DEPARTMENT OF ANIMAL HEALTH & MANAGEMENT

ALAGAPPA UNIVERSITY

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"Recent Trends in Vaccines and Biomaterials for Animal Health (RTVBAH-2024)"

RTVBAH-2024

1st& 2nd Febraury 2024

PROCEEDINGS BOOK

First Impression -2024

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Convener & Organizing Secretary
Professor and Head
Department of Animal Health and Management
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Correspondence
Prof. B. Vaseeharan, Convener & Organizing Secretary, RTVBAH-2024

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ALAGAPPA UNIVERSITY

Alagappapuram, Karaikudi - 630 003, Tamil Nadu, India.

(A State University Established by the Government of Tamil Nadu, Recognised by UGC)
[Accredited with A+ Grade by NAAC (CGPA: 3.64) in the Third Cycle]

Prof. G. Ravi, Ph.D., D.Sc.,
Vice-Chancellor

MESSAGE

I am happy to learn that the Department of Animal Health and Management is organising an International Conference on **"Recent Trends in Vaccines and Biomaterials for Animal Health"** (RTVBAH-2024). The convergence of researchers from across the globe to deliberate on this crucial subject to enhance animal health through cutting-edge research and innovation at our campus will stimulate our students' and scholars' interest in serious research. In recent years, the field of vaccines and biomaterials has witnessed unprecedented advancements, paving the way for improved animal health outcomes and a sustainable future for our planet. The exchange of knowledge and ideas at this conference will serve as a catalyst for transformative breakthroughs that will benefit not only the academic community but also the global agricultural and veterinary sectors.

Alagappa University has always been committed to fostering a culture of research excellence and academic collaboration. We take pride in providing a platform for scholars and professionals to engage in meaningful discussions, share insights, and contribute to the collective body of knowledge. The International Conference conducted here is a testament to our commitment for advanced research in critical areas that impact the welfare of animals and the safety of our environment. I congratulate the organizing committee, keynote speakers, and all the participants for their dedication to advancing scientific knowledge and addressing the challenges faced in the field of animal health. I commend the participants for utilising this platform to forge new collaborations, explore interdisciplinary approaches, and inspire the next generation of researchers and practitioners. The proceedings of this conference will undoubtedly serve as a valuable resource for scholars and professionals seeking to stay abreast of the latest developments in vaccines and biomaterials for animal health.

I wish the conference all success.

VICE-CHANCELLOR

Ph. : 04565 - 223101, 225200 • Fax : 04565 - 225202 • e-mail : vc@alagappauniversity.ac.in

PREFACE

Prof. P. Ramasamy
Former Vice Chancellor, Alagappa University

To my honoured Colleagues,

It is a pleasure to extend warm greetings to all of the distinguished academics, industry professionals, researchers, leaders, and attendees at the International Conference on "Recent Trends in Vaccines and Biomaterials for Animal Health" (RTVBAH-2024). I am delighted to have penned a preface for the proceedings book, which will undoubtedly convey the wealth of knowledge on innovative research, the creation of cutting-edge biomaterials and technologies for vaccine research, and the collaboration demonstrated during this significant occasion. The best possible health for both humans and animals can only be maintained through vaccination in environments where disease incidence is high and treatment becomes unpredictable. Devastating animal diseases such as avian influenza, bluetongue, peste des petits ruminants, anthrax, rabies, foot and mouth disease, brucellosis, and lumpy skin disease have been documented to have a negative impact not only on animal health but also on public health and well-being. The World Health Organization affirms that humans are immunized against cholera, COVID-19, rabies, rotavirus, rubella, tetanus, meningitis, hepatitis B, influenza, Japanese encephalitis, malaria, measles, meningitis, mumps, pertussis, pneumonia, polio typhoid, varicella, and yellow fever. Nucleic acid-based vaccines, biomaterial-based vaccines, mRNA vaccines, and vector vaccines are examples of current vaccine development trends. Any vaccine program, whether it is being developed from scratch or is already in place, needs to be evaluated and its effectiveness predicted using a variety of predictive models. Conventional vaccines are challenged by a complex array of antigens, enduring infections, extensive evolution in pathogens with high sequence variability, and emerging and re-emerging pathogens. Variability in hosts and pathogens, non-heritable factors, safety concerns, and a lack of understanding of the immunity-development process are some of the obstacles that prevent the successful development of vaccines. Adjuvant, long-term vaccination efficacy, public adaptability, knowledge gaps, virulence reversal, recipient-specific biological factors, business model loopholes, quality maintenance, societal expectations, and numerous other issues are among such concerns. The deficiencies in immunization programs ought to be evaluated by experts in both human and animal health at every stage. These scientific communities will inevitably collaborate and implement state-of-the-art vaccination protocols in order to promote the best possible health for both humans and animals. The exchange of ideas, interdisciplinary collaborations, and the dissemination of the most recent research findings become a keystone for promoting discussion and quickening the conversion of scientific discoveries into workable solutions as we traverse the complexity of global challenges related to animal diseases and the critical role of vaccines and biomaterials in mitigating these challenges. Our comprehension of the most recent trends, difficulties, and opportunities in the field will undoubtedly be improved by the contributions made by eminent academics, industry leaders, and speakers. Could it spur more investigation, creativity, and cooperation that advances veterinary medicine and improves animal welfare globally? I wish the conference all the best and am excited about the substantial outcomes that the participants' combined efforts will surely generate.

Sincerely,

Prof. P. Ramasamy
Formerly: Vice Chancellor, Alagappa University, Professor and Head, Department of Biotechnology, University of Madras, Director – Research, Sree Balaji Medical College and Hospital, BIHER, Chennai-600044, Tamil Nadu, India.

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Dr. **A. SENTHILRAJAN**
Registrar

Date: 24.01.2024

MESSAGE

Dear AdmiredContestants,

It is with great pleasure and enthusiasm that I welcome you to the proceedings of the International Conference on **"Recent Trends in Vaccines and Biomaterials for Animal Health"** (RTVBAH-2024). As the Registrar of Alagappa University, it is an honor to host this significant gathering of scholars, researchers, and industry professionals dedicated to advancing the field of animal health.In the ever-evolving landscape of veterinary medicine, the development of innovative vaccines and biomaterials plays a pivotal role in safeguarding the well-being of our animal companions. This conference serves as a platform for the exchange of knowledge, ideas, and cutting-edge research that will undoubtedly contribute to the improvement of animal health on a global scale.The breadth and depth of topics covered during this conference reflect the interdisciplinary nature of the challenges and opportunities in the field. From the latest breakthroughs in vaccine development to the exploration of novel biomaterials, the presentations and discussions herein showcase the collective efforts of researchers from around the world.As we navigate the complexities of animal health, it is essential to foster collaboration between academia, industry, and regulatory bodies. This conference not only facilitates the dissemination of scientific knowledge but also encourages meaningful partnerships that can drive practical advancements in the field. The shared commitment to improving the health and well-being of animals unites us all in a common purpose.I extend my sincere gratitude to the organizing committee, keynote speakers, presenters, and participants for their invaluable contributions to the success of this conference. I am confident that the insights gained, and connections forged during this event will have a lasting impact on the trajectory of research and innovation in vaccines and biomaterials for animal health.May the ideas generated, and collaborations formed during this conference inspire future endeavors that will lead to tangible improvements in the health and happiness of our animal companions.

With warm regards,

Dr. A. SENTHILRAJAN
REGISTRAR
ALAGAPPA UNIVERSITY
KARAIKUDI - 630 003

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Dr. Saengchan Senapin
Principal Researcher
National Center for Genetic Engineering and Biotechnology (BIOTEC), National Science and Technology Development Agency (NSTDA), Pratum Thani, Thailand.
Center of Excellence for Shrimp Molecular Biology and Biotechnology, Mahidol University, Bangkok, Thailand.
E. mail: saengchan@biotec.or.th

Dr. Saengchan Senapin's research primarily centers around the discovery of pathogens in aquatic animals, the advancement of diagnostic techniques and vaccines, and the exploration of host-pathogen interactions. She earned her Ph.D. in Biochemistry and Molecular Biology from The Australian National University in 2003. Currently, Dr. Senapin holds the position of principal researcher at the National Center for Genetic Engineering and Biotechnology (BIOTEC), a part of the National Science and Technology Development Agency (NSTDA) in Thailand. In addition to her role at BIOTEC, she serves as an adjunct staff member at various universities in Thailand, playing a key role as a co-advisor and external examiner for graduate students.

Dr. Senapin frequently shares her expertise as an invited speaker at both national and international conferences. Beyond academia, she offers consultancy services to companies in Thailand and abroad. Dr. Senapin actively participates as a reviewer for international journals and national and international grants. Furthermore, she serves as an Associate Editor for the Journal of Fish Diseases.

Kremlin Mark Bigtasin Ampode, PhD
College of Agriculture, Forestry, and Food Science
University of Antique, Republic of the Philippines.
E. mail: m_kremlin@yahoo.com

Dr. Ampode finished his Bachelor of Science in Agriculture majoring in Animal Science at Central Mindanao University (CMU), Musuan, Bukidnon. While employed at Gromax and Vitarich Feedmill as a Technical Nutritionist, he took the opportunity to pursue his Master's in Agriculture majoring in Animal Science at West Visayas State University – Lapaz, Iloilo City, and finished his degree in the year 2013. In the year 2016, he received a scholarship in New Zealand through the New Zealand ASEAN scholarship and obtained his Post Graduate Diploma in Agricultural Science at Lincoln University, Lincoln, New Zealand in 2017.

Fortunately, in the year 2018, he received a scholarship in The Netherlands where he received his International Diploma in Animal Feed at Aeres Training Center International, Barneveld, The Netherlands. After his studies in The Netherlands, EW Nutrition of EW Group (Germany) hired him as a consultant having the role of Technical Manager for the Philippines and South East Asia Pacific. He assumed this role from 2018 until 2021 and conducted several field trials on phytogenic feed additives as an alternative to antibiotics and mycotoxin trials in the region and presented technical seminars in livestock expo in Surabaya, Indonesia, and technical support in Thailand, Vietnam, Malaysia, Indonesia, Singapore, and The Philippines. Last January 2023, he finished his Doctor of Philosophy in Animal Science specialization in Animal Nutrition at Central Mindanao University, The Philippines, and in July 2023, he attended a short course in Poultry-cage free production at the University of Gadjah Mada, Yogyakarta Indonesia a fully funded by SEARCA. Today, he is a recipient of the ASEAN-India Research Training Fellowship of the government of India at Alagappa University. He’s a member of the Philippine Society of Animal Science and published an article in the reputable journal, animal nutritionist and Associate Professor III of the University of Antique, Republic of the Philippines.

Dr. Ha Thanh Dong
Aquaculture and Aquatic Resources Management
School of Environment, Resources and Development
Asian Institute of Technology, Thailand.

Dong (or Dong Ha) is a dynamic researcher in the field of aquatic animal health, with a primary focus on identifying emerging aquatic pathogens that impact crucial aquaculture species in Asia. He has made significant contributions to the understanding of infectious and emerging diseases, particularly in tilapia, Asian sea bass, catfish, snakeskin gourami, Siamese fighting fish, and whiteleg shrimp. Dong's innovative work extends to the development of diagnostic methods, fish vaccine development, nanobubble technology, and other disease control strategies as alternatives to antibiotics. His recent studies have unveiled unprecedented applications of nanobubble technologies in aquaculture, opening a promising new avenue for the further advancement of the industry. He has authored/co-authored over 100 international peer-reviewed articles in this field and currently serves as an advisory board member and guest editor for several reputable journals in this area. In 2023, Dong was listed as one of the world's top 2% most-cited scientists in the field of Fisheries by Stanford University. Additionally, he has been honored to contribute as an expert resource or consultant for several projects led by the Food and Agriculture Organization of the United Nations (FAO) and the WorldFish Center.

PREFACE

Prof. B. Vaseeharan
Convenor and Organizing Secretary
RTVBAH-2024

It is with great pleasure and enthusiasm that I welcome you to the proceedings of the International Conference on **"Recent Trends in Vaccines and Biomaterials for Animal Health" (RTVBAH-2024)** an international gathering that brings together scholars, researchers, and professionals from diverse fields across the globe. As the Organizing Secretary of this esteemed conference, I am honored to present this compilation of scholarly contributions that encapsulate the essence of our collective pursuit of knowledge and innovation. The RTVBAH-2024, held on 1st and 2nd February 2024 at the Conference hall, Science campus served as a dynamic platform for the exchange of ideas, insights, and cutting-edge research across a myriad of disciplines. From the outset, our goal was to foster meaningful dialogue, promote interdisciplinary collaboration, and pave the way for advancements that transcend geographical boundaries. This volume represents a tapestry of intellectual rigor, showcasing a diverse array of research papers, presentations, and discussions that took place during the conference. The contributors, hailing from various corners of the world, have brought forth their expertise, perspectives, and innovative approaches to address the complex challenges facing our interconnected global community. The papers delve into the latest developments, emerging trends, and potential solutions within each domain. As you peruse through the pages of this book, you will encounter a rich tapestry of knowledge that reflects the depth and breadth of our collective intellectual endeavors. I would like to express my heartfelt gratitude to the organizing committee, keynote speakers, session chairs, reviewers, and all participants who contributed to the success of the conference. Your dedication and commitment have played a pivotal role in shaping this intellectual mosaic. In conclusion, this proceedings book stands as a testament to the collaborative spirit that defines the RTVBAH-2024. May it serve as a source of inspiration and a reference for scholars and practitioners alike, fostering continued dialogue and progress in the realms of academia, research, and innovation.

Thank you for being a part of this enriching journey.

Warm regards,
Prof. B. Vaseeharan
Convenor and Organizing Secretary,
RTVBAH-2024.

International Conference on
"Recent Trends in Vaccines and Biomaterials for Animal Health"
(RTVBAH 2024)

Date: 1st&2nd,February-2024
Venue: Faculty of Science, Conference Hall, 4th floor, Science Campus, AlagappaUniversity, Karaikudi.

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Inaugural Invitation-01-02-2024

9.00 am	Registration	
10.30 am	Tamil Thai Vazhthuand VallalVazhthu	
10.30 am to 10.35 am	Lighting the Lamp & Honoring the Guest	
10.35 am to 10.45 am	Welcome address and Scope of the Conference	**Prof. B. Vaseeharan**, Convenor and Organizing Secretary,DAHM
10.45 am to 10.55 am	Inaugural address	**Prof. G. Ravi**, Vice-Chancellor, Alagappa University
10.55 am to 11.10 am	Presidential address	**Prof. P. Ramasamy,** FormerViceChancellor, Alagappa University
11.10 am to 11.20 am	Thematic address	**Prof. Saengchan Senapin,** Mahidol University, Thailand
11.20 am to 11. 30 am	Special address	**Prof. Ha Thanh Dong**, Chulalongkorn University, / Asian Institute of Technology (AIT), Pathumthani, Thailand
11.30am to 11.40 am	Keynote address	**Dr. Kremlin Mark Ampode**, Republic of the Philippines
11.40 am to 11.45 am	Vote of Thanks	**Dr. P. Srinivasan**, Professor, DAHM
11.45 am to 12.00 noon	**TEA BREAK**	

Prof. B. Vaseeharan,
Convenor and Organizing Secretary

Dr. A. Senthilrajan,
Registrar

Valedictory Invitation -02-02-2024

4.35 pm to 4.45 pm	Welcome address	**Dr. V. Nithya,** DAHM
4.45 pm to 5.15 pm	Report of the Conference	**Dr. N.M. Prabhu**, DAHM
5.15 pm to 5.30 pm	Felicitation Address	**Prof. Ha Thanh Dong**, Chulalongkorn University, / Asian Institute of Technology (AIT), Pathumthani, Thailand
5.30 pm to 5.45 pm	Valedictory Address	**Dr. A. Senthilrajan,**Registrar,Alagappa University
5.45 pm to 6.00 pm	Vote of Thanks	**Prof. B. Vaseeharan**, Convenor and Organizing Secretary, DAHM
6.00 pm	National Anthem	

Prof. B. Vaseeharan,
Convenor and Organizing Secretary

Dr. A. Senthilrajan,
Registrar

International Conference on
"Recent Trends in Vaccines and Biomaterials for Animal Health"
(RTVBAH 2024)

Date:1st&2nd,February-2024
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DAY-1

PlenarySessionI–01.02.2024

Session Chair :**Prof. B. Vaseeharan,** Professor and Head, DAHM **Session Co Chair** : **Prof. Ha Thanh Dong**, Chulalongkorn University, Thailand **Co-ordinator** : **Prof. V. Ramasubramanian**, Bharathiar University, Coimbatore **Rapporteur** :**Dr. N.M. Prabhu**, Associate Professor, DAHM		
12.00 noon to 12.45 pm	**Plenary Speaker 1** "Understanding Fish Immunocompetence: Fundamental Insights for Advancing Vaccine Research."	**Prof. Saengchan Senapin**, Mahidol University, Thailand.
12.45 pm to1.30 pm	**Plenary Speaker 2** Computational approach towards repurposing of FDA approved drug molecules: Strategy to combat antibiotic resistance conferred by *Pseudomonas aeruginosa*	**Prof. S. Karthikeyan**, VIT, Vellore
1.30 pm to 2.15 pm	**LUNCH BREAK**	
Plenary Session II–01.02.2024		
Session Chair : **Prof. Saengchan Senapin**, Mahidol University, Thailand **Session Co Chair** : **Prof. Ha Thanh Dong**, Chulalongkorn University, / Asian Institute of Technology (AIT), Pathumthani, Thailand **Co-ordinator** : **Prof. S. Karthikeyan**, VIT, Vellore **Rapporteur** : **Dr. P. Srinivasan**, Professor, DAHM		
2.15 pm to 3.00 pm	**Plenary Speaker 3** "Development of Marine Microalgae and Marine Copepods Derived BiomaterialsFor High Health Fish and Shrimp Production"	**Prof. Santhanam**, Bharathidasan University, Trichy
3.00 pm to 3.45 pm	**Plenary Speaker 4** "Brackish water finfish broodstock quarantine and health management in hatchery systems"	**Dr. R. Jayakumar**, Principal Scientist, ICAR, CIBA, Chennai
3.45 pm to 4.45 pm	**Session Evaluators** **Prof. Saengchan Senapin,** **Prof. Ha Thanh Dong** **Dr. Kremlin Mark Ampode** **Dr. M. Biruntha, DAHM**	**Oral Presentation**
4.45 pm to 5.00 pm	**TEA BREAK**	
5.00pm to 6.00pm	**Cultural Events**	

DAY-II
PlenarySessionIII–02.02.2024

Session Chair	**: Dr. Kremlin Mark Ampode**, Republic of the Philippines	
Session Co Chair	**:Dr. M. Jayalakshmi**, Madurai Kamaraj University, Madurai	
Co-ordinator	**: Prof. V. Ramasubramanian**, Bharathiar University, Coimbatore	
Rapporteur	**: Dr. V. Nithya**, Assistant Professor, DAHM	
10.00 am to 10.45 am	**PlenarySpeaker 5** " Nanobubbles: An Innovative Approach to Combat Antimicrobial Resistance inAquaculture"?	**Prof. Ha Thanh Dong**, Chulalongkorn University, / Asian Institute of Technology (AIT), Pathumthani, Thailand
10.45 am to 11.30 am	**Plenary Speaker 6** "Biotechnological Approaches in Aquaculture"	**Prof. V. Ramasubramanian**, Bharathiar University, Coimbatore
11.30 am to 11.45 am	**TEA BREAK**	
11.45 am to 12.30 noon	**Plenary Speaker 7** "Understanding the immunogenetics of South Indian population in the perspective of vaccine development"	**Dr. M. Jayalakshmi**, Madurai Kamaraj University, Madurai
12.30 noon to 1.30 pm	**Session Evaluators** **Prof. Saengchan Senapin,** **Prof. Ha Thanh Dong** **Dr. Kremlin Mark Ampode** **Dr. P. Kumar, DAHM**	**Oral Presentation**
1.30 pm to 2.15 pm	**LUNCH BREAK**	
2.15 pm to 3.00pm	**Plenary Speaker 8** "Antimicrobial alternatives in mitigating antimicrobial resistance for improvement of animal health and production"	**Dr. Kremlin Mark Ampode**, Republic of the Philippines
3.00 pm to 4.15 pm	**Session Evaluators** **Prof. Saengchan Senapin,** **Prof. Ha Thanh Dong** **Dr. Kremlin Mark Ampode**	**Poster Presentation**
4.15 pm to 4.30 pm	**TEA BREAK**	

PLENARY SPEAKERS

ORAL PRESENTATION

POSTER PRESENTATION

Understanding Fish Immunocompetence: Fundamental Insights for Advancing Vaccine Research

Saengchan Senapin[a,b*]

[a]*National Center for Genetic Engineering and Biotechnology (BIOTEC), National Science and Technology Development Agency (NSTDA), Pathum Thani, Thailand*.

[b]*Fish Heath Platform, Center of Excellence for Shrimp Molecular Biology and Biotechnology (Centex Shrimp), Faculty of Science, Mahidol University, Bangkok, Thailand*.

***Corresponding author: saengchan@biotec.or.th**

Abstract

Vaccination serves as a highly effective control strategy against infectious diseases, benefiting not only humans but also extends to animals, including fish. The implementation of early vaccination protocols in young fish emerges as a viable biosecurity measure, significantly mitigating the risk of infection and disease during the initial stocking period. However, the determination of the optimal age and size at which young fish attain immunocompetence for vaccine responsiveness remains a crucial inquiry. Our research delves into this phenomenon, focusing on two economically significant fish species prevalent in many Asian countries: Nile tilapia (*Oreochromis niloticus*) and Asian sea bass (*Lates calcarifer*). In the case of Nile tilapia, fish aged 1 to 42 days post yolk sac absorption, with one-week intervals, underwent immunization with an inactivated *Streptococcus agalactiae* immersion vaccination. Asian sea bass, on the other hand, was tested at 35- and 42 days post-hatching with an inactivated *Streptococcus iniae* immersion vaccination. Subsequent measurement of pathogen-specific IgM antibody levels using ELISA was conducted in both vaccinated and non-vaccinated fish. For the Asian sea bass study, the evaluation extended to immune-related genes implicated in both innate and adaptive immune pathways, assessed through RT-qPCR. In the case of Nile tilapia, the study included an examination of immune-related genes and an evaluation of vaccine efficacy through challenge tests. Our key findings indicate that Nile tilapia exhibits vaccine responsiveness as early as 28 days old (0.33 ± 0.01 g), while Asian sea bass demonstrates responsiveness at 35 days old (0.10 ± 0.03 g) in terms of both age and size. These results offer valuable insights into the optimal age and size of young fish for vaccination, shedding light on their immunological response post-vaccination. The implications of this study strongly support the feasibility of implementing an early vaccination strategy for young fish, particularly in economically significant species such as Nile tilapia and Asian sea bass.

Keywords: Immunocompetence, *Oreochromis niloticus*, *Lates calcarifer*, Vaccine.

Computational approach towards repurposing of FDA approved drug molecules: Strategy to combat antibiotic resistance conferred by *Pseudomonas aeruginosa*

Debolina Chatterjee and S. Karthikeyan
VIT Vellore, Vellore, Tamil Nadu-632 014.

Abstract

Pseudomonas aeruginosa is one of the leading causes of hospital-acquired infections like ventilator-associated pneumonia, cystic fibrosis, diabetic foot ulcers, and delayed wound healing due to the pervasiveness of the multiple drug-resistant strains. In the study, 862 unique anti-microbial resistant genes were retrieved from the NDARO database hosted by NCBI followed by which we searched for the protein-protein interaction using STRING V9.0 database and retrieved interaction for 45 genes which was then visualized and analyzed in Cytoscape 3.9.0. Among the 45 genes, the top 10 genes that manifested the maximum number of interactions are oprM, mexA, mexB, mexR, mexT, oprN, nfxB, nalC, nalD, and gyrB. Further, mexB was used in our further screening study to identify a potential inhibitor. 1602 clinically approved drugs were screened virtually against MexB to understand their ability to inhibit the MexB protein. Amongst them, the top 5 drug molecules were selected based on the binding energies for analyzing their physio-chemical and toxicity properties. Lomitapide was found to have the maximum negative binding energy followed by Nilotinib whereas the number of hydrogen bonds formed by Nilotinib was higher than that of Lomitapide. A Pharmacokinetics study revealed that all 5 drug molecules had limited aqueous solubility, and inadequate bioavailability scores for Lomitapide and Venetoclax, while Nilotinib, Eltrombopag, and Conivaptan demonstrated higher potential for therapeutic levels. A molecular dynamic simulation of Nilotinib on MexB protein was carried out for 200 nanoseconds. The Root Mean Square deviations, Root mean square fluctuations, hydrogen bond formation, and radius of gyration and MMPBSA demonstrated high stability of the protein drug complex and lesser distortions, thereby making Nilotinib a potential inhibitor to be used against MexB of *Pseudomonas aeruginosa*.

Keywords: *Pseudomonas aeruginosa*, Gene, Protein, Drug-resistant, Antibiotic resistance.

Development of Marine Microalgae and Marine Copepods Derived Biomaterials for High Health Fish and Shrimp Production

Santhanam Perumal*

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***Corresponding author: santhanamcopepod@gmail.com**

Abstract

Aquaculture remains one of the fastest-growing food-producing sectors, accounting for almost half of total food fish and substitutes for wild fish. Feed is a major input in the aquaculture system which supplies all essential nutrients for regulating growth, physiological processes, and resistance against diseases. Fishmeal is the most important ingredient of balanced feed formulas used in aquaculture. However, the rapidly growing aquaculture industry using fishmeal as a major protein source in compounded feed has strongly contributed to increased demand and prices for this product. Concern has been expressed that this may lead to over-fishing. Also, it may not be ethically correct to harvest fish for aquaculture feed which could be used directly as food for humans. Fish meal and Fish oil are especially targeted for use in protein-rich, energy-dense feeds designed for high-value marine finfish and shellfish. Among the many plant ingredients tested in fish diets, microalgae have garnered perhaps the most attention because of their widespread availability, competitive prices, and generally favorable nutrient composition. Microalgae possess high protein contents and amino acid profiles comparable to those of other reference food proteins. Apart from the high protein content, microalgae have been receiving attention as an animal food source due to their rich source of vitamins, minerals, essential fatty acids, and antioxidant pigments such as carotenoids. In addition to the high nutritional value, microalgae serve as an effective immune modulator in fish and may have the potential for use as an antimicrobial agent in aqua feed. The use of microalgae has been shown to enhance innate immunity and increase the resistance against pathogenic infection in shrimp. Therefore, considerable research has been done investigating the use of alternative ingredients to replace fish meals in feeds formulated for shrimp. In this line, the present paper reveals the effects of replacing fishmeal with microalgae meal on growth, survival, body composition, dietary antioxidant capacity, metabolic enzyme level, innate immune responses, and disease resistance of white leg shrimp *Penaeus vannamei* against shrimp pathogen *Vibrio harveyi*. Likewise, the use of live feeds for fish seed production is well established with *Artemia* and rotifer being the most common among them. Although *Artemia* and rotifer are being widely used as live food, by no means it is the optimal live food organism in terms of the nutritional requirement of fish larvae. Hence, the production of highly vulnerable larvae remains a bottleneck in the commercial culture of many fish and shrimp in India. Enrichment of *Artemia* and rotifer are widely adopted to overcome the problem of inferior nutrition supply. However, there are still other nutrient deficiencies in the enriched *Artemia,* nauplii, and rotifers, such as free amino acids availability. Furthermore, the biological composition of *Artemia* and rotifers is not stable even after enrichment. Moreover, the enrichment with commercial emulsifiers can enhance the cost of production of fish larvae. Traditionally, antibiotics have been used to treat pathogenic and nutrient-deficient fish diseases. However, the use of antibiotics causes problems for cultivable organisms and consumers. Hence, the emergence of immune exciting feed is the need of the hour. It is well-accepted that copepods are rich sources of essential amino acids (EAA), highly unsaturated fatty acids (HUFA), enzymes, antioxidants, astaxanthin, and vitamins. The high nutritional profile of copepods could counteract the compromised immune response capacity caused by stressful conditions and enhance the resistance in fish larvae. Various researchers have attempted to mass culture the different species of copepods and used them as feed for larval production of various fish and shrimp in developed countries. However, only limited attempts have been made in the Indian subcontinent on the culture and utilization of copepods in fish and shrimp larviculture on a laboratory scale. The systematic use of copepods in hatcheries has not yet been practiced so far in India. This paper reveals the significance of culture and use of marine copepods as an alternative live feed towards the high-quality larval production of commercially important fin fishes and shell fishes.

Keywords: Microalgae, Copepods, Fish, Shrimp, EAA, HUFA.

Brackishwater Finfish Broodstock Quarantine and Health Management in Hatchery Systems

Jayakumar Rengarajan*, Muniyandi Kailasam, Marappan Makesh, Ramasubbu Subburaj and G. Thiagarajan

ICAR - Central Institute of Brackishwater Aquaculture (CIBA), 75, Santhome High Road, MRC Nagar, Chennai – 600 028, Tamil Nadu, India.

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Abstract

In recent years, brackish water and marine aquaculture have been growing rapidly on a global basis with the development and expansion of sea cage farming. Salmonids, amberjacks, seabreams, sea basses, croakers, groupers, drums, mullets, turbot, other flatfishes, snappers, cobia, pompano, cods, puffers, and tunas are the major groups that are cultured. One of the major reasons for the growth of commercial fish farming is the availability of breeding techniques that can produce a sufficient quantity of seeds for different high-value marine finfish. In India, the broodstock development and seed production of sea bass, cobia and silver pompano, grouper, milkfish, grey mullet, and pearl spot was developed and standardized for commercial-level production. Broodstock collection, quarantine, and conditioning are crucial factors for successful finfish hatchery operations. Maintaining a healthy group of broodstock acclimated in captive conditions provides viable eggs through spawning, year-round. Prophylactics and quarantine are mandatory steps prior to maturation, spawning, larval, and fingerling rearing. Finfish broodstock quarantine protocols were standardized over a period of time. Detailed standard operating procedures were developed for treating the broodstock fishes against various pathogens and parasites.

Keywords: Broodstock management, Brackishwater, Finfish, Quarantine.

Nanobubbles: An Innovative Approach to Combat Antimicrobial Resistance in Aquaculture

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Abstract

Aquaculture is vital for global food security, but infectious diseases pose challenges. The widespread use of antimicrobials has led to antimicrobial resistance, necessitating alternative solutions. Our study explores nanobubble technology in aquaculture by injecting nanobubbles (≤ 130 nm) with oxygen or ozone gas into the water. Unlike larger bubbles, these nanobubbles remain suspended for extended periods. Our research reveals that zone nanobubbles (NB-O_3) at ~2-3×10^{10} bubbles/L (~1.33 mg ozone/L) are safe for tilapia juveniles, effectively reducing bacterial and viral concentrations and improving dissolved oxygen (DO) levels. Coupled with a recirculation system, NB-O_3 allows multiple treatments without harming fish, reducing bacteria in water, and improving Nile tilapia survival with an RPS of 64.7-66.7%. Interestingly, NB-O_3 treatment activates the fish's innate immune system, enhancing the response to subsequent infections and improving survival by 60-70% compared to untreated fish. Subsequently, we developed an innovative vaccination strategy, combining NB-O_3 pre-treatment, immersion vaccination during transportation (VAC-in-BAG), and oral boosters (VAC-in-FEED). This transformative approach may offer an alternative to costly and labor-intensive injection-based vaccination for the aquaculture industry. We also exploring oxygen nanobubbles as a novel delivery system for immersion vaccines. Overall, the findings highlight nanobubble technology as a promising "alternative to antibiotics" for controlling infectious diseases in aquaculture.

Keywords: Nanobubble technology, AMR, Alternatives to antibiotics, Diseases, Vaccine.

Biotechnological Approaches in Aquaculture

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Abstract

Aquaculture is an important economic sector worldwide. In this, Biotechnology has tremendous potential and it will play a crucial role in the future in substantially increasing aquatic organism production in India. The bio-encapsulation technique is one of the important techniques determining the acceptability as well as marketability of fishes, oysters, mollusks, ornamental fishes, prawns, and Shrimps. During the quality evaluation of any aqua food, any increase in food values such as proximate composition, carotenoids, amino acids, and fatty acid levels would increase the marketability of the product. Bio-enrichment studies were carried out in practical aqua culture to maintain a mass culture of edible fishes, Ornamental fishes, Prawns, and shrimp. The Nutritional quality of live feeds can be improved by enriching them with an exogenous source of nutrients. Bio-enrichment (or) Bio-encapsulation is defined as the process by which live food organisms are enriched with specific nutrients and feed to the target organism.

Cryopreservation is a process where viable cells and tissues are preserved by cooling to sub-zero temperatures, typically such as -196°C (the boiling point of liquid nitrogen). At these low temperatures, any biological activity, including the biochemical reactions that would lead to cell death, is effectively stopped.

IMPORTANCE OF CRYOPRESERVATION IN AQUACULTURE

- Preservation of genetic stocks
- Transfer of genes from wild to hatchery
- Spawning of asynchronous populations
- Better control of selective breeding
- Prevent in-breeding
- Transport over long distances

Induced Breeding is a technique of fish breeding in confined water, stimulated by artificial hormone administration, which is a Gonadotropin. Fish Breeding is the act of producing young ones from parent brood fish. In hatcheries, fish breeding is achieved by induced (artificial) breeding.

Keywords: Aquaculture, Bio-encapsulation, Cryopreservation, Breeding.

Understanding the immunogenetics of the South Indian population in the perspective of drug-induced hypersensitivity

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Abstract

The genomics era has steered a renewed interest in understanding the population-based genetic polymorphism of HLA. The HLA complex has evolved as the most shaped and is a "hyper polymorphic" system in humans. This enormous diversity is the result of the diversifying selection imposed by the threats to the immune system. Polymorphic differences between class I and class II molecules contribute to selective immune responsiveness by influencing the repertoire of their peptide binding. In recent times, HLA studies have also gained enormous interest as they are linked to adverse drug reactions which can also be ethnic-specific. The mechanism of HLA-influenced ADR starts with short peptide fragments, derived from either the drug or its metabolites, forming a peptide-HLA complex. This complex activates CD8+ T cells, which release inflammatory cytokines and initiate the hypersensitivity response. Genetic screening for such sensitive alleles could significantly reduce the incidence of drug-induced hypersensitivity. The European Medicines Agency and the US Food and Drug Administration (FDA) recommend prospective screening for sensitive alleles in patients for chosen drugs. The present study unravels the pattern of HLA allele variation in the south Indian population by employing NGS-based typing. We found most of those listed alleles are observed in more than 2% of the study population. However, alleles such as HLA-B*5701 (sensitive to the drug abacavir, flucloxacillin, pazopanib), DRB1*0701 (sensitive to ximelagatran) and DRB1*1501 (sensitive to co-amoxiclav) are observed more than 6% in this population. This study throws light on the advantages of screening the HLA alleles in at-risk ethnic groups prior to the administration of drugs that cause immune-mediated hypersensitivity reactions.

Keywords: Immunogenetics, Adverse drug reaction, HLA, NGS.

Antimicrobial alternatives in mitigating antimicrobial resistance for improvement of animal health and production

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Abstract

Livestock and poultry are the major sources of protein consumed globally. The performance of the animals in producing proteins varies due to several factors such as management, breed, and nutrition. These factors will affect animal productivity including meat quality. To achieve the desired protein production, technical specialists and farmers kept on improving their operations. Selection of breeds suited for the environment, upgrading of the buildings from conventional to tunnel-ventilated, and diet manipulation by the inclusion of antibiotics, were being considered. The inclusion of antibiotics either in the feed in water or as sub-therapeutic doses played an important role in improving animal performance and production. Specifically, in the poultry sector, farmers use antibiotics to improve production by obtaining a kilogram of meat in a shorter period, improving the feed conversion ratio, and, enhancing disease prevention. Furthermore, the inclusion of antibiotics as antimicrobial growth promoters (AGP) is a primary concern due to antimicrobial resistance (AMR). Globally, the impact of AMR will create a drug-resistant superbug and unable to produce new antibiotics for treating human and animal diseases. The antimicrobial-resistant pathogens in poultry will result in treatment failure and economic losses and could pose a risk to human health. Several strategies have been practiced in mitigating AMR using alternative approaches such as the inclusion of phytogenic feed additives or essential oils from various plant species with antimicrobial and antioxidant properties, organic acids, probiotics, vaccines, and nanoparticles. However, several challenges and limitations have been reported due to performance and environmental contamination.

Keywords: Antibiotics, Antimicrobial Resistance, Antimicrobial growth promoters, Livestock, Poultry.

Genomic and proteomic profiling of *Streptococcus agalactiae* serotypes Ia, Ib, and III to reveal novel surface antigens as cross-protective vaccine candidates

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Abstract

Tilapia *(Oreochromis* sp.) places second to carp in fish farming globally and is a major component of the global aquaculture industry. Intensification of tilapia farming has promoted severe disease outbreaks, resulting in high mortalities and economic burden with *Streptococcus agalactiae* being a major pathogen in tilapia culture. Although commercial *S. agalactiae* vaccines exist, they do not cross-protect between serotypes, making vaccine development a challenge. Conserved surface proteins are among the most promising candidates for the development of new and effective vaccines. The present study focuses on the major *S. agalactiae* serotypes (1a, 1b, and III) affecting tilapia aquaculture and to develop a vaccine that will cross-protective against different *S. agalactiae* serotypes found in tilapia farming systems in Southeast Asia. The present study aims to identify common and unique proteins to develop a universal vaccine against the bacterium by "shaving" the live bacterial cells with trypsin, followed by LC-MS/MS analysis to identify common immune genes shared by all three *S. agalactiae* serotypes for vaccine design. The immunogenic (and potentially protective) vaccine candidates common between all three serotypes (Ia, Ib, and III) using archived serum from infected and convalescent fish (i.e. fish that have survived an infection) were studied by immunoproteomic analysis. *S.agalactiae* serotypes 1a, 1b and III were cultured (28°C, 24 h), harvested, and resuspended in 20 mM Tris-HCL (pH- 7.6) supplemented with 1M D-arabinose, 150 mM NaCl, 10mM $CaCl_2$ and 80µg ug of Trypsin. After incubation at 37°C for 4 hours, cells were removed and supernatants with proteins were sterilized using membrane filtration. The proteins were subjected to 2D- gel electrophoresis and the identical spots corresponding to the proteins underwent LC-MS/MS analysis. Western blot was performed with the bacterial shavomes against - Anti –*S.agalactiae* (rabbit serum) 1a, 1b, and III respectively, and identified the specific 1a, 1b, and III protein in respective shavomes using HRP conjugated anti-rabbit secondary antibody followed by DAB staining. Archived serum from tilapia infected with each serotype was used for immunoproteomic studies to identify immunogenic vaccine candidates common to all three serotypes. Pan-genome analysis was also undertaken to identify virulence genes and proteins common to all three serotypes (Ia, Ib, and III). Our findings will provide new insights for developing vaccines based on representative antigens common to all three *S. agalactiae* serotypes affecting fish having the potential to cross-protect against *S. agalactiae* in farmed tilapia and other fish species. The method prescribed in this study can be taken as a general approach for identifying common surface antigens in other groups of bacterial fish pathogens having different serotypes.

Acknowledgments: The authors deeply acknowledge the funding support by BactiVac Catalyst Programme (BVNCP6-16), for the study.

Keywords: *Streptococcus agalactiae,* serotypes, surface antigens, LC-MS/MS, Nile tilapia.

The role of natural organic matter on the toxicity of polystyrene microplastics with metal oxide nanoparticles on freshwater microalgae *Chlorella vulgaris*

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Abstract

The widespread presence of microplastics (MPs) and nanoparticles (NPs) in the aquatic environment has been well documented, but few studies have examined their potential adverse effects on aquatic organisms. MPs/NPs' behaviour, bioavailability, and impacts in aquatic environments are affected by humic acid (HA). However, the effect of microplastics (MPs) on metal oxide nanoparticles (MNPs) dissolution and toxicity under humic acid in aquatic organisms is unknown. We investigated the individual and combined toxicity of MPs and MNPs in the freshwater microalgae *Chlorella vulgaris* in the presence and absence of HA. *C. vulgaris* cultures were exposed to 5 μm size polystyrene microplastics (PS-MPs) (5 mg/L), 50-100 nm size MNPs ((copper oxide nanoparticles (CuO NPs) and zinc oxide nanoparticles (ZnO NPs)) (1 mg/L) in the presence and absence of humic acid (HA) (5 mg/L) in a laboratory bioassay. Inductively coupled plasma-optical emission spectrometry (ICP-OES) quantified the accumulation of metals in algae-exposed MNPs. The toxicity effect was assessed using environmental biomarkers of physiological and biochemical activities, such as growth, Chl-a, and cell densities showed significant variation depending on the PS-MP along MNPs with/without HA, antioxidant, and oxidative damage such as GPx, LPO, ROS, and MT in microalgae were evaluated. Significant changes in biochemical activities were observed in microalgae exposed to PS-MP along MNPs with/without HA. The microscopic visualization by scanning electron microscope (SEM) data shows that PS-NPs and MNPs particles have adhered to microalgae, as shown by their damaging effects. Finally, ICP-OES is used to measure accumulation and changes in essential element quantity in microalgae. These findings show the importance of the natural organic matter in mediating MPs effects on co-existing pollutants and enhancing our awareness of MPs ecological risks in aquatic ecosystems.

Acknowledgment – This work was supported by the Postdoctoral Fellowship (PDF/2021/000713) and CRG project grant (CRG/2021/006020), funded by the Science and Engineering Research Board, India.

Keywords: Organic matter; Microplastic; Nanoparticles; Chemical mixtures; Microalgae.

Indigofera linnaei Mediated Silver Nanoparticles: A Potential Bio-Insecticidal Agent against *Aedes albopictus* Larvae

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Abstract

Mosquitoes (Diptera: Culicidae) are primary vectors responsible for transmitting numerous disease-causing pathogens, affecting millions of individuals globally. Their impact on human health and the environment, coupled with the emergence of resistance due to prolonged use of synthetic insecticides, necessitates urgent exploration for novel, cost-effective, and targeted bio-insecticidal solutions. Green nanomaterials present an increasingly prioritized strategy for effective mosquito control. This study focused on the biosynthesis of silver nanoparticles (Ag NPs) using aqueous extracts of *Indigofera linnaei*. The synthesized Ag NPs underwent comprehensive characterization through various analytical techniques: UV-VIS, FTIR, XRD, SEM, and TEM. Biotoxicity assessments were conducted, comparing the efficacy of *I. linnaei* leaf extract and the green-synthesized Ag NPs against third-instar larvae of Aedes albopictus. The findings revealed noteworthy larvicidal activity of Ag NPs against *A. albopictus*, displaying an LC_{50} value of 24.38 µg/mL, surpassing the efficacy of the leaf aqueous extract. Importantly, these Ag NPs exhibited higher safety towards non-target mosquito predators, notably *Gambusia affinis*, with an LC_{50} value of 3041.78 µg/mL. In conclusion, the *I.linnaei*-mediated Ag NPs revealed significant larvicidal potential against mosquito larvae, emphasizing their potential as a biocontrol agent for reducing mosquito populations. This study highlights the promise of utilizing plant-mediated synthesis of nanoparticles as a sustainable and effective strategy in combating mosquito-borne diseases while minimizing environmental impact.

Keywords: Nanotechnology, Silver nanoparticles, *Indigofera linnaei, Aedes albopictus*, Biotoxicity.

Peltophorum africanum Extracts as Natural Larvicides against *Aedes aegypti*

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Abstract

Mosquito-borne illnesses, such as malaria, filariasis, dengue, and chikungunya, remain a significant global health concern. Traditional methods of controlling mosquito populations often involve the use of insecticides, leading to issues such as resistance development and environmental harm. Seeking alternative, eco-friendly measures, this study explored the potential of *Peltophorum africanum* extracts as larvicides against *Aedes aegypti* mosquitoes. Crude leaf extracts of *P. africanum* were obtained using different solvents: methanol, ethyl acetate, chloroform, and hexane. These extracts were tested for their effectiveness against third-instar *Ae.aegypti* larvae, with observations of larval mortality recorded 24 hours after treatment. Among the various solvent extracts examined, methanol displayed the greatest efficacy, showing LC_{50} and LC_{90} values of 93.33 and 201.70 µg/ml, respectively. Control groups showed no mortality, confirming the specificity of the extracts. Statistical analysis indicated significant chi-square values at $P < 0.05$, validating the efficacy of the methanol extract against the targeted vector. In conclusion, the methanol extract derived from *P. africanum* demonstrated substantial larvicidal activity against *Ae.aegypti* mosquitoes. These findings underscore the potential application of these plant-derived extracts as a promising eco-friendly alternative for mosquito control strategies, emphasizing their role in combating mosquito-borne diseases while minimizing environmental impact.

Keywords: *Peltophorum africanum*, Dengue vector, Larvicidal activity, Leaf extract, Mortality.

Assessment of Acute toxicity of Food Additive-Sodium Metabisulphite in *Danio rerio* (Zebrafish)

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Abstract

Sodium Metabisulphite is widely used as an antioxidant in pharmaceuticals, a preservative, and a reductant in the food industry. Using *Danio rerio* (Zebrafish) as an animal model, this study aims to assess the acute toxicity and morphological and behavioural abnormalities caused by sodium metabisulphite. The Fishes were exposed to 96 hours of acute treatment at 5 different concentrations of SMB – 100ppm, 200ppm, 300ppm, 400ppm, and 500ppm with appropriate experimental conditions maintained in the aquarium. The Fish mortality, 100% was recorded at a higher concentration of 500 ppm. Mortality rates dropped at lower concentrations subsequently, with the least amount of mortality observed at 200 ppm and zero at 100 ppm. The fish in higher concentrations displayed obviously evident abnormalities in their morphological and behavioural pattern. These tests were performed in triplicates and the LC_{50} was determined to be 280ppm through Probit Analysis.

Keywords: Preservative, Acute treatment, Mortality, Behavioural changes.

Exploring the Therapeutic Potential of *Gelidella acerosa* Bioactive Compound in Alleviating Thyroid Disorders: Insights into Molecular Targets and Pharmacological Activities

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Abstract

A spectrum of disorders that affect the structure or function of the thyroid gland, substantially impacting metabolic regulation and overall health. The bioactive potential of marine seaweed species *Gelidella acerosa* helps alleviate diseases related to the heart, inflammation, diabetes, antioxidants, and digestive health. The bioactive compound of *Gelidella acerosa* has the potential to alleviate thyroid disorders according to their molecular mechanism. This study focuses on the molecular targets associated with thyroid problems and how certain chemicals interact with them. By using network analysis, it deduces the pharmacological activities of the drug by mapping their linkages to important targets in thyroid pathways. Exploring the molecular interactions between the drug and its targets is the goal of the molecular docking Probe. These results suggest that important proteins connected to the thyroid may be modulated, which might have therapeutic ramifications for thyroid diseases. These findings significantly contribute to our consideration of molecular aspects related to thyroid dysfunction. Additionally, they illuminate capable paths for the development of new therapies.

Keywords: *Gelidella acerosa,* Bioactive compounds, Thyroid disorder. Pharmacological activities.

Effect of dietary polysaccharides from *Caulerpa racemosa* on growth, biochemical, immunity, and Disease resistance in *Cirrhinus mrigala*

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Abstract

The objective of this study is to analyze the immunostimulatory and disease-resistance properties of polysaccharides derived from *Caulerpa racemosa* in *Cirrhinus mrigala*. *Caulerpa racemosa* polysaccharide (Cr-Ps) structure has been determined using HPLC, FT-IR, XRD, and NMR. The antioxidant and antibacterial properties of Cr-Ps were investigated. Three hundred fishes were separated into five groups with triplicates each replicates having 20 fish Different groups were fed with Cr-Ps diet at different concentrations (0.5%, 1.0%, 1.5%, and 2.0%) and without Cr-Ps diet (Control-0%) for 45 days. At the end of the experiment, growth, survival, haematological, and immunological characteristics were examined. The research findings showed that adding 1.5 % Cr-Ps to the diet resulted in a significant improvement in the final weight, weight gain, and specific growth rate (SGR) of *C. mrigala* and feed conversion ratio (FCR) decreased significantly compared to control and other experimental groups. Similarly, the 1.5% Cr-Ps diet-fed groups increased the activities of amylase, protease, and lipase. The results of the *Pseudomonas aeruginosa* challenging study show that groups fed Cr-Ps had higher survival rates. Increases in the enzymes superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), Nitroblue tetrazolium test (NBT), serum lysozyme activity, and immunoglobulin (IgM) levels before and after the challenging research show that Cr-Ps diets enhanced *C. mrigala* non-specific immune responses. The study indicates that although dietary Cr-Ps is a potential immunostimulant in *C. mrigala* against the *P. aeruginosa*.

Keywords: *C. racemosa*, *C. mrigala*, *P. aeruginosa*, Multi Drug Resistance, Polysaccharide.

Synthesis of high purity prebiotic isomalto-oligosaccharides (IMO) by cell-associated transglucosidase of *Debaryomyces hansenii*, selective fermentation by *Saccharomyces cerevisiae* and its prebiotic efficacy studies

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Abstract

An efficient recycling method was used to develop the continuous production of high-purity isomalto-oligosaccharides (IMOs) by cell-associated transglucosidase of a novel strain, *Debaryomyces hansenii* from maltose and selective fermentation by *S. cerevisiae*. The most potent transglucosidase producer was screened, isolated from pre-treated soil with sweet potato from a sugarcane field, and identified as *D. hansenii* using LSU region sequencing. Parameters optimization studies were investigated using whole cells of *D. hansenii* (~4023 units $^{L-1}$ α-glucosidase activity) from a 10 L fermenter to increase the enzyme activity through biotransformation. IMOs were continuously synthesized by reusing the cell biomass (6 %) using a microfiltration membrane system with 30 % maltose concentration under a controlled temperature of 34 °C for an average of 12 h for 5 cycles. The obtained low-purity IMOs (67 %) were further incubated with a cell pellet of isolated strain *Saccharomyces cerevisiae* (4 %, w/v) in a 3 L bioreactor for 1 h to utilize glucose completely without affecting the product to obtain high-purity IMOs by recycling method. This novel study using these yeasts was found to utilize more than 98 % maltose with higher conversion efficiency for the production of IMOs with > 91 % purity, 79 % yield, and the highest productivity of 198.79 g $L^{-1.h}$ which was confirmed by HPLC. IMOs showed prebiotic properties by stimulation of probiotics.

Keywords: *Debaryomyces hansenii*, *Saccharomyces cerevisiae*, Prebiotic, Isomalto-oligosaccharides.

Haemolymph of Indian cooperative spider, *Stegodyphus sarasinorum,* and Golden orb spider, *Nephila pilipes,* and its antimicrobial activity against pathogenic bacteria

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Abstract

Haemolymph of spiders contains antimicrobial peptides, which are one of the potential sources of antibiotics against drug-resistant microbes. We studied antimicrobial potential in the haemolymph of the spiders *Stegodyphus sarasinorum* and *Nephila pilipes* against ten pathogenic bacteria. The Indian cooperative spider, *S. sarasinorum* haemolymph showed antimicrobial activity against 8 out of 10 tested pathogenic bacteria and showed a maximum Zone of inhibition against *Streptococcus pneumonia* (15 mm). On the other hand, the golden orb spider, *N. pilipes* showed antimicrobial activity against 5 pathogenic bacteria with the maximum zone of inhibition against *Staphylococcus aureus* (10.5 mm). The total haemolymph protein content of *N. pilipes* and *S. sarasinorum* were 91.8 µg/ml and 16.10µg/ml respectively. The dominant band of the protein profile of *S. sarasinorum* and *N. pilipes* was in the range of 60-100 kDa and 50-120 kDa respectively. The study showed that the spiders' haemolymph is a promising source of antimicrobial peptides.

Keywords: Spider, Antimicrobial activity, *Stegodyphus sarasinorum, Nephila pilipes.*

Isolation of Ligninolytic *Bacillus sanguinis* OR787559 with Lignin Peroxidase Activity and *Micrococcus luteus* OR787563 with Manganese Peroxidase Activity from Pulp and Paper Mill Effluent

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Abstract

Industrialization ushers in economic prosperity, but on the other hand, leads to the degradation of the environment. The pulp and paper industry is a major consumer of natural resources (wood, water) and energy (fossil fuels, electricity), and is the sixth largest polluter, discharging a variety of gaseous, liquid, and solid wastes into the environment. Pulp and paper mill effluent was collected from the renowned Seshasayee Paper and Boards Limited at Erode, Tamilnadu. The characteristics of paper mill effluent such as pH, color, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), Total Dissolved Solids (TDS), lignin, phosphates, chlorides, sulphates, nitrates, sodium, potassium, iron, copper, zinc, manganese, and nickel were determined using standard methods (APHA, WEF, & AWWA, 2017). The wastewater was dark brown in colour, pungent odour, and was alkaline in nature with high values for TDS (1700 mg/L), lignin, potassium, sodium, phosphates, chlorides, and sulfates. The persistent dark brown colour, due to the presence of lignin and its derivatives, reduces the photosynthetic activity of aquatic plants and affects the food chain, decreasing the dissolved oxygen level in aquatic resources and creating anoxic conditions for aquatic organisms. Total solids include organic, inorganic, and many dissolved substances, which create a toxic environment by changing the ion composition, increasing salinity, and posing threats to aquatic organisms. The mean viable count of total heterotrophic microbes in paper mill effluent was 5.383 x 10^5 CFUs/mL. Metagenomic analysis of the pulp and paper mill effluent, revealed the presence of 75 distinct genera of bacteria, with the presence of *Pseudospirillum sp.* (11%), *Fluviicola sp.* (3%), and *Hydrogenophaga sp.* (3%) among the highest. Lignin and its derivatives in pulp and paper mill effluent are recalcitrant to degradation, and lead to a chain of adverse effects on the aquatic ecosystem, as the growth of primary as well as secondary and tertiary consumers are adversely affected. Bacteria utilize low-molecular weight lignin oligomers as the sole source of carbon and energy, produce enzymes and cleave inter-monomeric linkages of lignin, and have a wider tolerance of temperature, pH, and oxygen limitations than fungi. The various enzymes involved are lignin peroxidase, manganese peroxidase, and laccase. The effluent was screened for potential ligninolytic bacteria with lignin peroxidase (LiP) and manganese peroxidase (MnP) activity on agar medium amended with Azure B and Phenol red respectively. The putative ligninolytic LiP-producing isolate was identified by sequencing the 16S rRNA gene as *Bacillus sanguinis*, while the isolate with MnP activity was identified as *Micrococcus luteus*. Phylogenetic trees were constructed using the Molecular Evolutionary Genetics Analysis, version 11 (MEGA 11) software. The possible use of these microorganisms and their enzymes in the breakdown of aromatic compounds, possible depolymerization of lignin, and decolorization of pulp and paper mill effluent is under evaluation.

Keywords: *Pseudospirillum, Fluviicola, Bacillus sanguinis*, Manganese Peroxidase.

Exploring Ethyl Acetate Extracts from *Ruellia prostrata* Leaves as a Novel Weapon against *Aedes albopictus* Larvae: A Nature's Guardian

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Abstract

Mosquito-borne diseases pose a significant threat to public health globally, emphasizing the urgent need for effective and environmentally friendly mosquito control strategies. In this study, we investigated the larvicidal efficacy of ethyl acetate crude extracts obtained from *Ruellia prostrata* leaves against *Aedes albopictus* mosquitoes. The experiment involved assessing the mortality rate and determining the lethal concentrations for 50% (LC_{50}) and 90% (LC_{90}) of the mosquito larvae. Crude extracts were prepared at concentrations of 70, 140, 210, 280, and 350 µg/mL. The larvicidal activity was evaluated by calculating the percentage of mortality ± standard deviation (SD) at each concentration. The data revealed a concentration-dependent increase in larval mortality, with the highest concentration resulting in 96% mortality. Statistical analysis produced an LC_{50} value of 184.26 µg/mL and an LC_{90} value of 317.60 µg/mL. Our findings demonstrate the potent larvicidal activity of ethyl acetate crude extracts from *R. prostrata* leaves against *Ae. albopictus* mosquitoes. This research contributes to the development of eco-friendly alternatives for mosquito control, emphasizing the potential of botanical extracts in combating mosquito-borne diseases.

Keywords: Vector-borne diseases, Plant-based insecticides, Biological control, Sustainable solutions, Public health.

Integration of Single Cell Protein as an Alternative to Fish Meal In an Innovative Aquaponics System to Enhance The Well-Being of Fish and Plants

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Abstract

This study explores the integration of spirulina as a viable alternative to fish meal in an aquaponics system, with a simultaneous focus on cultivating tomatoes (*Solanum lycopersicum*) and tilapia (*Oreochromis niloticus*). Fingerlings of *O. niloticus*, with an average initial weight of 2.50 ± 0.045 g and total length of 5.6 ± 0.18 cm were randomly distributed into four treatments. The research addresses sustainability and resource efficiency by exploring varied levels of fish meal replacement including 25%, 50%, 75%, and 100%. These replacements utilize a combination of tomato waste and spirulina as alternative protein sources. The effect of spirulina and tomato waste enhanced aquaponic system on growth, feed utilization, and whole-body composition of *O. niloticus* was determined. A one-way analysis of variance (ANOVA) was used to determine the treatment effect and whenever the effects of the treatments were significant ($p \leq 0.05$) means were compared using Turkey's test. Polynomial contrasts analysis showed that the cubic trend for final total weight (FTW), gain in weight, final total length (FTL), specific growth rate (SGR), feed conversion ratio (FCR), and protein efficiency (PE) were significantly ($P < 0.05$) increased by the inclusion of 75% replacement of traditional fish meal with a composite of tomato waste and spirulina in the fish diet. The aquaponics system, structured in a media bed configuration, produces notable outcomes. Specifically, a 75% replacement of traditional fish meal with a composite of tomato waste and spirulina demonstrates optimal conditions, and enhanced growth in both tomato plants and tilapia. Throughout the study, rigorous monitoring of key parameters, including water quality, nutrient levels, and overall system performance, provides insightful data. The present results not only affirm the feasibility of reducing reliance on conventional fish meals but also highlight potential advantages associated with incorporating SCP into aquaponics for sustainable agricultural practices. The observed enhanced growth in both tilapia and tomato plants underscores the promise of achieving a synergistic equilibrium between aquaculture and hydroponics.

Keywords: Aquaponics, Spirulina, Fish meal, Tomato, Tilapia.

Molecular Identification and Biochemical Composition of Calanoid copepod *Sinodiaptomus sarsi*

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Abstract

The watery planktonic habitat is home to around 2,500 species of copepods (Class Maxillopoda; Subclass Copepoda). The group has remarkable morphological conservation, with several sibling species groups, making it difficult, even for highly skilled taxonomists, to identify individual species. Based on DNA sequencing of individual specimens and environmental materials, molecular methods of species identification have facilitated the quick detection, differentiation, and identification of species. Using a molecular technique called 18S rRNA sequencing, copepod species that had been taxonomically recognized were further validated in a lab setting. The confirmed species Calanoid copepod was cultured in different concentrations of cow urine distillate (CUD) to evaluate the biochemical composition between the trials and showed greater variation. In general, the protein content was higher than other lipids and carbohydrate content in all the treatments.

Keywords: DNA sequence, *Sinodiaptomus sarsi*, Copepods, DNA sequencing.

Implementation of Biomaterials in Treating Cartilage Tissue to Precise Host Response towards Biomaterials

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Abstract

Tissue engineering seems to be an emerging technology to repair damaged tissue parts of the human system. This approach is possible only because of biomaterials-associated treatment which is been practiced for a few years and emerges as an effective alternative option to traditional practices like microfracture, and subchondral drilling. These biomaterials are of two types: synthetic polymers and naturally derived biomaterials each has its own advantages and disadvantages that determine the capability of specific types of biomaterials. Some common properties of these biomaterials are mechanical strength and biocompatibility. The cartilage tissues are immune privilege which is a reflection of evolutionary adaptation to protect vital structures. Articular cartilage is a smooth, translucent surface that lacks blood vessels, nerves, and lymphatic vessels which is said to be highly organized connective tissue. This articular cartilage tissue has the function of protection and in hand, it lacks self-healing capacity. This ensures the occurrence of osteoarthritis in the joint where these articular cartilage tissues are present. The in vivo condition of biomaterials might also lead to acute (or) chronic inflammation of tissues. This inflammation of tissues can be avoided by Biomaterial-mediated tissue healing and biomaterial-mediated host reactions in the presence of adhesion proteins like fibrinogen, and vitronectin and also includes albumin, γ globulin which forms a protein surface that regulates host cell inflammatory cell interactions. With the help of this protein surface over the implantable biomaterial the intake of components of blood like neutrophils, and monocyte-derived macrophages become the most common cell type around the implanted biomaterial.

Keywords: Biomaterials, Synthetic polymers, Articular cartilage, Biocompatibility.

Electron beam-supported fabrication of biocompatible silver/iota-carrageenan for wound healing application

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Abstract

Silver nanoparticles (AgNPs) are a potent antibacterial agent, especially when used to treat bacteria that are multidrug resistant. However, it is challenging to eliminate the hazardous reducing agents that remain in AgNPs produced by the conventional chemical reduction process. To overcome these challenges, the presented research demonstrates the fabrication of AgNPs using iota-carrageenan (ι–carra) as a carbohydrate polymer using electron beam (EB) irradiation. Well-characterized ι–carra@AgNPs is a face-centered cubic (FCC) structure with spherical morphology and an average size of 26 nm. Herein explored the approach for fabricating ι-Carra @ AgNPs that is technique and suitable for scaling up the production of nanoparticles that exhibit excellent water stability. Further, the optimized ι–carra @AgNPs exhibited considerable antibacterial activity when tested with Gram-negative bacteria *Escherichia coli* (*E. coli*) (ATCC 43895), as well as Gram-positive *Staphylococcus aureus* (*S. aureus*) (ATCC 6538), and low cytotoxicity. To establish the potential biomedical application, as proof of the concept, the ι-carra @AgNPs showed antibiofilm and wound healing abilities. Electron beam assisted ι–carra@AgNPs showed significant beneficial effects against specific bacterial strains and may provide a guide for the development of new antibacterial material for wound dressing material for large-scale production for biomedical applications.

Keywords: Electron beam, AgNPs, Wound healing activity, Antibiofilm activity.

Emergence and Outbreak of Inordinately Mutated BA.2.86 and JN.1-an Infectious Threat

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Abstract

As the world enters its fifth year of COVID the new highly mutated Covid variants BA.2.86 and JN.1 have achieved global dominance. It may lead to more severe disease than other Omicron variants. In late 2023, the World Health Organization listed nine variants as circulating at the time and more than 50 variants have been identified although some are no longer spreading. Some Covid variants that developed earlier in the pandemic include Alpha(B.1.1.7), Beta(B.1.351), Gamma(P.1), Delta(B.1.617.2), Mu(B.1.621), R.1. and some variants of interest are still being monitored. BA.2.86 strain nicknamed "Pirola" is a variant under monitoring-VUM. BA.2.86 first turned up in the US and is now the third most common variant, causing an estimated 1 in 11 new cases. With more than 30 mutations to its spike proteins, BA.2.86 was so genetically distinct from previous versions of the virus that cause COVID-19. JN.1 is a mutant type from BA.2.86, which has one mutation in its spike protein. With just one additional receptor binding domain mutation compared to its predecessor. The first case of the JN.1 variant has been found in Kerala, India. It comprises an estimated 15-29% of cases in the US as of December 8. The virus that causes Covid keeps mutating, producing new variants, or strains. This is a natural process. Most of these changes make no difference to a person's health. But some mutations make a Covid variant spread more easily or cause a more severe form of the disease.

Keywords: BA.2.86, JN.1, Pirola, Spike protein.

Unveiling Monkeypox: A Comprehensive Analysis of Epidemiology and Emerging Trends of A Rare Virus and Human Health Connections

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Abstract

There has been a dramatic increase in the number of monkeypox cases worldwide since June 2022. Given the spread of this epidemic, WHO has declared the monkeypox epidemic as a global public health emergency. In the face of changing epidemiology during this monkeypox outbreak, vaccines and preventive measures are researched in response to this emerging disease. Monkeypox, a zoonotic disease was first identified in humans. More than 90% of the known cases were in men who have sex with men (MSM). A key reason for the rapid increase is the lack of protection from smallpox. Studies have indicated that the vaccine used for smallpox provides about 85% protection against Monkeypox due to cross-immunization, which can prevent the occurrence of Monkeypox and reduce the severity of symptoms. Monkeypox viruses are unlikely to undergo sudden mutations that would cause a substantial increase in human–human transmission because they are DNA viruses and are better at detecting and repairing mutations than RNA viruses. The vaccines for Monkeypox in high-risk groups or post-exposure prophylaxis are still smallpox–specific vaccines. Immunodeficiency may be led to worse clinical outcomes of Monkeypox infection suggesting that an advanced or poorly virally controlled HIV infection may lead to more severe outcomes after monkeypox infection. In fact, Monkeypox, a communicable disease has been added to the current COVID-19 tracking system for better surveillance and management.

Keywords: Monkeypox, Smallpox vaccine, Epidemiology, COVID 19.

Antimicrobial activity of Green Synthesised Se-NP'S; Against Pathogenic Microorganism

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Abstract

The green synthesis of metal nanoparticles (NPs) using medicinally important plants has attracted great interest, as a better choice for modern medicine without any side effects. From very old, plants have been used in traditional medicine and it shows good remedies against a wide range of diseases. It has been shown a combination of photochemical with nanoparticles has considerable biological functions such as anti-microbial, anticancer, antioxidant, and ant-diabetic activity. Most Phytonanotherapy is usually done with the green synthesis of silver or gold nanoparticles. However, selenium nanoparticles (SeNPs) are more effective than any other nanoparticle. It is a nutrient very essential for humans, animals, and other organisms. The therapeutic qualities that plant and selenium nanoparticles (SeNPs) offer may be clinically bioequivalent to many synthetic medications, with minimal side effects. With such insights, the present investigation focused on the synthesis and characterization of Se-NPs and their activity against different microbes.

Keywords: Green synthesis, Anticancer, Phytotherapy, Micronutrient.

Subcellular component of probiotic *Bacillus* spp. induces protective immunity against bacterial fish pathogen

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Abstract

Infectious illnesses are a significant barrier to aquaculture development. Using probiotics as a control method can defend against bacterial infections and reduce the need for antibiotics. *Bacillus* species produce a wide range of antimicrobial proteins (bacteriocin) with a remarkable variety of antimicrobial spectrum and have the ability to release some antimicrobial substances it responds with a bactericidal (toxic) or bacteriostatic (inhibitory) effect on potentially pathogenic bacteria. However, to enhance aquaculture production, the extensive use of antibiotics has led to drug resistance problems. Therefore, studies are essential to find alternative chemotherapeutic agents for sustainable aquaculture production. This study aimed to isolate the probiotic *Bacillus* spp. and was used to determine the efficacy of its subcellular component on the immune system of *Labeo rohita* and also to evaluate its effectiveness against the fish pathogen. Fish were immunized intraperitoneally in the case of subcellular components [cell wall proteins (CWPs), extracellular proteins (ECPs), whole cell proteins (WCPs)] and orally in the case of live cells (10^8 CFU/g of feed). After the 14th day of administration, fishes from each group were challenged intraperitoneally with 0.1 ml of *A. hydrophila* cell suspension in PBS (10^5 cells ml^{-1}). Groups immunized with subcellular components and live cells had significantly lower mortalities in experimental groups compared to control. The nonspecific humoral and cellular immune parameters were substantially increased in the cellular components and viable cells of the probiotics. This study concludes that subcellular products could potentially be used as adjuvant or as vaccine substitutes for antibiotics. Thus, the subcellular component may be considered a good candidate for a vaccine to reduce the loss in the aquaculture sector and increase the production rate.

Keywords: Probiotic**,** *Labeo rohita***,** *Bacillus* spp. Cellular components**,** *A. hydrophila.*

Synthesis of Selenium Nanoparticles from *Solanum nigrum* Leaf Extract and their Biomedical Applications

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Abstract

In this work, selenium nanoparticles were synthesized using *Solanum nigrum* leaf extract by precipitation method and it was confirmed by UV, FTIR, XRD, TEM, and Zeta potential. UV absorbance peak was observed at 350nm, TEM revealed the synthesized Se NPs were spherical in shape and the average size ranges between 50 to 60 nm. Comparably, the synthesized Se NPs were tested for their antioxidant, MIC, antibacterial, and antibiofilm activities against two-gram negative (*Staphylococcus aureus* & *Pseudomonas aeruginos*a) and two-gram positive (*Shigella sonnei* and *Enterococcus faecalis*) bacteria to determine the inhibitory impact. The results indicate increased activity against these bacteria due to the establishment of antibacterial zones. In addition, the photocatalytic activity was tested on acridine orange and methylene blue dye under UV & Sunlight irradiation.

Keywords: *Solanum nigrum*, Antibacterial, Photocatalytic, Antibiofilm.

Efficacy of antioxidant and antimicrobial effectiveness of *Gracilaria salicornia from marine algae*

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Abstract

*Gracilaria salicornia*has high potential benefits for human health from the diet. The present study investigates the effects of the antioxidant and antimicrobial activity of *Gracilaria salicornia* against a human pathogen. The study aims to *in vitro* antioxidant activity of *Gracilaria salicornia* by using 1,1-diphenyl-2-picrylhydrazyl (DPPH)-2,2-diphenyl-1-picrylhydrazyl (DPPH) methods. In addition to that the antimicrobial activity of *Gracilaria salicornia* by using Agar well diffusion method was estimated. From the results, the *Gracilaria salicornia* has antioxidant potential to reduce oxidative stress by using DPPH Assay. The *Gracilaria salicornia* inhibited the growth of bacteria and fungi with high levels of antibiotic resistance, such as *Pseudomonas aeruginosa, Citrobacter murliniae, Aspergillus fumigatus,* and *Candida albicans.* The results showed the antioxidant and antimicrobial effectiveness of *Gracilaria salicornia* against bacteria and fungi. Our results proposed that *Gracilaria salicornia,* which may be useful against antibiotic-resistant bacteria and fungi justifies more research consideration claims of traditional practitioners and pharmaceutical applications.

Keywords: DPPH, *Pseudomonas aeruginosa, Gracilaria salicornia*, Antimicrobial activity.

Evaluation of antimicrobial, antioxidant, and cytotoxicity potential of aqueous extract of *Opuntia Ficus-Indica* on hepatocellular carcinoma – *In vitro*

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Abstract

This investigation was carried out to understand and determine the antimicrobial, antioxidant, and cytotoxicity effects of the aqueous extract of *Opuntia Ficus-Indica* fruit. This study aims to analyze the phytochemical constituents from the extracts and evaluate their antimicrobial, antioxidant properties, and cytotoxicity. Antioxidant activity was determined using the, α- diphenyl- β-picrilhydrazyl radical-scavenging assay system, and compared with those of the positive controls of butylated hydroxytoluene (BHT). The cell viability was critically evaluated in the hepatocellular carcinoma cell line (HepG2) by employing the MTT method. To reaffirm the viability of the cells, and to evaluate the number of apoptosis cells, Trypan blue dye exclusion technique was also employed. The results showed that the aqueous extract of *Opuntia Ficus-Indica* fruit was found to have more significant, and excellent effects, in the reduction of viable cells of the examined cell line recorded in the MTT measure. Whereas, the Typhon blue exclusion technique, displayed that a small number of viable cells and a large number of dead cells were noticed in the aqueous extract of *Opuntia Ficus-Indica* fruit-treated HepG2 cells. As a concluding remark, aqueous extract of *Opuntia Ficus-Indica* fruit contains enriched bioactive principles that involve a reduction in viable cancer cells, remarkably, on HepG2 cells. The findings of the present investigation can be used as a benchmark for detecting more effective specific compounds, pertaining to design, and anticancer agents for the pre-clinical studies.

Keywords: *Opuntia Ficus-Indica*, Cell viability, Cytotoxicity, HepG2.

β-Chitosan - A Promising Sustainable Biomaterial For Tissue Engineering Applications

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Abstract

Chitosan is the only existing natural cationic polysaccharide so far on Earth. It is derived by the deacetylation of chitin. Over the last era, enormous research has been carried out extensively to explore the possibility of extracting chitosan from inexpensive sources such as seafood waste discards and utilizing them as functional biomaterials for Tissue Engineering applications. There Most of the commercially available products of chitosan are α-chitosan extracted from the exoskeleton of crustaceans that contain high inorganic material. Thus, chitin production from these sources is always accompanied by a release of ammonia and CO_2 that pollutes the environment. β-chitosan, another form of chitosan is an appealing choice of biomaterial owing to its positive facets such as unique physico-chemical properties, excellent biocompatibility, tailorable biodegradability, and low toxicity. Nevertheless, it contains a minimal amount of inorganic material and is considered to be less polluting during extraction than chitosan derived from crustaceans. To date, the commercial availability and extensive literature review of β-chitosan is very limited compared to that of α-chitosan and still remains one of the untapped resources to be used as a sustainable biomaterial. Thus, this review provides a concise insight into the structure, sources, and properties of β-chitosan and its tissue engineering applications that craft it as a versatile biopolymer.

Keywords: Biomaterial, β-chitosan, Tissue Engineering, Biomaterial.

Insects, Arachnids and Centipedes venom: A powerful weapon against bacteria, A literature review

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Abstract

Misuse and overuse of antibiotics have contributed in the last decades to a phenomenon known as antibiotic resistance which is currently considered one of the principle crisis. The aim to find alternative drugs has been demonstrated as a real challenge, insects represent in largest class of organisms in the animal kingdom. The humoral immune response includes the production of antimicrobial peptides (amps).*mastoparan* and vancomycin from *synoeca surinma* (wasp) are effective against methicillin-resistant *Staphylococus aureus* and *Enterococus species*. Amp like hadrurin, scoprpine, pandinin from *heterometrus xanthopus* is employed in killing intra-erythrocytic malarial pathogens without harming the erythrocyte. The antibacterial activity of bee, wasp, ant, scorpion, spider, and scolopendra crude venom and of their main biologically active compounds. after a brief overview of each animal and venom use in folkloristic medicine, this review reports, in a comprehensive table, the results obtained by the most relevant and recent research carried out on the antibacterial activity of different venom and their AMPs.

Keywords: Antimicrobials, Multidrug resistance, AMPs, *Staphylococus aureus*.

The Effects of Life Style and Environment on Human Gut Microbiome and its Potential Utility as Biomarkers for Diagnosis of Diseases - A Review

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Absract

Microbiome is the term that defines microbial diversity in an environment. These microbiomes, under almost every circumstance, prove to be extremely potent and beneficial. One such biome is the gut microbiome, which is found to be impacted by geographical location, diet, genetics, physiology, and individual micro biota. The majority of the microbiome diversity includes *Bacteroidetes, Firmicutes, Actinobacteria*, and *Tenericutes*. These bacterial species help in justifying the health of an individual. The gut micro biome can gut hampered by various reasons that include diseases like obesity, type 2 diabetes, cancer, poor sanitation, and increased intake of processed food. This imbalance contributes to inefficient digestion, resistance, and a higher rate of inflammation. Recent studies show that a high-fiber diet increased inflammation, while a highly fermented food diet reduced inflammation and increased the gut micro biota. The micro biome acts as a biomarker that aids in disease diagnosis. Obese people have higher *Firmicutes* and *Bacteroidetes* than healthy people. Happier people had low levels of *Firmicutes* and *Ruminococcaceae*, whereas less happy people it was vice-versa. Sequencing the microbiome of healthy people helps in identifying the healthy baseline of a particular person. Current technologies like fecal transplantation are reported to save lives too. Nevertheless, there are reports of various attempts at in vivo microbiome modulation therapeutics to help people with *C. dificile* infections. This paper reviews some of the aspects related to gut micro biomes and their therapeutic potential.

Keywords: Gut micro biome, Human disease, Diagnosis, Biomarkers, Therapeutics.

Evaluation of the Diabetic Wound Healing Effect of *Cassia auriculata* Based ZnO NPs Coated with Chitosan

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Abstract

Diabetic wounds are one of the main health issues of a wide range of populations all over the world. There is a need for new and novel natural sources of medicines rather than commonly used pharmaceuticals which show several adverse effects. Diabetes wounds have the potential for lower extremity amputation, infection, and even death if they become chronic and infected. This study aims to determine the wound-healing effect of *Cassia auriculata* aqueous extract-based ZnO NPs. *C. auriculata*- based NPs are synthesized using the co-precipitation method. Further, it was confirmed through the characterization using UV, FTIR, XRD, Zeta potential, and TEM. CA-ZnO NPs were authenticated by UV-Vis peak range at 353nm. The XRD spectra proved the crystalline nature of the CA-ZnO NPs. The FTIR spectrum illustrated the presence of functional groups in the CA-ZnO NPs. The TEM micrograph showed that the size of NPs ranges from 50-70 nm with a spherical structure. Further, the synthesized CA-CSZnO NPs were coated with chitosan and used to determine the α-amylase and α-glucosidase inhibition activity. Results demonstrated the anti-diabetic activity of CA-CSZnO NPs (70% respectively), and DPPH [2,2-diphenyl-1-picrylhydrazyl hydrate] antioxidant activity of nanoparticles (78%) at a concentration of 100 µg/ml. The antimicrobial property of CA-CSZnO NPs was tested by agar well diffusion and analysed by measuring the diameter of the inhibition zone using gram-negative and gram-positive bacteria. *Ecoli* shows a higher zone of 8-9 mm in radius. Plant-based nanoparticles synthesized in this study have shown effective anti-diabetic, anti-oxidant, and anti-bacterial properties that can be used for various biomedical fields in the future.

Keywords: *Cassia auriculata,* ZnO, *Staphylococcus aureus*, Zeta potential, Chitosan.

Efficacy of flagellin-coupled cross-protective vaccine against *Streptococcus agalactiae and Aeromonas hydrophila* infections for finfish aquaculture

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Abstract

Aquaculture is a promising sector for economically rich food and livelihood playing a major trade commodity for Low to middle-income countries. However, the escalation of multispecies culture resulted in disease outbreaks following high mortality and economic loss due to the major pathogens *Streptococcus agalactiae* and *Aeromonas hydrophilla*. Emerging alternatives to antibiotics, vaccines were proven to be utilized as a safe and targeted therapy against multidrug-resistant *S.agalactiae* and *A. hydrophilla* co-infections. In the present study, we aim to develop a bivalent cross-protective flagellin-incorporated vaccine against *S. agalactiae* and *A. hydrophilla*. Flagellin is a potent inflammatory activator of bacterial Pathogen Associated Molecular Patterns (PAMPs). Flagellin activates the TLR5 which forms the basis of both innate and adaptive immune response in fishes which promotes its efficacy as an adjuvant. Isolated virulent strains of both pathogens will be grown in TSB broth and treated with 0.5% formalin. The bacterial pellets will be washed with PBS, resuspended in a 1:1 ratio, and conjugated with flagellin (30%). SDS-PAGE will determine the antigenic profile. Flagellin adjuvanted FKVs will be used for the initial immunization of fish followed by a 21-day post-booster dose as an intraperitoneal injection and a 14-day and 21-day booster dose for feed-based (oral) and immersion delivery routes respectively. The fish will be challenged with virulent *S. agalactiae* and *A. hydrophilla* after 35 days of initial immunization. The expression of the immune genes and immune-histopathological alterations will be assessed in the samples of fish serum and tissues at several fixed periods. IgT, IgD, TNF-α, MHC Iα, MHC IIβ, CD4-L2, and CD8α gene regulations in the bivalent vaccine will be compared between the monovalent vaccine of the pathogens. We hypothesize the study will explore the plausible efficacy of molecular adjuvanted vaccine cross-protection against both pathogens to protect aquatic crops.

Keywords: Flagellin, *Streptococcus agalactiae, Aeromonas hydrophilla*, Bivalent vaccine, Aquaculture.

Effect of *Annona muricata* L. extract on Bimetallic Nanoparticles (ZnO–CuO) for Antimicrobial, Antioxidant and Anticancer activity

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Abstract

The present study, emphasise the green synthesis of ZnO-CuO bimetallic nanoparticles (NPs) done with a mixture of zinc oxide (ZnO) and copper oxide (CuO) using *Annona muricata* L. extract. The ZnO-CuO NPs were characterized with UV-Vi's spectroscopy (UV), Fourier transform infrared (FT-IR) spectroscopy, Field emission scanning electron microscopy-energy dispersive X-ray spectroscopy (FESEM-EDX), and X-ray diffraction analysis (XRD). The FESEM analysis reported that ZnO-CuO has a spherical morphology and is evenly dispersed. Additionally, the XRD findings provide information on the crystalline planes of ZnO-CuO. The biosynthesized ZnO-CuO NPs were further investigated for their antibacterial, antioxidant, biocompatibility, and anticancer properties. The activity of the synthesized bimetallic nanoparticles in inhibiting the growth of breast cancer (MCF-7) cell line studies was made using MTT assay. The antibacterial activity of ZnO-CuO NPs was evaluated using growth inhibition, reactive oxygen species (ROS) generation, and live and dead cell assays. ZnO-CuO NPs exhibited higher efficacy against bacteria at 100 µg/mL concentration. Furthermore, ZnO-CuO NPs have demonstrated significant in vitro anticancer activity against MCF-7 cell lines. The cytotoxicity study exhibited a dose-dependent effect against MCF-7 cell lines using MTT assay, the inhibitory concentration (IC_{50}) was found to be 25 µg/mL. The ZnO-CuO NPs exhibited strong antioxidant properties in a way that was dependent on the dose, demonstrating their potential efficacy as antioxidant agents. The biocompatibility of ZnO-CuO NPs was assessed by subjecting fibroblast cells. The results showed that the cells were unaffected at higher concentrations (100 µg/mL) of the NPs, indicating excellent biocompatibility. The findings revealed that the ZnO-CuO NPs synthesized from green sources showed significant potential antibacterial, antioxidant, and anticancer properties.

Keywords: Green synthesis, *Annona muricata*, ZnO–CuO nanoparticles, Antioxidant, Anticancer activity.

Evaluation of phytochemicals, antioxidant and antimicrobial properties of *Garcinia cambogia*: a candidate species for practical aquaculture

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Abstract

Nutrition of fish is an important consideration in fish health management of farmed finfish and shellfish. The shift in some countries from extensive to semi-intensive and intensive farming of fish demands that nutritionally complete feeds be provided by the farmer. The use of nutritionally inadequate feeds can result in reduced growth and production due to stress, but more seriously, the use of such feeds can result in the loss of fish from nutritional deficiency syndromes and/or from mortality brought on by increased susceptibility of nutritionally compromised fish to infectious diseases. Phytobiotics can be defined as plant-derived products added to feed in order to improve the performance of animals. The phytobiotics have a wide variety of properties such as antioxidant, antimicrobial, anticarcinogenic, analgesic, insecticidal, antiparasitic, anticoccidial, growth promoters' appetite enhancement, stimulant of secretion of bile and digestive enzyme activity, etc. The present work focuses on the phytochemical analysis and antimicrobial and antioxidant properties of *Garcinia cambogia* (Malabar tamarind) plants in aquaculture. Medicinal plants are the main sources of natural antioxidants and antimicrobial compounds. A large number of plants have been used in traditional medicine for the treatment and control of several diseases. This unexplored work bridges the research gap and gives an idea about the potential of *Garcinia cambogia* (Malabar tamarind) plants in aquaculture. The research provides a new perspective on the use of *Garcinia cambogia* (Malabar tamarind) as adjuvant therapy added to fish food to prevent diseases.

Keywords: *Garcinia cambogia*, Phytobiotics, Phytochemical analysis, Antioxidant, Antimicrobial.

Development of formalin-inactivated vaccine with chitosan nano-particle based delivery system against *Streptococcus agalactiae* in Nile Tilapia

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Abstract

Aquaculture plays a promising role in global food production; it is estimated up to 70% of supplementary protein will be required from animal sources by 2050 (WOAH). Disease outbreaks are encountering complications with sustainable aquaculture. Among bacterial pathogens, antimicrobial-resistant (AMR) *Streptococcus agalactiae* affects aquaculture production which leads to economic loss in low- and middle-income countries. Vaccines have been figured out as an attractive way for AMR. The current work is designed to develop a formalin-killed whole-cell vaccine for *Streptococcus agalactiae* with a chitosan nanoparticle-based delivery system in *Oreochromis niloticus*. Chitosan is a polysaccharide obtained from crustacean shells, which can be used as non-toxic biodegradable environmentally friendly nanoparticles (cNP). Chemical synthesized nanoparticles will be characterized by U-V spectrometer, FTIR, and Zeta potential analysis. The strong stable cationic nanoparticles will have high binding efficiency against negatively charged formalin-inactivated *S. agalactiae* (sero type III) bacterial by conjugation. Vaccine delivery studies will be carried out with $3x10^7$CFU/ml with cNP for tilapia fingerlings. 15^{th} and 36^{th} days of post-vaccinated animals will be examined for Interleukin-1, Interleukin-8, and LBP (lipopolysaccharide binding protein) immune gene in the head kidney and liver by RT – qPCR & IgM in the serum of the *O. niloticus* by indirect ELISA and compared with a controlled group. 36 days post vaccinated animals challenged with bacterial inoculation ($1x10^9$ CFU/ml) will be further examined for relative percentage survival (RPS) against *S. agalactiae*. The study reveals a plausible approval for the product of cNP conjugated vaccine for a non-toxic and environmentally friendly approach for *S. agalactiae* in aquaculture systems.

Keywords: *Streptococcus agalactiae*, Chitosan nanoparticle, intra-peritoneal vaccine, RT-q PCR, *Oreochromis niloticus.*

Effects of *Biophytum sensitivum* and *Eupatorium triplinerve* as dietary supplementation on growth, hematology, histology, immunological responses, and immune-related gene expression in Nile tilapia *(Oreochromis niloticus)*

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Abstract

Herbs have been a traditional medicine for treating human diseases for thousands of years. Recently, it has been used for its immunostimulant and growth-promoting features in treating fish diseases. The intensified aquaculture practices have resulted in several new disease outbreaks and it has increased the dependency on antibiotics. The uncontrolled administration of synthetic chemotherapeutics has resulted in antimicrobial resistance (AMR) and immune depression. Tilapia is one of the most cultured fish in low-income countries and a major source of income. The outbreaks of *Streptococcus agalactia* have been reported in several countries worldwide. Medicinal plants as natural immunostimulants are promising alternatives to antibiotics, which could reduce AMR in aquaculture. This study evaluates the efficacy of Indian medicinal plants, namely *Biophytum sensitivum* and *Eupatorium triplinerve*, as phytotherapeutics to manage fish health. Tilapia production is blooming in India and likewise, many new or re-emergence pathogens are also being reported. In this scenario, the role of medicinal herbs as a natural immunostimulant to combat elevated antibiotic usage is gaining the spotlight as a sustainable aquaculture practice for disease prevention. In this study, preliminary phytochemical screenings were done, and the plant extracts have significant antioxidant and antibacterial properties. The antioxidant activity of the plant extract was determined by the DPPH assay, and the antibacterial activity was tested by the Kirby-Bauer disc diffusion method. Five experimental groups were fed with formulated feed and would be treated for 6 weeks. It will be then analysed for growth and various immune parameters followed by the challenge test to be carried out with *S. agalactiae*. The blood and tissue samples will be collected and will be subjected to analyse growth and various parameters in hematology, biochemistry, and histology. Studies on gut microbiota will be done and finally, the expression of innate immune-related genes will be performed. The herbal immunostimulants would be a sustainable alternative to prevent AMR in aquaculture.

Keywords: Natural immunostimulants, Antimicrobial resistance, *Streptococcus agalactiae*, Immune responses, Nile tilapia.

Effect of Strontium Nanoparticle against Aquatic Pathogens

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Abstract

The aim of the study is to evaluate the effect of strontium oxide nanoparticles (SrO NPs) against aquatic pathogens. The reaction under hydrothermal technique is proposed for synthesizing the strontium oxide nanoparticles (SrO NPs) by the strontium nitrate powder with NaOH followed by heat treatment at 500˚ C for 2 h. Strontium oxide was characterized by Energy Dispersive X-ray analysis (EDAX), powder X-ray diffraction (PXRD), and scanning electron microscopy (SEM) analysis. The antibacterial properties of SrO NPs, and aqua pathogens such as *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Bacillus cereus* were tested in the Mueller–Hinton well diffusion method. The XRD analysis revealed that the synthesized samples exhibited a tetragonal crystalline structure for SrO NPs. The EDAX spectrum confirms the chemical composition and elemental mapping of SrO NPs synthesis. The strontium nanoparticles are unevenly globular in shape and exhibited cluster nature through a Scanning Electron Microscope (SEM). The SrO NPs were tested against both Gram-positive and Gram-negative aqua pathogens. The synthesized SrO NPs exhibited effective antibacterial properties.

Keywords: Strontium Oxide, Hydrothermal Method, Aquatic Pathogens, *Staphylococcus aureus*, *Pseudomonas aeruginosa.*

Effect of Bromelain on immune and growth parameters of Nile Tilapia (*Oreochromis niloticus)*

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Abstract

In the hunt for a safer substitute for conventional nanoparticles that are hazardous for use in biomedical applications, bionanomaterials have been shown to be an ideal fit. Bio nanomaterials are made from biomolecules that are taken from microorganisms, plants, agricultural wastes, insects, marine species, and some mammals or they can be used to encapsulate or immobilize a traditional nanomaterial, is defined as a nonviable material used in a medical device that is intended to interact with biological systems. The high-surface area, nano-sized (1-100 nm) biomaterial particles find many applications in tissue engineering, cancer therapy, drug and gene delivery, medical imaging, and many more in the biomedical field. According to research on nanoscale biomaterials, they are biodegradable, non-toxic, immunogenic, and biocompatible. In Nano biomedicine, the use of nanoscale molecular instruments is directed toward both improvement and diagnosis. These Nano biomaterials aid in the synthesis of peptides, drug molecules, and other biomolecules for customized therapeutics in smart drug delivery systems and showed improved biocompatibility, bioavailability, and bio reactivity with low or insignificant toxicity toward people, other species, and the environment. The dumping of plastic waste and non-biodegradable materials is a principal problem of environmental pollution. In their numerous chemical forms, cellulose and various other biodegradable materials can be possible alternatives to resolve these challenging issues. Our biosphere provides us with plentiful substances that cater to our different needs at every point in life. These include several plant extracts, vitamins, biopolymers, peptides, proteins, sugars in the form of glucose, fructose, and many more. So Bio-inspired nano/micromaterials are mostly nontoxic and many of them are well appreciated as green reduction agents.

Keywords: Bio nanomaterials, Nanoscale, Cancer therapy, Biodegradable, Environmental pollution.

A Study on Antibacterial and Antihelminthic effect of *Solanum torvum* Extract

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Abstract

As a result of drug resistance antibiotics and other anti-microbial medicines become ineffective and infections become difficult or impossible to treat, increasing the risk of disease spreading severe illness, disability, and death. The antibacterial activity of the extract was tested against six pathogenic bacteria *Staphylococcus aureus, Staphylococcus intermedius, Staphylococcus epidermis, Bacillus cereus,* and *Pseudomonas aeruginosa.* Intestinal helminthic infections, such as ascariasis trichuriasis hookworm and tapeworm infections continue to be a cause of major concern to human health. It causes malabsorption, diarrhea, anemia, and other states of poor health. Traditional plant-based remedies continue to be an important therapeutic aid for treating worm infections throughout the world. *Solanum torvum* is used in folk medicine in India for treating intestinal worms. This study evaluates the antihelminthic activity of its ripe fruit extract using experimental *Hymenolepis diminuta* (a zoonotic tapeworm) infection in albino rats. Our aim is to study and overcome the antibacterial resistance bacteria (*Staphylococcus aureus, Pseudomonas aeruginosa Vibrio cholera, Staphylococcus epidermis, Bacillus cereus*) and Antihelminthic activity by using leaf and fruit extract of *Solanum torvum.*

Keywords: Antibacterial, Antihelminthic, *Solanum torvum,* Antibacterial resistance.

Evaluation of phytochemicals, antioxidant and antimicrobial properties of *Majidea zanguebarica*

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Abstract

Nutrition of fish is an important consideration in fish health management of farmed finfish and shellfish. The shift in some countries from extensive to semi-intensive and intensive farming of fish demands that nutritionally complete feeds be provided by the farmer. The use of nutritionally inadequate feeds can result in reduced growth and production due to stress, but more seriously, the use of such feeds can result in the loss of fish from nutritional deficiency syndromes and/or from mortality brought on by increased susceptibility of nutritionally compromised fish to infectious diseases. Photobiotics can be defined as plant-derived products added to feed in order to improve the performance of animals. The photobiotic have a wide variety of properties such as antioxidant, antimicrobial, anticarcinogenic, analgesic, insecticidal, antiparasitic, anticoccidial, growth promoters' appetite enhancement, stimulant of secretion of bile and digestive enzyme activity, etc. The present work focuses on the phytochemical analysis, and antimicrobial and antioxidant properties of *Majidea zanguebarica* plants in aquaculture. Medicinal plants are the main sources of natural antioxidants and antimicrobial compounds. A large number of plants have been used in traditional medicine for the treatment and control of several diseases. This unexplored work bridges the research gap and gives an idea about the potential of *Majidea zanguebarica* plants in aquaculture. The research provides a new perspective on the use of *Majidea zanguebarica* as adjuvant therapy added to fish food to prevent diseases.

Keywords: *Majidea zanguebarica*, Phytobiotics, Phytochemical analysis, Antioxidant, Antimicrobial.

A Study on Antibacterial and Antibiofilm Effect of *Prosopis Juliflora* Extract

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Abstract

Antibacterial resistance is a serious public health problem, infections caused by antibacterial-resistant bacteria are more challenging and costly to treat. Antibacterial-resistant bacteria are bacteria that cannot be killed by antibiotics. They are able to survive and even multiply in the presence of antibiotics. *Staphylococcus aureus* and *Neisseria gonorrhoeae* are now always resistant to benzyl penicillin which was once used to control them. The antibacterial activity of leaf and fruit extract of *Prosopis juliflora* was tested against *Staphylococcus aureus, Staphylococcus epidermis, Pseudomonas aeruginosa, vibrio cholera,* and *Bacillus cereus.* Surgical site infections (SSI) are common post-operative complications caused by hospital-acquired bacteria as well as other opportunistic germs. SSI rates remain alarmingly high posing a risk to the health care system. Biofilm-forming bacteria are responsible for around 80% of human surgical site infections including persistent wound infections. Biofilm-associated surgical site infections are exceedingly difficult to treat with standard antibiotics due to multidrug-resistant bacteria tolerance. Biofilm-forming endogenous bacteria associated with surgical site infection are *Staphylococcus aureus*, *Enterococcus, E.coli,* and exogenous bacteria include *Staphylococci and Streptococci* our aim is to study and overcome the antibacterial- resistant bacteria Vibrio cholera, *Pseudomonas aeruginosa, Staphylococcus aureus, Staphylococcus epidermis, Bacillus cereus* and Biofilm forming bacteria using the leaf and fruit extract of *Prosopis juliflora.*

Keywords: *Prosopis juliflora*, Antibacterial, Biofilm, Antibacterial- resistant.

Influence of seaweed on the growth of native earthworms, *Perionyx excavates* and *Lampito mauritii* and formulation of novel biofertilizer from vermi products

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Abstract

The earthworms are employed to produce organic fertilizer from a variety of organic waste materials. The lack of accessibility of organic waste materials poses a constraint on the production of large quantities of organic fertilizer. There are many natural resources in the aquatic environment, particularly seaweeds. Around 844 seaweed species have been identified in India. Seaweed is a specific kind of macroalgae found in marine ecosystems and it is being employed for food and healthcare applications as well as an organic fertilizer. In fact, seaweed-based organic fertilizer supplies essential nutrients and can improve soil health. The main objectives of the current study are (i) to analyze key physiochemical parameters during the vermicomposting of seaweed using earthworms *Perionyx excavatus* and *Lampito mauritii;* (ii) to determine the total microbial populations at the initial stage and end of the product; (iii) to quantify the various enzymes at the initial and final substrate and (iv) to ascertain the variations in earthworm biomass during the vermicomposting process. According to the findings, the biomass of seaweeds can be employed as a viable substrate for vermicomposting operations after being mixed with cow dung in an appropriate ratio. During the vermiremediation process, there was clear evidence of an increase in the levels of all plant-friendly nutrients.

Keywords: Seaweed, Cow dung, *Perionyx excavatus*, *Lampito mauritii*, Physicochemical.

Therapeutic exploration of biomolecule(s) from the earthworm coelomic fluid: Isolation, Characterization and Bioactivity Assessment

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Abstract

The prospective scope of the purification and characterization of the bioactive biomolecules from the coelomic fluid of earthworms. It is Immunological recognition and memory. Coelomic fluids have a rich source of biomolecules like proteins, carbohydrates, lipids, and their compounds. A number of bioactive substances with pharmaceutical properties have been isolated from earthworm coelomic fluid. This study was carried out to investigate the bioactivity assessment of endogenic species of earthworm (*perionyx excavates*) coelomic fluid. In this study, the protein concentration of earthworms was estimated by Lowry's method. The molecular size of the protein was analyzed by SDS-PAGE. The current study objectives are (1) to isolate and standardize the biomolecule(s) from the coelomic fluid of earthworm, and (2) to screen the antioxidant, antimicrobial, and antitumor properties of the isolated biomolecule(s). The antimicrobial, antioxidant, and antitumor properties of the biomolecules, could pave the way for the development of promising drug molecules.

Keywords: *Perionyx excavates*, Antioxidant, Antimicrobial Antitumour, Earthworm.

Antimicrobial and proteolytic activity of Glycolipoprotein complex from the gut microbes isolated from *Drawida pellucida pallida*

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Abstract

Earthworms have been used in traditional medicine for centuries and are used worldwide as a standard ecotoxicological test species. Bacterial isolates from tapeworm (*Drawida pellucida pallida*) intestine were selected and identified by various biochemical tests. We used ion-exchange chromatography for sequential separation and purifying the *Bacillus cereus* worm protein characterized by sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE). The antimicrobial and proteolytic activity of an earthworm protein purified from *Bacillus cereus* was studied in vitro. This study highlighted the importance of researching earthworms as a viable sustainable protein option for the future, and more research and awareness of the benefits of their consumption is needed to activate research among the wider scientific community and promote potential therapeutic development.

Keywords: Earthworms, *Drawida pellucida pallida, Bacillus cereus*, Glycolipoprotein.

Anti-infective potential of isolated probiotic bacterium against *Vibrio parahaemolyticus* in *Litopenaeus vannamei*: *In vivo* evaluation

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Abstract

In the present study, the anti-infective potential of the isolated probiotic bacterium *Bacillus subtilis* from the stomach of *Litopenaeus vannamei*, was evaluated against the most prevalent disease-causing bacterial pathogen *V. parahaemolyticus* in *L. vannamei*. Shrimps were divided into six groups, Group 1: Control, Group 2: Infected with *V. parahaemolyticus* alone, Group 3: Probiotic alone, Group 4: Pretreatment (before bacterial exposure), Group 5: On the day of treatment on the same day of *V. parahaemolyticus* exposure), Group 6: Post-treatment (probiotics applied after initial symptoms of infection observed). In each group, 30 shrimps (Average body weight of 2 ± 0.1 g) were stocked with triplicates. Shrimps in Groups 3 and 4 were fed with probiotic feed from day 1. Probiotic-coated feed was given to the shrimp at the rate of 6% of the body weight per day, in Group 5 probiotic feed was given on the 8th day when the shrimps were exposed to the pathogen. Shrimps in Group 6 were fed with the probiotic-coated feed after they started to show disease symptoms (on the 10th day). Group 1 and Group 2 were fed with the normal commercial feed without probiotics at the same feeding ratio till the end of the experiment. To prepare probiotic feed PBS suspended *B. subtilis* of 1 x 10^8 CFU ml^{-1} was sprayed on the commercial feed (CP Feed) where agar was used as a binder (0.005 g/mL). Among the different supplementation groups, shrimp pretreated with *B. subtilis* at 1×10^8 CFU ml^{-1} concentration group (Group 4) exhibited high survival (83.33 ± 1.95 %), specific growth rate (16.6 ± 0.16 %), THC (10 ± 1 X 10^6 cells ml^{-1}), hyaline cells (76 ± 5.2 %), lowest ammonia (0.26 ± 0.05 ppm), nitrite (0.23 ± 0.05 ppm) and bacterial log value (4.91 ± 0.01 log CFU ml^{-1}) in culture water and improved midline section of the shrimp cephalothoraxes (gills, hepatopancreas and cross-section of abdominal segments) than the other treated groups. These findings conclude that the supplementation of probiotics through feed effectively prevents bacterial disease in shrimp and is valuable information to farmers and aquaculture researchers.

Keywords: *Vibrio parahaemolyticus*, Probiotics, Shrimp disease, Antibacterial activity.

Development of a Noval Oral Vaccine against *Edwardsiella tarda* using a Chitosan Nanoparticle-based Delivery System in *Oreochromis niloticus*

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Abstract

Aquaculture has led the world's fastest-growing food production sector. However, disease and environmental factors have negative impacts on productivity. *Edwardsiella tarda* is a type of pathogenic bacteria that causes a serious Edwardsiellosis infection in many commercially important fish species across the world. Edwardsiellosis results in significant economic losses in both freshwater and marine fish aquaculture. Tilapia is one of the most commonly farmed fish in aquaculture. However, the impact of *E. tarda* has resulted in high mortality rates, leading to significant economic losses in recent years. Vaccines have been developed as a potential therapeutic for antimicrobial resistance (AMR). This study aims to develop a vaccine for *E. tarda* using Chitosan nanoparticles extracted from crustacean shells, which have a significant impact on drug delivery. Chemically synthesized nanovaccines will be characterized by spectroscopy methods, SEM, FTIR, and Zeta potential analysis. Strong, stable cationic nanoparticles have a high affinity to negatively charged *E. tarda* by conjugation. The nanovaccine will be prepared to deliver formalin-inactivated *E.tarda* to tilapia. The nanovaccine will be given by oral delivery followed by a booster dose. A virulent strain of *E. tarda* will be injected into the vaccinated fish and subsequent mortality will be measured for 3 weeks. The relative percentage survival of each group will be calculated. Specific IgM antibody levels in Nile tilapia sera against *E. tarda* will be determined by ELISA. The spleen tissues will be sampled for histopathology and immune histochemistry analysis. To study whether the inclusion of nanovaccines affected the expression of selected cytokine genes after vaccination and relative to fish receiving the vaccine alone. Gene expression will be analysed by using qRT-PCR with genes like IgM, IgT, IgD, CD4, CD8α, IL1β, IL-10, IL-2, GATA3, IL-4/13, TNF-α, TGF-β, T-bet, MHC-Ia, and IFN-γ in the vaccinated fish. The study emphasizes a safe potential approach for vaccination strategies employing a novel bacterin vaccine incorporated with nanoparticles protecting fish and inducing protective immunity against infectious bacterial diseases. The study presents an approach for producing an eco-friendly and non-toxic cNP-conjugated vaccine against *E. tarda* in aquaculture.

Keywords: Tilapia, *E.tarda*, Chitosan nano-particle, Oral vaccine, UV spectrometer, ELISA, RTq-PCR.

Bottom-up synthesis of fluorescence carbon dots for biomedical applications

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Abstract

Carbon dots (CDs), as a new type of carbon-based nanomaterial have stimulated the curiosity of biomedical researchers due to their unique properties, such as less toxicity, high biocompatibility, physicochemical properties, and also favorable attributes like their size are usually smaller than 10 nm, long-term chemical stability, fluorescence property, eco-friendly & abundant functional groups (e.g., amino, hydroxyl, carboxyl). A huge number of researchers worldwide are working on CDs-based drug delivery systems to evaluate their versatility and efficacy in the field of pharmaceuticals. The present study mainly focuses on green CDs synthesis, characterization techniques, and their biomedical applications. An eco-friendly hydrothermal (180^0C for 24hrs) method was employed to synthesize high fluorescent, plants-derived novel carbon dots from seeds of *Cucurbita maxima* (CM) *and* leaves *of Aegle marmelos* (AM). The synthesized CM-CDs and AM-CDs were investigated by physicochemical evaluation such as UV absorbance at 280 nm for CM-CDs and 340 nm for AG-CDs. TGA analysis has shown good thermal stability at 687^0C for AG-CDs and 684^0C for CM-CDs. The antimicrobial activity of CDs was performed against *E. coli* and *B. subtilis* and antioxidant assay was performed by DPPH method. The present work is used to investigate the future research exploration of green CDs-based theranostic systems for the treatment of multiple disorders and also CDs as nanocarriers including gene delivery, vaccine delivery, and antiviral delivery.

Keywords: Antimicrobial, *Aegle marmelos, Cucurbita maxima*,. Nanomaterial.

Disease outbreak in Tilapia farms: molecular characterization, histopathological analysis and antibacterial activity of isolated probiotic bacterium against *Streptococcus agalactiae*

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Abstract

Tilapia (25 nos) that showed disease signs of exophthalmia, erratic swimming, ascites in the abdominal cavity, and peripheral hemorrhages on the body surface were collected from the three disease outburst farms. The wet mount and molecular studies confirm that fish were not infected with viral, parasitic, and fungal infections. In the selective media, all the bacterial colonies demonstrated *Streptococcus*-like character in the biochemical assays and displayed 99 to 100% similarities to *Streptococcus agalactiae* in 16S rRNA gene sequencing (MH057380). In the histopathology, meningoencephalitis, necrosis, hyaline droplet degeneration, bacterial granulomatous lesions with gram-positive cocci, hemorrhagic congestion, and inflammation were observed. When tilapia was exposed to *S. agalactiae* (10^5 & 10^6 CFU/ml) 100% mortality was recorded with similar clinical symptoms and histological changes to the fish collected from the disease outbreak farms. These findings confirm the Streptococcosis outbreak in the tilapia farm. The pathogenic *S. agalactiae* displayed resistance to Ampicillin, Amikacin, Cotrimoxazole, Gentamicin, Kanamycin, and Nalidixic Acid. An *in vitro* antibacterial study was conducted using *Bacillus cereus* (MK660022) isolated from the healthy tilapia gut. In *in vitro*, the whole cell product (WCP) and cell-free supernatant (CFS) of the *B. cereus* effectively inhibited the *S. agalactiae*. These findings are the base for in-depth *in vivo* analysis using probiotics to prevent *S. agalactiae* infection in tilapia farms.

Keywords: Tilapia, Streptococcosis, 16S rRNA, Meningitis, Probiotics.

Study of Antibacterial and Anticancer activity of *Celastrus orbiculatus*

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Abstract

Gingivostomatitis is an infection of the mouth and gums that leads to swelling and sores. It may be due to a virus or bacteria. The aqueous extract of the leaves of oriental bittersweet leaves acts against bacterial strains It acts against gram-positive bacteria (*Staphylococcus aureus, Streptococcus spp, Bacillus cereus*), while for gram-negative bacteria (*Escherichia coli, Pseudomonas aeruginosa, Vibrio*). The extract is used as a natural remedy to treat various chronic diseases. The leaf extract of oriental bittersweet leaves is used for treating gingiviostomatitis and oral cancer. It acts against the oral pathogens *Candida albicans* and *Streptococcus mutans.* Oral cancer is the sixth most common malignancy worldwide. Three hundred thousand patients (2.1% of the total cancer cases) were afflicted with cancer of the oral cavity and lip in 2012. One hundred and forty-five thousand patients passed away from cancer of the oral cavity and lip. *Celastrus orbiculatus* leaf extract has anticancer activity against oral cancer. This study aims to analyze the antibacterial and anticancer activity of *Celebrate orbiculatus*.

Keywords: *Celastrus orbiculatus*, Antibacterial properties, Anticancer properties.

Silk fibroin nanoparticles loaded gossypetin as a potential Drug delivery system

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Abstract

Aqueous silk fibroin (SF), derived from *Bombyx mori* silk, was used to synthesize silk fibroin nanoparticles (SFNPs) at ambient temperature. Gossypetin (GTIN) as a hexahydroxylated flavonoid was synthesized from the leaves of *Moringa Oleifera* with various pharmacological activities, including antioxidant, antibacterial and anticancer activities. The SFNPs with sizes of ~95 nm were synthesized via the dissolution method, which encapsulates the GTIN *in situ*. The resulting GTIN-SFNPs composites were characterized by physio-chemical techniques. From the UV spectroscopy, the appearance of absorbance at 435 nm confirmed the formation of GTIN-SFNPs. The synthesized nanocomposites were well characterized using HR-TEM (High-Resolution Transmission Electron Microscope), XRD (X-ray Diffraction), FT-IR (Fourier Transform Infrared), and TGA (Thermogravimetric) techniques. The drug loading content (DLC) and the encapsulation efficiency (EE) varied with the relation between GTIN and SFNPs in the loading solution. The highest encapsulation efficiency was found at 81.5 ± 0.22% and a loading content of 0.815 ± 0.27% had also the highest loading content for formulations with 1:40 drug-to-polymer ratios, respectively. The development of gossypetin-loaded silk fibroin nanoparticles is advanced by this discovery, which may be investigated further for drug entity loading and targeting.

Keywords: *Bombyx mori*, Gossypetin, Nanoparticles, Silk fibroin.

Dietary Supplementation of Chitosan on Growth Performance, Hematological Profile, and Digestive Enzyme Activity in *Oreochromis mossambicus*

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Abstract

This study investigates the impact of extracted chitosan, derived from the shells of prawns, on the growth performance, hematological profile, and digestive enzymes of *Oreochromis mossambicus*. Fish fed with a supplementary diet of chitosan at different levels of concentrations (10, 15, and 20 mg/kg^{-1}) owing to their body weight for 60 days of the experimental trial at the end of the trial Growth parameters including weight gain, feed conversion ratio, Specific Growth Rate, and hematological parameters were monitored to evaluate the overall performance of the fish. Hematological analysis provided insights into the effects of chitosan on red and white blood cell counts. Furthermore, the study explored the influence of chitosan on the activity of key digestive enzymes such as amylase, protease, and lipase. These enzymes play a crucial role in nutrient digestion and absorption within the gastrointestinal tract. After 60 days of the experimental trial showed that the result indicating a significant increase in Red Blood Cell (RBC) and White Blood Cell (WBC) counts, as well as improved growth performance and increased activity of digestive enzymes in *Oreochromis mossambicus* at a chitosan concentration of 15 gm/kg^{-1} suggests positive physiological responses to this particular concentration.

Keywords: Chitosan, *Oreochromis mossambicus*, Enzymes, Hematological profile.

Bio-Nanomaterials

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Abstract

In the hunt for a safer substitute for conventional nanoparticles that are hazardous for use in biomedical applications, bio nanomaterials have been shown to be an ideal fit. Bio nanomaterials are made from biomolecules that are taken from microorganisms, plants, agricultural wastes, insects, marine species, and some mammals or they can be used to encapsulate or immobilize a traditional nanomaterial, is defined as a nonviable material used in a medical device that is intended to interact with biological systems. The high-surface area, nano-sized (1-100 nm) biomaterial particles find many applications in tissue engineering, cancer therapy, drug and gene delivery, medical imaging, and many more in the biomedical field. According to research on nanoscale biomaterials, they are biodegradable, non-toxic, immunogenic, and biocompatible. In Nano biomedicine, the use of nanoscale molecular instruments is directed toward both improvement and diagnosis. These Nano biomaterials aid in the synthesis of peptides, drug molecules, and other biomolecules for customized therapeutics in smart drug delivery systems and showed improved biocompatibility, bioavailability, and bio reactivity with low or insignificant toxicity toward people, other species, and the environment. The dumping of plastic waste and non-biodegradable materials is a principal problem of environmental pollution. In their numerous chemical forms, cellulose and various other biodegradable materials can be possible alternatives to resolve these challenging issues. Our biosphere provides us with plentiful substances that cater to our different needs at every point in life. These include several plant extracts, vitamins, biopolymers, peptides, proteins, sugars in the form of glucose, fructose, and many more. So Bio-inspired nano/micromaterials are mostly nontoxic and many of them are well appreciated as green reduction agents.

Keywords: Bio nanomaterials, Nanoscale, Cancer therapy, Biodegradable, Environmental pollution.

Targeted drug delivery in Oncotherapy

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Abstract

Tumors, as a major global public health issue, pose a serious threat to human health. Therapeutic strategies were used initially but it has many limitations. In this research field, a large number of researchers have achieved significant breakthroughs and advances in oncotherapy, in targeted drug delivery is a precise and effective strategy in oncotherapy that can accurately deliver drugs to tumor cells or tissues to enhance their therapeutic effect and, meanwhile, weaken their undesirable side effects on normal cells or tissues. Typically, nanocarriers as a promising drug delivery strategy can effectively deliver drugs to the tumor site through enhanced permeability and retention (EPR) effect-mediated passive targeting and various types of receptor-mediated active targeting, respectively. Nanocarrier-based targeted drug delivery mainly includes passive targeting and active targeting. Recently, the various developed nanocarrier-based targeted drug delivery strategies have mainly included the introduction of targeting molecules (antibodies, peptides, aptamers, small molecules, etc.) and delivery vehicles (liposomes, polymers, metal oxides, silica, etc.). The design and optimization of these targeting molecules and delivery vehicles enable a strong interaction with tumor cells and improve the bioavailability, biodistribution delivery efficiency, and specificity of drugs. In addition, nanocarrier-based targeted drug delivery can enhance drug accumulation in tumor tissue and reduce drug distribution in normal tissue. Although significant progress has been made in targeted drug delivery in oncotherapy, many challenges and limitations, such as the complexity of tumor structure, the ambiguous biosafety of delivery systems, as well as the rapid metabolism and clearance of drugs, still remain. Therefore, further research is still necessary to promote the development and clinical application of targeted drug delivery technologies in efficient oncotherapy.

Keywords: Nanocarrier, EPR, Passive targeting, Active targeting, Oncotherapy.

Biogenic synthesis of Nanoparticles via Seagrasses

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Abstract

The largely unexplored marine environment that covers approximately 70% of the earth's surface is home to many naturally occurring and renewable marine plants. Seagrasses contain a wide variety of biologically active compounds and secondary metabolites that enable these plants to act as biological factories for the manufacture of metal and metal oxide nanoparticles. An important aspect of nanotechnology is the synthesis of nanometer-scale materials and the direct control of particle morphology and dimensions during formation. Nanometer-scale materials have at least one dimension less than 100 nm and can have a wide variety of geometric shapes such as plates, sheets, tubes, wires, and particles. Nanomaterials can be broadly classified into two types namely, organic and inorganic. Organic nanomaterials are carbon-based, while inorganic nanomaterials include noble metals (gold, platinum, and silver), magnetic materials (iron oxide Fe_3O_4), and semiconductors such as titanium dioxide and zinc oxide. Accordingly, research in recent years has focused on manufacturing nanomaterials via nanotechnology-based processes that promote the principles of green chemistry and reduce or totally eliminate the use of hazardous chemicals. Thus, ecofriendly green nanotechnology-based processes for the manufacture of nanoparticles have attracted considerable interest worldwide. So the synthesis of novel nanoparticles with the desirable characteristics required for developing biosensors, biomedicine, cosmetics, and Nano-biotechnology, and in electrochemical, catalytic, antibacterial, electronics, sensing, and other applications.

Keywords: Nanoparticle, Green Chemistry, Seagrass, Noble metals, Ecofriendly.

Metagenomic Analyses Unveils Microbial Diversity of *Gracilaria canaliculata* OQ696182 and *Solieria robusta* OQ696183 from Thondi, Tamil Nadu

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Abstract

Seaweeds are natural, abundant bioresources of the marine ecosystem, whose untapped potential needs further exploration. With both ecological and economic significance globally, marine macroalgae, particularly in traditional medicine, play a pivotal role in industries such as pharmaceuticals, nutraceuticals, cosmetics, and food. Macroalgae and their associated bacteria form a highly efficient metabolic system in the ocean, yet the intricacies of their interactions remain largely unexplored. The dynamic interplay between hosts (basibionts, e.g., algae) and microbes (epibionts, e.g., bacteria) serves as a driving force for mutualism in the marine environment. However, these interactions can be either essential for the host or potentially harmful, influencing overall ecosystem functionality. In this study, seaweed samples were collected from Thondi coastal waters in Palk Bay, Tamil Nadu, south-east coast of India. Employing DNA barcoding with the 5' end of the COI gene of the mitochondrial genome, the seaweed samples were identified as *Gracilaria canaliculata* and *Solieria robusta, Gracilaria canaliculata*, family *Gracilariaceae*, is cultivated for agar preparation, and used in porridges, and jellies. Plants are erect, brownish-red, irregularly branched. *Solieriaceae*, a family of red algae (Rhodophyta), is an agarophyte. Plants are red, grey, or bleach yellow, fairly soft when fresh, and 100-230mm tall, tubular (cylindrical), pinched at the base, tapering to a point. Examining the metagenomes of *Gracilaria canaliculata* and *Solieria robusta* involved a detailed analysis of the V3–V4 region of the 16S rRNA gene to gain insights into the microbial communities associated with each algal species. The analysis of *Gracilaria canaliculata* disclosed the existence of algae-associated bacteria, encompassing 81 genera, 44 families, 36 orders, 18 classes, and 9 phyla. At the genus level, the examination of *Gracilaria canaliculata* revealed the highest presence of *Acinetobacter* (43%), *Enterobacter* (12%), and *Aeromonas* (5%). The analysis of *Soliria robusta* unveiled the existence of 99 genera, 50 families, 40 orders, 22 classes, and 13 phyla. At the genus level, the community is dominated by *Vibrio* (21%), followed by *Fusibacter* (10%), and *Burkholderia-Burkholderia-Paraburkholderia* (6%). This research enhances our understanding of algal microbial ecology and will provide valuable insights into their metabolic characteristics, ecological functions, and potential applications.

Keywords: Seaweed, *Gracilaria canaliculata*, Red algae, Microbial Diversity.

Plant- and Bacteria-mediated Synthesis of Zinc Oxide Nanoparticles and Evaluation of Their Antibacterial and Anticancer Potential

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Abstract

Nanotechnology enables the development of nanoscale metal particles with novel, distinctive, physicochemical properties, and a wide array of scientific and technological applications. Metal nanoparticle synthesis by biological systems such as plants, algae, fungi, diatoms, and bacteria, is biocompatible, inexpensive, safe, non-toxic, and eco-friendly. The seeds of the Indian medicinal plant *Nigella sativa* L. have been demonstrated to have anti-oxidant, anti-inflammatory, anti-cancer, anti-helminthic, and antimicrobial potential. *Nigella sativa* was reared from commercially procured seeds in earthen pots. Zinc Oxide nanoparticles (ZnO NPs) were synthesized from the leaf extract of *N. sativa*. Textile dye effluent collected from a discharge point in Tirupur, Tamil Nadu, was used as a source for isolation of a zinc-resistant bacterial strain, which could be employed in the synthesis of zinc oxide 'bionanoparticles'. The bacterial isolates were screened for zinc resistance. The zinc-resistant bacterial isolate was identified by sequencing the 16S rRNA gene as *Stutzerimonas stutzeri.* The extracellular synthesis of ZnO NPs using bacterial supernatant. The synthesis of ZnO NPs was confirmed by UV-Vis spectroscopic analysis, X-ray Diffraction (XRD), Fourier Transform Infra-Red spectroscopy (FTIR), Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM) and EDAX. The ZnO NPs resulting from plant-mediated synthesis were round or rectangular in shape, while those obtained by bacteria-mediated synthesis were diamond or flower-shaped. The size of the former ranged from 50 - 500 nm, while those of the latter from 25.5 – 40.4 nm. Significant antibacterial activity by the ZnO NPs was observed against four pathogenic strains of *Escherichia coli*, *Klebsiella pneumonia*, *Staphylococcus aureus*, *Bacillus cereus*, with inhibition zones ranging from 8 to 13 mm for ZnO NPs synthesized using *N. sativa*, and 16 to 17 mm for the ZnO NPs derived by bacterial synthesis. The cytotoxicity of ZnO NPs fabricated using plant extract on NCCS cell line RAW-264.7 (mouse tumor induced by murine leukemia virus), and ZnO NPs synthesized by bacteria on NCCS cell line HeLa (immortalized human cervical cancer cells), was determined by the MTT assay. The ZnO NPs showed effective cytotoxicity, with an IC50 value of 155.4 µg/ml against the RAW-264.7 macrophage cell line, and an IC_{50} value of 48.75 µg/ml against the HeLa cervical cancer cell line. Zinc oxide nanoparticles obtained by *Nigella sativa*-mediated synthesis and bacteria-mediated synthesis have potential applications as bactericidal and anti-cancer agents.

Keywords: *Nigella sativa, Stutzerimonas stutzeri,* Anticancer, Nanoparticles.

Biosynthesis of Nickel Oxide Nanoparticles using *Ficus racemosa* Linn. and *Micrococcus yunnanensis* OQ892256 and Comparison of their Antibacterial, Anticancer Potential

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Abstract

Nanotechnology is a burgeoning field of interdisciplinary research, where, novel techniques are being developed to probe and manipulate individual atoms and molecules enabling novel applications. Due to their small size and large surface area, metal nanoparticles display extraordinary properties, and can combat conditions like cancer and fight human pathogens. *Ficus racemosa* Linn., used in Ayurvedic medicine, is purported to have anti-inflammatory, anti-diabetic, and anti-diarrheal properties, and is used to treat liver disorders, respiratory and urinary infections. Nickel Oxide Nanoparticles (NiO NPs) were synthesized in an environmentally benign manner using the leaf extract of *F. racemosa* as a bio-reductant. The nickel-resistant bacterial strain *Micrococcus yunnanensis* was isolated and identified by screening textile dye effluent collected from Tirupur, Tamil Nadu. The synthesis of NiO NPs by *Micrococcus yunnanensis*. Synthesized NiO NPs were characterized by UV-Vis spectroscopic analysis, X-ray Diffraction (XRD), Fourier Transform Infra-Red spectroscopy (FTIR), Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM) and EDAX. NiO NPs obtained using *F. racemosa* leaf extracts were ovoid in shape, whereas those fabricated by the bacteria were ovoid to round (in chains). Plant-mediated synthesis resulted in NiO NPs with sizes varying from 26.2 nm to 46.2 nm, while NiO NPs from bacterial synthesis ranged from 45.2 nm to 69.8 nm. The antibacterial activity of the NiO NPs against ATCC strains of Gram-negative *Salmonella typhi*, *Escherichia coli*, Gram-positive *Staphylococcus aureus*, and *Bacillus subtilis*. NiO NPs exhibited significant antibacterial activity against the four pathogens with inhibition zones ranging from 10 to 21 mm for *F. racemosa*-synthesized NiO NPs and inhibition zones varying between 10 to 13 mm in the case of bacteria-synthesized NiO NPs. The cytotoxicity of NiO NPs fabricated using plant extract on NCCS cell line A549 of human lung carcinoma and NiO NPs obtained employing bacteria on NCCS cell line RAW 264.7, determined by the MTT assay (Mosmann, 1983), confirmed cytotoxicity, with an IC50 value of 36.44 µg/ml for the former and 66.03 µg/ml for the latter. The appreciable antibacterial and anti-cancer properties of nickel oxide nanoparticles fabricated using leaf extracts of *Ficus racemosa* and nickel-resistant bacterial strain *Micrococcus yunnanensis* makes them potential therapeutic agents meriting further study.

Keywords: *Ficus racemosa, Micrococcus yunnanensis,* Nanoparticle, Antibacterial, Anticancer.

Harnessing the Potential of Secondary Metabolite Extracted from Marine Bacteria *Acinetobacter baumannii* and its Biomedical Applications

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Abstract

A diverse group of organic compounds, commonly called secondary metabolites, are produced by bacteria that are not directly essential for their growth but hold significant therapeutic properties. The present study extracted secondary metabolites from the bacteria *Acinetobacter baumannii* isolated from surface sea water and explored their biomedical applications. The GCMS profiling of ethyl acetate extracted crude (EAEC) shows 30 peaks, with the highest and adjacent peaks evidenced for compounds including pentanoic acid, oxazine, octanoic acid, 2piperidinone, quinoline, aziridine, and pyrrolopyrazine, which have previously reported to hold significant pharmaceutical importance. The presence of methylene, alkene, phenyl rings, amides, carboxylic acids, etc. was identified through FTIR analysis. The agar well diffusion assay using EAEC shows inhibition against ESKAPE pathogens and the fungal strain *Candida albicans* and the inhibition starts from the 25µl/ml concentration of crude itself. MIC starts from the 8µl/ml concentration of the crude. Further, the EAEC shows significant anti-diabetic (46.41% inhibition of alpha-amylase), anti-oxidant (41.03% inhibition of free radicals using DPPH assay), anti-cancer (MCF-7 breast cancer cell line using MTT assay) and antibiofilm activity against selected bacterial pathogens. The exhibited biological applications are believed to be due to the presence of heterocyclic, saturated fatty acids, polyamides, proteinogenic amino acids, aromatics, and other organic compounds present in the bacterial EAEC. Further studies are warranted to explore the untapped resources of marine bacteria for the development of novel therapeutic agents.

Keywords: Anti-microbial, *Acinetobacter baumannii*, Secondary metabolites, Anti-diabetic.

Molecular Dynamics Simulation and Quantum Mechanical Studies on Agonist/Antagonist Binding Reactions in Human Estrogen Receptor Alpha

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Abstract

The enzyme Human estrogen receptor alpha (ERα) belongs to the nuclear receptor superfamily of transcription factors that mediate most of the biological effects of estrogens at the level of gene regulation. ERα has much involvement in endocrine-related functions and abnormality in this particular enzyme leads to heavy disturbances in metabolism, sexual behavior, and central nervous systems. Till now various studies have examined the structural details of ERα along with its agonist/antagonist binding information. Recently, *Arao et al.*, 2013 have experimentally provided two mutations in the H12 region that have the ability of agonist reversal activity. In this work, we perform Molecular dynamics (MD) Simulations and Quantum Mechanics (QM) based reaction mechanism studies on those L543A, and L544A mutations, to report the structural information behind the agonist reversal activity. Our results on 100ns MD simulations suggest that the ERα with agonist and ERα with antagonist have different conformational changes that are especially observed in the H12 region. Typical conformations of wild and mutant are analyzed for their activation energy calculation through QM calculations and transition state search. The study is based on QM-based free energy calculations along properly selected transition states of each conformation obtained from MD simulations, and on the analysis of the main structural changes and interactions taking place at every step. Our findings through QM studies will bring structural insight into the agonist reversal mechanism and to understand the Ligand Binding Domain Dimerization Associated with DNA Binding Mechanism.

Keywords: Receptor, Quantum Mechanics, Molecular Dynamics, Receptor.

Interactive effects of freshwater acidification and anti-epileptic drug gabapentin on biochemical changes and neurotoxicity in freshwater fish *Labeo rohita*

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Abstract

Freshwater acidification and increasing discharge of toxic pollutants including pharmaceutical compounds into the aquatic ecosystem are emerging motorists of environmental change affecting aquatic ecosystems. Wide spread research demonstrates that freshwater acidification has direct and indirect impacts on aquatic organisms in combination with other stressors mainly pharmaceuticals, which have received insufficient attention to date. Among various aquatic organisms, fishes are a vital bioindicator among various aquatic organisms that were badly affected by gabapentin. The research presented here was designed to evaluate the influences of the anti-epileptic drug gabapentin on biochemical changes and neurotoxicity in freshwater fish *Labeo rohita* when exposed to different concentrations (0.1 µg/L and 10 µg/L) of gabapentin and pH-7.1 for chronic (28 days) toxicity. At all concentrations, stress-related biomarkers including increased reactive oxygen species level (ROS), biochemical parameters Glutathione -S- transferase (GST), Glutathione peroxidase (GPx), Superoxide dismutase (SOD), Catalase activity (CAT), enzymes for biotransformation lipid peroxidation (LPO) and protein carbonyl activity (PCO), cellular damage Metallothionein (MT) and Reduced glutathione (GSH) were significantly ($P \leq 0.05$) altered in *L. rohita*. Hence, the obtained results confirmed severe damages with an increase in metabolic depression and oxidative stress treated with gabapentin. Overall, the present results highlighted that chronic exposure to gabapentin may exert a strong effect on the antioxidant enzymes, oxidative stress, and increased neurotoxic effects in *L.rohita*.

Keywords: Gabapentin, *Labeo rohita,* Oxidative stress, Neurotoxicity, Cellular damage.

Investigating the effects of manganese and manganese oxide on the fungi *Aspergillus flavus* and *Aspergillus niger*: A cellular and metabolic exploration

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Abstract

The present work thoroughly explores the intricate cellular and metabolic responses of the fungi *Aspergillus flavus* and *Aspergillus niger* when exposed to manganese and manganese oxide. Through a comprehensive exploration, we examine the generation of reactive oxygen species (ROS) as a key indicator of oxidative stress in these fungal species. The investigation encompasses the impact of manganese and manganese oxide on vital metabolic pathways, shedding light on alterations in energy production, biosynthetic processes, and overall cellular homeostasis. Utilizing advanced analytical techniques, including ROS activity assays and metabolic pathway profiling, we uncover the effects of manganese and its oxide form on these fungi. The findings also provide insights into how these alterations manifest in the metabolic networks of *Aspergillus flavus* and *Aspergillus niger*. This cellular and metabolic exploration contributes valuable knowledge to the broader understanding of metal-induced stress responses in fungi, offering potential implications for environmental and industrial contexts.

Keywords: *Aspergillus flavus*, *Aspergillus niger*, ROS, Manganese oxide, Environment.

Development of bioactive polysaccharide-coated ZnO nanoparticles to investigate the antioxidant, antibiofilm, and biocompatibility properties

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Abstract

The bioactive polysaccharide Ulvan was isolated from the green seaweed *Ulva lactuca* and identified via FTIR and ^{1}HNMR analysis. Ulvan-coated zinc oxide nanoparticles (U-ZnO NPs) were produced and characterized using UV, XRD, FTIR, SEM, and EDX analysis. The appearance of a strong peak at 370 nm in UV-vi spectroscopy basically confirms the NPs production. Furthermore, the crystallinity and functional groups present in U-ZnO NPs were disclosed by X-ray diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR), respectively. Scanning electron microscopy (SEM) revealed that the produced U-ZnO NPs were heavily agglomerated with spherical-shaped particles. The elemental composition detected in EDX indicated that the U-ZnO NPs were primarily composed of zinc. U-ZnO NPs showed antibacterial and antibiofilm properties when tested against aquatic Gram-negative *Vibrio alginolyticus*, *Vibrio paraheamolyticus*, *Vibrio vulnificus*, and *Vibrio anguillarum*. The results showed that U-ZnO NPs considerably reduced the development and biofilm structure of the studied Gram-negative bacteria when compared to ulvan. This was verified by the protein leakage experiment and EPS quantification analysis, which also demonstrated that U-ZnO NPs had potent antibacterial and antibiofilm activities by dislodging intracellular proteins from the bacterial cell membrane and decreasing EPS formation, respectively. Furthermore, the findings of the DPPH radical scavenging assay and the free reducing antioxidant power (FRAP) experiment indicated enhanced antioxidant activity of U-ZnO NPs. In addition, *Artemia salina*, a micro crustacean, was used to assess the toxicity of U-ZnO NPs. After 48 hours of exposure, no obvious acute toxicity was seen; however, after 96 hours, the immobilization rate rose considerably when compared to the control group. As a result of their environmentally friendly manufacture, nontoxicity, and biocompatibility, U-ZnO-NPs could be used as promising candidates in biomedical and environmental applications.

Keywords: Polysaccharide, Nanoparticles, Antibiofilm, Biocompatibility.

Ecological insights and sustainable life: Unraveling the role of soil mites in microplastic biodegradation within agroecosystems

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Abstract

In this study, we undertake a comprehensive exploration into the potential role of soil mites in the breakdown of microplastics (MPs) within agroecosystems emphasizing MPs breakdown and biodiversity. Utilizing taxonomic and genetic approaches enhances the identification of species and understanding of the mechanism of MPs remediation. Diverse mites in agroecosystems play a vital role in maintaining ecological balance. Roles of mites offer critical insights into the issue of microplastic contamination. The research seeks to establish a foundation for addressing the urgent and sustainable challenge posed by MPs. The synthesis of findings contributes to the advancement of knowledge and informs practical strategies for mitigation. Understanding the role of mites in waste degradation provides guidance for targeted interventions and promotes sustainable practices. The significance of biodiversity in addressing broader environmental issues is underscored throughout the study. The importance of nature of these efforts highlights the importance of collaborative approaches in addressing complex environmental challenges.

Keywords: Soil mites, Microplastics (MPs), Biodegradation, Environment.

Innovative vaccine formulation: Manganese-coated carbon nanotube conjugated with outer membrane protein of *Aeromonas hydrophila* for enhanced immunization of *Labeo rohita*

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Abstract

This study presents an innovative approach to vaccine development by employing manganese-coated carbon nanotubes (Mn-CNTs) in combination with the outer membrane protein of *Aeromonas hydrophila* for immunizing *Labeo rohita*. The manganese coating on carbon nanotubes serves as an efficient carrier for antigen delivery, enhancing the overall immunogenicity of the vaccine. The vaccine preparation involves optimization of Mn-CNT concentration and the antigenic component to ensure efficacy and safety. Characterization techniques such as TEM, FT-IR, and UV-vis spectroscopy validate the successful synthesis of Mn-CNTs and confirm the binding of the outer membrane protein. Immunization trials on *L. rohita* demonstrate the vaccine's efficacy in inducing a strong immune response, as evidenced by antibody production, cytokine expression, and histopathological examinations. The study signifies the potential of Mn-CNTs as a versatile platform for aquaculture vaccine development, highlighting its role in enhancing immunization strategies against prevalent fish pathogens. The findings contribute to advancing sustainable aquaculture practices through the development of effective and targeted vaccines.

Keywords: *Labeo rohita*, *Aeromonas hydrophila*, Carbon nanotubes, Manganese, Cytokines.

Dietary supplementation of *Trachyspermum ammi* improves growth performance, immune responses, and resistance against *Aeromonas hydrophila* in *Oreochromis niloticus*

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Abstract

This study reported that the dietary supplementation of *Trachyspermum ammi* (Ajwain) improves growth performance, immune responses, and resistance against *Aeromonas hydrophila* in *Oreochromis niloticus*. The healthy fish were purchased and fed with a *T. ammi* mixed diet for 28 days; it was separated into three groups (control, three different concentrations of *T. ammi* mixed diet). Growth performance was measured (FW, SGR, and FCR), immune parameters (TP, ALP, MPO, and LYZ), and antioxidant activities (SOD, CAT, GPx, and PCA) were done at the end of the experiment. A significant enhancement in the biochemical and immunological parameters of fish were observed which is fed with experimental diets compared to control. *O. niloticus* showed high resistance against *A. hydrophila* when it was fed with a *T. ammi* mixed diet. The result shows significant ($P < 0.05$) in the fishes fed with a *T. ammi* mixed diet improves their health and gains resistance against *A. hydrophlia* when compared to the fishes in control.

Keywords: *Trachyspermum ammi*, *Oreochromis niloticus*, *Aeromonas hydrophila*, Dietary supplementation.

Green synthesis of zinc oxide nanoparticles from *Glycyrrhiza glabra* leaf extract: Characterization and its biomedical applications

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Abstract

This study explores the eco-friendly synthesis of zinc oxide nanoparticles (ZnO NPs) utilizing the leaf extract of *Glycyrrhiza glabra.* The green synthesis of ZnO NPs is characterized by its cost-effectiveness and eco-sustainability. The biological activity of *Glycyrrhiza glabra* leaf extracts includes antibacterial, antioxidant, and anti-inflammatory properties. *Glycyrrhiza glabra*-based ZnO NPs were synthesized using the precipitation method and further characterized through UV-vis spectroscopy, FTIR, XRD, TEM, and Zeta potential analysis. Here, the UV was noted at a range of 350nm. TEM shows a spherical structure with an average size of 25.39nm. ZnO NPs were tested for MIC, antibacterial, antibiofilm, and antioxidant activities against gram-positive bacteria (*Bacillus horneckiae, Enterococcus faecalis,* and *Staphylococcus aureus*) and gram-negative bacteria (*Escherichia coli* and *Pseudomonas aeruginosa*). The synthesized *Glycyrrhiza glabra* ZnO NPs effectively inhibit bacterial growth by zone formation in antibacterial activity. This study determines the antibacterial, antioxidant activity, and toxicity assessment of *Artemia salina* synthesized from *Glycyrrhiza glabra* leaf extract and reveals the potential applications in nanomedicine paving the way for exciting future development in this field.

Keywords: *Glycyrrhiza glabra,* Antibacterial activity, Toxicity study, Zinc oxide nanoparticles.

Acute Toxic Effects of Polypropylene Microplastic on Freshwater Fish *Labeo rohita*

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Abstract

In recent years, throughout the world microplastics have accumulated in soils and oceans with maximum concentrations reaching 1,00,000 particles m^3. This study determines the water exposure of fluorescently tagged polypropylene microplastics for up to 28 days (chronic exposure) at various concentrations, including control, group 1 (1 mg/L), group 2 (10 mg/L), and group 3 (100 mg/L) in freshwater fish *Labeo rohita*. In order to assess the harmful consequences, it is essential to consider key indicators including reactive oxygen species, antioxidant parameters (SOD, CAT, GST), and the impact of oxidative stress on proteins and lipids. Also, examined the activity of the neurotransmitter enzyme acetylcholine esterase. Further, the accumulation of microplastic in their digestive tract was analyzed using a fluorescent microscope using a yellow filter (470 nm). Additionally, neurotransmitter activity demonstrated the slow movement of fish exposed to a high concentration of microplastics (100 mg/L). The aquatic ecosystem and ecology are facing an increasing threat from microplastics and hence, this study concludes that ingestion of microplastics in rohu causes severe damage to internal parts like gills, intestine, and brain.

Keywords: Microplastics, Polypropylene, *Labeo rohita*, Microplastics.

A Review on Nano Science Approaches for Fisheries Development

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Abstract

Globally, aquaculture shows enormous potential in using the advantages of nanotechnology. Numerous nanoparticles have less harmful impacts on the immune system of fish. Although the use of nanoparticles in aquaculture has shown promise in improving water quality, feeding aquatic animals, providing drugs, diagnosing and treating diseases, and maintaining them, only a few studies have been conducted using a greener methodology, which is opening up new possibilities in the aquaculture industry. Nanoparticles are less expensive than other materials for transporting biological substances. These are the latest instruments for fish biotechnology, genetics, reproduction, aquaculture, and aquatic health, among other fields. Nanoparticles have gained popularity in aquaculture as a sensitive and precise screening tool for bacterial, fungal, and viral infections. There have been recent activities in the fields of health management, water treatment, seafood processing and preservation, and the improvement of fish and shellfish development by dietary supplementation with nutraceuticals. Nanotechnology has shown the most promising ability for enhancing aquaculture through the development of new nanotools. This article presents the recent developments of nanotechnology and its applications in aquaculture and fisheries. As a result, nanotechnology will be essential for enhancing this industry's efficiency as well as decreasing its negative environmental effects.

Keywords: Aquaculture, Nanotechnology, Fisheries industry, Aquatic health.

Heavy metal impact on freshwater milkfish *(Chanos chanos)*: Expansion responses *via* biomarkers

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Abstract

The environmental impact of heavy metal pollution is significant because of its toxicity, persistence, bioaccumulation, and bio-magnification properties. Several anthropogenic and natural factors can lead to heavy metal pollution in the environment. Metals are ingested by fishes, they accumulate the entire body through the gills. The most prevalent heavy metal contaminants that cause severe toxicity in fish is arsenic. The basic molecular mechanism of metal poisoning is the development of oxidative stress. Stress impairs immunity, and damages organs and tissues which leads to growth defects, and lowers the capacity for reproduction. The highest metal burden was found in the kidney and liver. While reduced glutathione (GSH) levels were relatively low and increased levels were high, oxidative stress markers such as superoxide dismutase (SOD), catalase (CAT), glutathione transferees (GST), and lipid peroxidation (LPO) were significantly greater in all tissue the various concentration of 20<40<60<80<100 in *Chanos chanos*. Histopathology analysis also shows the damage to the gills, liver, and kidney. Higher concentrations show great accumulation and significant damage to both DNA and histological analysis. As a result, the accumulation of metal shows high oxidative stress, and histopathology is an important indicator for monitoring freshwater ecosystem pollution and native fish adaption strategies.

Keywords: Pollution, *Chanos chanos,* Arsenic, Superoxide dismutase, Histopathology.

Advances in aquatic vaccine and their importance to aquaculture

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Abstract

Aquaculture, the farming of aquatic organisms, has become a critical source of protein for a growing global population. However, the industry faces numerous challenges, including disease outbreaks that can devastate fish and shrimp populations. The development and implementation of aquatic vaccines have emerged as a crucial tool in promoting sustainable aquaculture. Researchers have made significant strides in developing vaccines tailored to the unique immune systems of aquatic species. Aquatic vaccines play a pivotal role in preventing the spread of infectious diseases among farmed species. Vaccination helps to reduce the use of antibiotics and other medications, promoting a more sustainable and environmentally friendly approach to aquaculture. Disease outbreaks can lead to significant economic losses in the aquaculture industry. Vaccination safeguards the investment of aquaculture farmers by minimizing the impact of diseases and ensuring a consistent and healthy supply of aquatic products. Limiting the need for therapeutic treatments, such as antibiotics, through vaccination contributes to reducing the environmental impact of aquaculture. This aligns with the growing global emphasis on sustainable and responsible agricultural practices. Advances in aquatic vaccines are instrumental in addressing challenges faced by the aquaculture industry. Through the application of cutting-edge technologies and targeted research, these vaccines contribute to disease prevention, economic sustainability, environmental responsibility, and global food security. As the aquaculture sector continues to evolve, the ongoing development and adoption of effective vaccines will be crucial for its long-term success.

Keywords: Vaccine, Diseases, Aquaculture, Sustainability.

Neonicotinoid-induced Hematological and Biochemical toxicity in the Asian Catfish (*Clarias batrachus*)

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Abstract

Neonicotinoid pesticides, which account for almost 25% of the worldwide insecticide market, are extensively utilized in pest management and agriculture. They contribute to aquatic toxicity downstream and are extremely water-soluble, persistent in soil, and capable of entering the aquatic compartment by spray drift, runoff, or leaching. While it seems that insects are the most vulnerable species to neonicotinoids, other taxa might also be impacted. The present investigation examined the haematological and biochemical reactions of *Clarias batrachus* to three different exposure patterns resulting from pesticide pulse exposure. Specifically, the patterns comprise four hours of high pesticide concentration pulse exposure, followed by 28 days of depuration; four hours of high concentration pulse exposure; and 28 hours of continuous low pesticide concentration exposure. For haematological and biochemical investigation, fish samples were taken on days 1, 14, and 28. Results showed that following pulse, continuous, and pulse & continuous exposure to the pesticides, white blood cell count, total cholesterol, bilirubin, urea, and potassium ion increased in *Clarias batrachus* ($P < 0.05$), while red blood cell count, packed cell volume, hemoglobin, platelet count, and sodium ion decreased. Nevertheless, alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase activity, and creatinine levels were not substantially impacted by pulse exposure to the pesticides. The alterations in these biomarkers suggest that a 4-hour high-concentration pulse exposure was just as dangerous as a 24-hour continuous exposure to low pesticide concentration ($P > 0.05$). By day 14, most of the harmful effects of pulse exposure had disappeared. This determined that short-term exposure to high pesticide concentrations was just as dangerous as long-term pesticide exposure using *C. batrachus*.

Keywords: Neonicotinoids, Pesticides, *Clarias batrachus*, Hemoglobin, Cholesterol.

Combined Impact of Polypropylene Microplastics and Silver Nanoparticles on *Oreochromis mossambicus*: Synergistic Toxicity

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Abstract

In recent years, microplastics have emerged as pervasive and concerning pollutants in aquatic environments. These enduring microplastics often interact with various pollutants, particularly nanoparticles that adhere to their surfaces, posing potential risks to biota. The current study focuses on the individual and combined exposure of polypropylene microplastics (11.86 ± 44.62 µm) and silver nanoparticles (32 ± 89 µm) over 28 days in freshwater aquatic fish, *Oreochromis mossambicus*. After 28 days, alterations in crucial antioxidant biomarkers, including superoxide dismutase (SOD), catalase (CAT), glutathione -S-transferase (GST), oxidative stress in carbonyl protein (CP), and lipid peroxidation (LPO) in liver tissues were observed. Additionally, there was an increase in reactive oxygen species (ROS) levels, leading to the formation of unpaired electrons in oxygen molecules, consequently affecting biochemical markers. Histological results revealed a decrease in leukocyte infiltration within sinusoids, necrosis, and atrophy of hepatocytes, as well as vacuole formation in hepatocytes. When comparing individual and combined exposures, the combined exposure to pollutants in *O. mossambicus* resulted in more pronounced detrimental effects. These included a decline in antioxidant enzyme parameters, oxidative stress-induced damage to proteins and lipids, and severe histological damage. Overall, the study's findings suggest that the combination of polypropylene microplastics and silver nanoparticles, particularly the silver ions, poses severe toxicity and ecological threats by inducing physio-chemical effects within the freshwater ecosystem.

Keywords: Polypropylene microplastics, Silver nanoparticles, *Oreochromis mossambicus*, Biochemical markers, Histology.

Unveiling the Potential of Silk Sericin-Based Hydrogel to Revolutionize Wound Care

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Abstract

Sericin a water-soluble adhesive protein, was found in the cocoon of the *Bombyx mori* mulberry silkworm. In the present study, SDS with 8M urea was used to isolate the sericin. Sericin was identified in a range of sizes by urea extraction, from 10 to over 225 kDa as determined by SDS. The principal constituent of the hydrogel is silk sericin. The remarkable qualities of silk sericin, such as its antioxidant activity, biocompatibility, and biodegradability, led to its selection. In this study, horse radish peroxidase is used to generate an enzyme-mediated cross-linked hydrogel. The stability of the hydrogel is tested in a variety of settings, such as physiological pH levels, protease XIV, and Tris Buffered Saline (TBS). The viability was confirmed by applying the sericin-based hydrogel, which was investigated using in vivo diabetic wound model. The hydrogel exhibited a local anti-inflammatory effect, promoting the healing process in diabetic wound. Overall, the results highlight the promising properties of the silk sericin-based hydrogel, making it a potential for wound care.

Keywords: Sericin, Horse radish peroxidase, Antioxidant activity, Hydrogel.

Comparative study of Inactivated, Recombinant and DNA Nano vaccines by oral immunization against viral nervous necrosis (VNN) in Silver pompano (*Trachinotus blochii*)

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Abstract

The betanoda viruses are an important, emerging group of viruses known to infect over 40 marine fish species worldwide. Viral nervous necrosis (VNN) can affect multiple fish species in all production phases broodstock and hatchery, but it is especially severe in larvae and juvenile stages, where can it cause up to 100% mortalities. The prevalence of infectious diseases in the aquaculture industry and a limited number of safe and effective oral vaccines have imposed a challenge not only for fish immunity but also a threat to human health. To overcome such challenges in designing easier, cost-efficient, and effective vaccination methods are being adopted to safeguard antigens from the intestinal atmosphere for their immunogenic functions. In the present study, an oral ZnO nanoparticle-based DNA, Inactivated and Recombinant vaccine, against VNN was developed to evaluate the immunization effectiveness in silver pompano (*Trichinotus blochii*) through oral administration. All the vaccines were given at a dose of 0.05 ml mixed with the formulated feed (Nutrella 0.8µm). After two boosters of 14-day intervals, the positive control and vaccinated groups were challenged with live betanodavirus (10^6 $TCID_{50}$) by intraperitoneal route on 30 DPV. After 11 days of DPC, the positive control fish displayed the clinical symptoms of viral infection like circling surfacing and acute death. From the studies carried out, ZnO nanoparticle-based Inactivated, Recombinant, and DNA vaccine administered through feed was found to be most effective since it gave RPS of 65.3 %, 73.6 %, and 89.7 % respectively. The DNA nano vaccine administered through feed was more effective as it gave the maximum RPS of 89.7% in comparison to inactivated and recombinant nano vaccines. Based on our nano vaccination experiment through the feed, the vaccinated fish samples showed viral neutralization, which has been confirmed by RT-PCR. Studies on the Immunohistochemistry of the brain and eye revealed moderate to severe expression of inflammatory cytokines (IL1, IL3, and TNFα) in positive control in comparison to the vaccinated group. In all the experiments, the DNA nano-vaccinated group differed significantly ($P < 0.05$) and also showed higher growth metrics compared to the other nanovaccines. The data in this study suggested that DNA nano vaccines were promising carriers for plasmid DNA vaccines through oral vaccination. This method could be extended to the development of other oral vaccines and applied to other fish species against VNN in the aquaculture industry.

Keywords: Pompano, Nano vaccine, Betanodavirus, Brain, Cytokines.