirming its ability in non-destruction of red blood cells, making it a suitable material for biological applications.

Keywords: Marine resource, Blue Economy, Red seaweeds, Bioceramics, Hydroxyapatite, Haemolytic

WASTE TO VALUES

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ABSTRACT

In this 21st Century, with lots of technical concepts and tricks people have created lots of mechanisms to build a Developed Society. But till date it is a Major global issue in the sector of Waste management. A lot of technology has been developed to manage the Waste production but still there is a great challenge how to sort or separate Municipal Solid Wastes. With the development of Internet of Things (IoT), Machine Learning (ML) and Artificial Intelligence (AI), the traditional waste management system can be replaced with smart sensors embedded into the system to perform real time monitoring and allow for better waste management. The aim of this research is to get rid of the Global issue by implementing a segregation process with the help of Internet of Things (IoT), Sensor Chips, Multimedia embedded processor and Image processing. At present, municipal solid waste incineration (MSWI) in waste-to-energy plants is one of the main management options in most of the developed countries. The waste material collection is piling up every day in almost all the cities of India and creating hazardous situation in terms of pollution. Due to this the average life span of living beings has deteriorated to a great extent. Our main aim is to utilize these waste materials in an effective way to help mankind by the process of incineration. Incineration is the best process of combustion of Organic materials present in the waste and giving useful byproducts. The by-products of incineration are heat, flue gases and ash. The effective use of these by products can be generation of electricity, and controls the emission with producing valuable byproduct from the hazardous emission. The attempt as an assessment has been made to bring in awareness about the effective utilization of low-cost incineration and Air pollution control devices used for cleaning.

Keywords: Waste Segregation, (IoT) Internet of Things, Machine Learning, Waste Management, Incineration, Municipal Solid Waste, Pollution Control, Fuel Gas

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