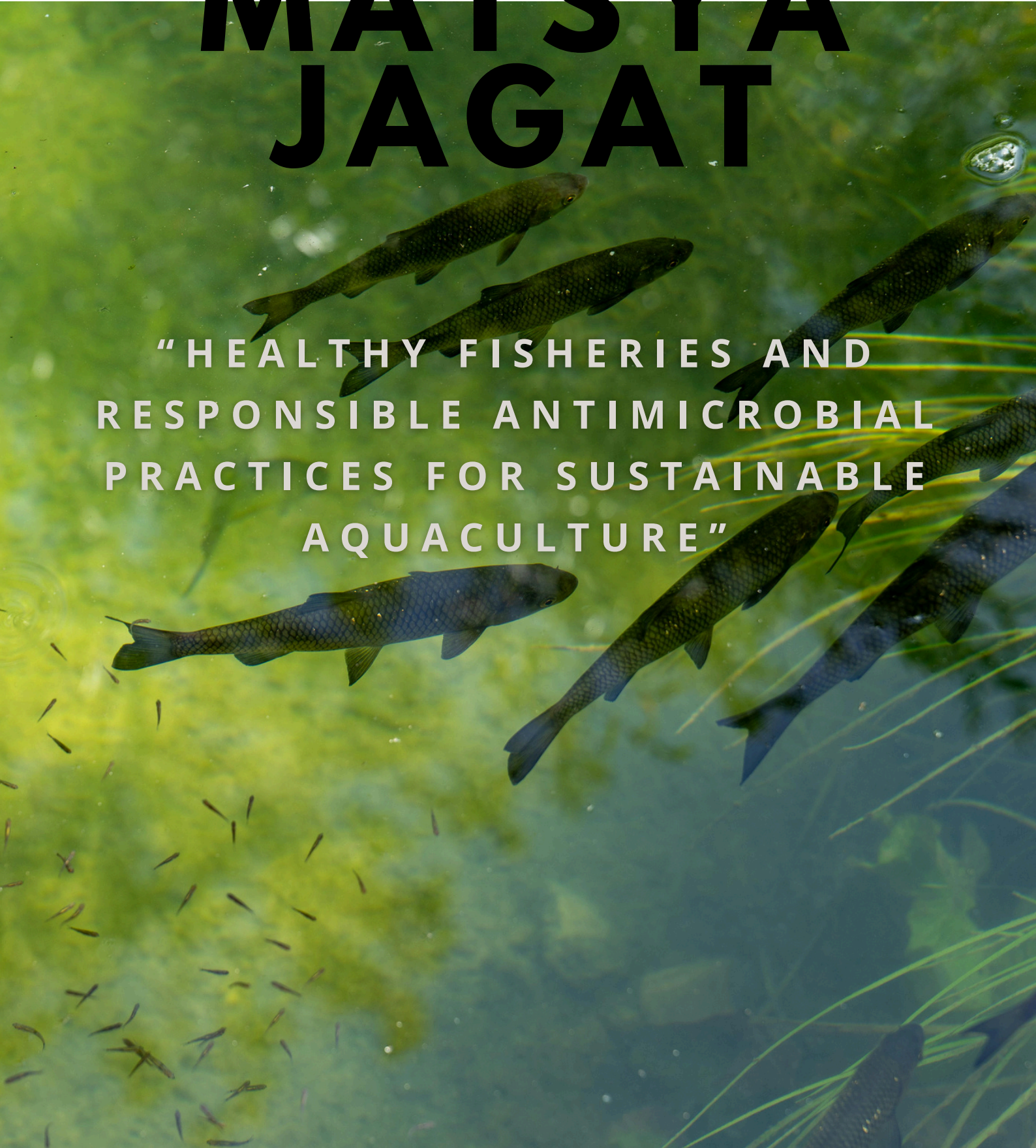


VOLUME 3 • ISSUE NO. 4

MATSYA JAGAT

"HEALTHY FISHERIES AND
RESPONSIBLE ANTIMICROBIAL
PRACTICES FOR SUSTAINABLE
AQUACULTURE"



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FOREWARDS



DR. BISWAJIT GHOSH VICE CHANCELLOR THE NEOTIA UNIVERSITY



Dear Readers,

Welcome to the 4th issue of the 3rd volume of Matsya Jagat, the E-Magazine of the Division of Fisheries Science, The Neotia University. It is with great pride that we present this edition, which places a critical focus on one of the most urgent challenges of our time—climate change and its far-reaching impacts on fisheries and aquatic ecosystems.

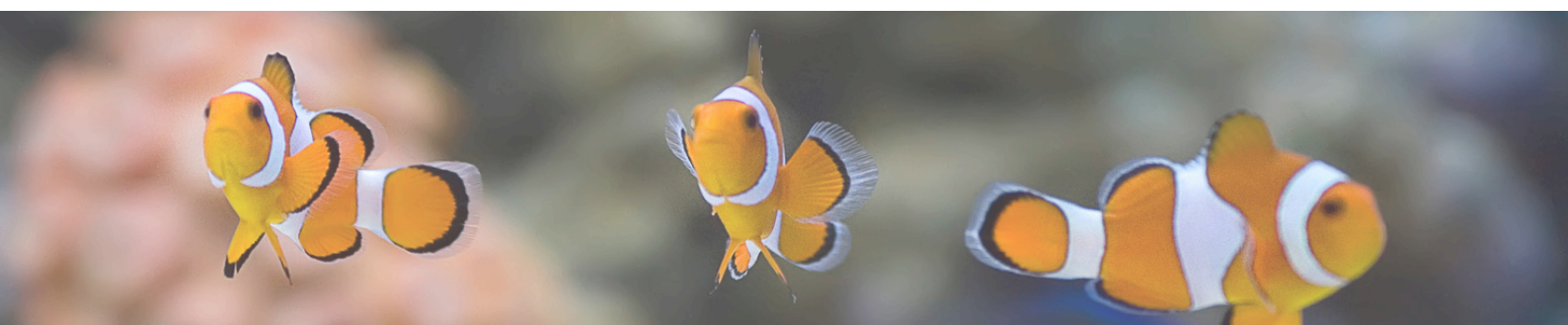
Fisheries serve as a vital source of sustenance, livelihood, and economic security for millions worldwide. However, rising temperatures, ocean acidification, habitat degradation, and unpredictable climatic events are increasingly threatening fish stocks, biodiversity, and the delicate balance of aquatic ecosystems. In this issue, our esteemed contributors—faculty experts, researchers, and passionate scholars—explore scientific innovations, adaptive management strategies, and policy interventions essential for ensuring the sustainability of fisheries in a rapidly changing world.

From the ecological consequences of climate shifts to the emerging technologies and conservation practices that offer hope for the future, this edition sheds light on the evolving landscape of fisheries science. As we navigate these challenges, it becomes imperative to adopt a collaborative and forward-thinking approach to mitigate climate impacts and safeguard the blue economy for generations to come.

I extend my sincere appreciation to the editorial team for their relentless dedication in curating this issue, and to Prof. (Dr.) H. Shivananda Murthy (Chair Professor, Division of Fisheries Science, TNU) for his visionary guidance. Let Matsya Jagat be a catalyst for awareness, dialogue, and action toward resilient and climate-adaptive fisheries management.

Wishing you an insightful and thought-provoking read.

**Dr. Biswajit Ghosh
Vice Chancellor
The Neotia University**



**PROF (DR.) H
SHIVANANDA MURTHY
DEAN AND CHAIR
PROFESSOR
DIVISION OF FISHERIES
SCIENCE**



It is my pleasure to welcome you to the 4th issue of the 3rd volume of Matsya Jagat, the E-Magazine of the Division of Fisheries Science, The Neotia University. This edition is dedicated to a topic of immense significance—climate change and its profound impact on fisheries and aquatic ecosystems.

Fisheries are not just an economic backbone but also a crucial component of global food security and environmental balance. However, the escalating threats posed by rising temperatures, ocean acidification, habitat degradation, and unpredictable climatic events are reshaping aquatic ecosystems at an alarming pace. As these challenges intensify, it is imperative to explore scientifically driven solutions, adaptive management strategies, and sustainable policies to mitigate their impact.

This issue brings together insights from faculty experts, researchers, and scholars who delve into climate-adaptive fisheries practices, technological advancements, and conservation efforts. Our collective responsibility is to ensure that fisheries remain resilient in the face of climate uncertainties, securing livelihoods and marine biodiversity for future generations.

I extend my heartfelt appreciation to the editorial team for their dedicated efforts in bringing this issue to life. It is my hope that Matsya Jagat serves as a platform for awareness, discussion, and transformative action in the realm of fisheries science.

Wishing you an engaging and thought-provoking read.

**Prof H Shivananda Murthy
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DR. NEERAJ PATHAK

FACULTY HEAD

DIVISION OF FISHERIES

SCIENCE



It is with great pleasure that I extend my warmest greetings to the readers of Matsya Jagat as we present Volume 3, Issue 4. In the ever-evolving field of Fisheries Science, this magazine continues to serve as a beacon of knowledge, fostering intellectual curiosity and professional growth among students, researchers, and industry experts.

As Assistant Professor and Faculty Head of the Division of Fisheries Science at The Neotia University, I recognize the significance of sharing valuable insights and building a collaborative learning community. This issue, centred around the sustainable fisheries, environment and promises to deliver thought-provoking discussions and research findings that highlight critical challenges and innovative solutions in fisheries and aquatic ecosystem management.

From sustainable aquaculture practices to climate-resilient fisheries, each article has been carefully curated to provide a comprehensive perspective on the pressing issues shaping our industry. I commend the editorial team for their commitment to excellence and thank the contributors whose expertise and dedication enrich the pages of this publication.

Matsya Jagat remains a vital platform for knowledge exchange, discussion, and shaping the future of fisheries science. I hope this edition inspires readers to explore new ideas, contribute to meaningful research, and work toward sustainable solutions in the face of environmental change.

Wishing you all an insightful and engaging read!

Dr. Neeraj Pathak

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DR. AVISHEK BARDHAN EDITOR-MATSYA JAGAT DIVISION OF FISHERIES SCIENCE



As we embark on yet another exciting edition of Matsya Jagat, I am delighted to welcome you to a magazine that promises to be thrilling, insightful, and thought-provoking. Our goal is not just to inform but to inspire curiosity and a deeper appreciation for the fascinating world of fisheries science.

This issue places a special emphasis on climate change and its far-reaching impact on fisheries and aquatic ecosystems. From rising ocean temperatures to shifting fish populations, climate change is redefining the way we understand and manage aquatic resources. Through expert analyses, cutting-edge research, and innovative solutions, we explore ways to adapt, mitigate, and build resilience in the fisheries sector.

But fisheries science is more than just data and conservation—it is a dynamic, ever-evolving field filled with discovery, technology, and real-world applications. Our student corner, recent fisheries news, and engaging articles bring together a mix of scientific rigor and engaging storytelling to make this subject not only educational but also exciting!

We hope that Matsya Jagat continues to be your go-to platform for knowledge, dialogue, and inspiration. Let's work together to make fisheries science an intriguing and impactful domain, fostering sustainable practices that protect both livelihoods and aquatic biodiversity.

Enjoy this issue, and may it spark new ideas, collaborations, and a passion for aquatic sciences.

Best Regards,

Dr. Avishek Bardhan,

Editor- Matsya Jagat

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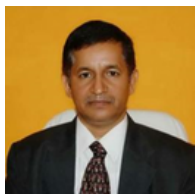
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ACTIVITIES IN DIVISION OF FISHERIES



PARTICIPATION OF PROF (DR) H S MURTHY, DEAN & CHAIR PROFESSOR IN DIFFERENT MEETINGS AND WORKSHOPS

ICAR QRT MEETING

As a member of the Quinquennial Review Team (QRT) of ICAR-Central Inland Fisheries Research Institute, Barrackpore, Dr H S Murthy attended the meeting at CIFRI H Q during 28-29 November, 2025. The research work carried out by the Institute during 2018-23 was reviewed.



PARTICIPATION IN THE MATSYAMELA

Prof H S Murthy attended the "Matsyamela-2025" organised by the Government of Karnataka - State Fisheries Department on the KVAFSU Veterinary College grounds at Hebbal, Bangalore along with the Vice Chancellor of KVAFS University, Bidar, during November 22, 2025.



WORKSHOP AND GOLDEN JUBILEE CELEBRATIONS

Prof H S Murthy participated in the Workshop and the Golden Jubilee Celebration of the BFSc batch (1975-79) of the College of Fisheries, Mangalore held at GKV Campus, University of Agricultural Sciences (UAS), Bangalore and at College of Fisheries, at Mangalore during November 18-20, 2025. Vice Chancellor, UAS, Bangalore, participated as Chief Guest. Teachers were felicitated during the occasion.



PARTICIPATION IN THE BANGALORE ICAR QRT MEETING

Prof H S Murthy as a member of the Quinquennial Review Team (QRT) of ICAR-Central Inland Fisheries Research Institute, Barrackpore attended the meeting at Bangalore Regional Center of CIFRI, Hesaraghatta, Bangalore and visited FRIC, KVAFSU and ICAR-CIFA Regional Center and other places. Research work done by the center during 2018-23 was reviewed.



DEPARTMENT OF FISH PROCESSING TECHNOLOGY

EXPERIENTIAL LEARNING PROGRAMME ON VALUE-ADDED FISHERIES PRODUCTS

Recently, the Department of Fish Processing Technology, The Neotia University, successfully organized an Experiential Learning Programme (ELP) for BSc 7th semester students focusing on the development of value-added fisheries products. Conducted under the guidance of the Head of the Department, Dr. Neeraj Pathak, the programme provided intensive hands-on training in product formulation, processing methods, hygiene and quality control practices, packaging, labeling, and introductory entrepreneurial concepts. Students were actively involved in preparing a range of innovative fish-based products, allowing them to translate theoretical knowledge into practical application within a controlled processing environment.



In addition to technical skill development, the ELP aimed to strengthen students' understanding of market requirements, food safety standards, and consumer preferences relevant to the fish processing sector. The programme encouraged teamwork, problem-solving, and creative thinking while familiarizing students with small-scale production planning and value addition strategies. Overall, the initiative significantly improved students' professional readiness and practical confidence, highlighting the department's sustained focus on application-oriented, and industry-relevant education in fisheries processing technology.



DEPARTMENT OF AQUACULTURE

STOCKING OF MYSTUS GULIO (TENGRA) SEEDS IN CAMPUS FISH PONDS

A total of 1,500 seeds of *Mystus gulio* (Tengra) seeds were procured and properly acclimatized to the hatchery water conditions to minimize handling and thermal stress. Following acclimatization, the seeds were stocked in the spawn collection chamber equipped with adequate aeration.



**ACCLIMATIZATION OF SEEDS
PRIOR TO STOCKING**



REARING OF TENGRA SEEDS IN NURSERY TANKS



SEEDS OF MYSTUS GULIO



BREEDING OF COMMON CARP (CYPRINUS CARPIO)

Brooders of common carp in the sex ratio of M:F (2:1) weighing 4.6 kg (F) and 1.3-1.4 kg (M) were injected with the synthetic hormone SPAWN PRO as per the recommended doses and were released into the spawning/breeding pool supplied with spawning substrates i.e., Eichhornia. After 8-10 hours of injection, spawning occurred and adhesive eggs were attached on the substrates. The eggs were transferred to an incubation tank provided with proper aeration and prophylactic measures to prevent the fungal infection. After 72 hours, eggs were hatched out which remained on their yolk sac for 3 days. More than 10 lakhs of spawn was estimated.



SETTING UP OF THE BREEDING POOL



BROODERS OF COMMON CARP



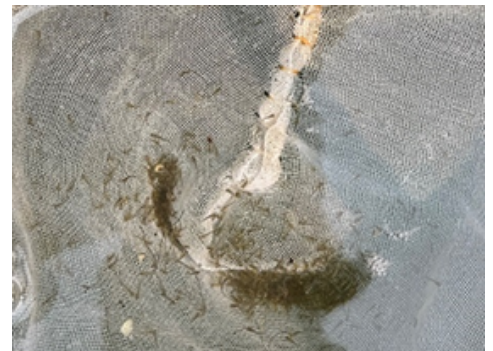
STUDENTS PERFORMING THE HORMONE INJECTION



ADHESIVE EGGS OF COMMON CARP ATTACHED TO EICHHORNIA ROOTS



INCUBATION OF EGGS



SPAWN OF COMMON CARP



BREEDING OF RED CAP GOLDFISH

Brooders of both male and female of red cap gold fish were kept in the breeding tank (aquarium) with the sex ratio of 2:1 (M: F). Spawning substrates were provided along with gentle aeration. After spawning, the brooders were removed.



RELEASE OF COMMON CARP SPAWNS IN HAPA

The spawn of common carp were released into the hapa kept in a bigger earthen grow out pond. Hapas of size $10 \times 10 \text{ ft}^2$ were prepared and installed in Pond No. 2 using bamboo poles for proper support and stability. The spawn were then carefully released into the hapa, and regular monitoring was undertaken to assess survival and growth.



CELEBRATION OF WORLD FISHERIES DAY

The Faculty of Fisheries Science, The Neotia University, celebrated World Fisheries Day with great enthusiasm and academic spirit under the supervision of Dr. H. S. Murthy, Dean, Faculty of Fisheries Science, The Neotia University on 27th November 2025. The event was graced by Dr. T. S. Nagesh, Dean, Faculty of Fisheries Science, WBUAFS, who attended as the Chief Guest. Mr Suhas Mukherjee, Vice President of TNU participated as Guest of Honor. The celebration witnessed active and wholehearted participation from all students of Fisheries Science. As part of the event, students showcased their innovative ideas in the field of Fisheries through a range of activities, including: Model Presentations Oral Presentations and Poster Presentations. To recognize and encourage student excellence, First, Second, and Third prizes were awarded across all three categories: Model Presentation, Oral Presentation, and Poster Presentation. The awards acknowledged the students' originality, clarity of ideas, scientific relevance, and quality of presentation. Prof H S Murthy made introductory remarks, Mr Suhas Mukherjee spoke and appreciated the activities of the Fisheries Division. The Chief Guest, Dr. T. S. Nagesh, delivered a guest lecture and appreciated the day's activities and congratulated the students for their active involvement, creativity, and dedication. He further added that the quality of presentations reflected the students' deep interest and growing competence in fisheries science. Overall, the celebration of World Fisheries Day proved to be an inspiring and motivating event, encouraging students to think innovatively and contribute meaningfully to the future of the fisheries sector.



ALL INDIA STUDY TOUR

The All India Study Tour was conducted from 01 to 15 November 2025 for the final-year BFSc students of the Division of Fisheries Sciences, The Neotia University. The tour was designed to complement classroom learning through direct exposure to premier fisheries education, research, technology, and management institutions across different regions of India. It enabled students to understand the functional linkages between fisheries science, governance, industry practices, and sustainable resource use.

The tour commenced in Mumbai with visits to the Central Institute of Fisheries Education, where students interacted with advanced laboratories covering biotechnology, nutrition, aquaculture systems, aquaponics, and fish breeding units. This was followed by a visit to the Fishery Survey of India, where students gained insight into marine resource assessment, survey vessels, fishing gear technology, and national fisheries data generation for policy support.



In Goa, students visited the National Institute of Oceanography, learning about multidisciplinary ocean research, marine ecology, climate interactions, and environmental monitoring supported by advanced instrumentation and research vessels.



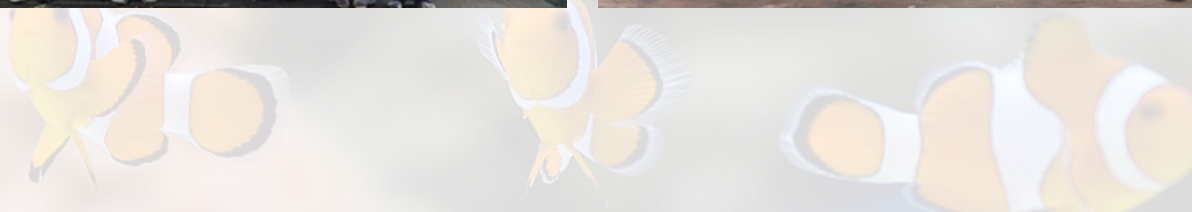
The Karnataka leg included the College of Fisheries Mangalore, where exposure was provided to aquaculture, microbiology, aquatic environment management, fisheries engineering, refrigeration, and fish processing facilities. Students also visited the regional centre of Central Marine Fisheries Research Institute, focusing on marine biodiversity, stock assessment, and coastal fisheries research.

In Kochi, Kerala, the tour covered several national-level institutions. These included the Centre for Marine Living Resources and Ecology, emphasizing marine living resource mapping and ecosystem-based management, and the Kerala University of Fisheries and Ocean Studies, where students explored fisheries engineering and aquaculture teaching and research facilities. Visits to the headquarters of Central Marine Fisheries Research Institute and Central Institute of Fisheries Technology provided exposure to marine fisheries research, seafood processing, quality assurance, and value addition. Students also visited Marine Products Export Development Authority, Central Institute of Fisheries Nautical and Engineering Training, and National Institute of Fisheries Post Harvest Technology and Training, gaining insights into exports, fishing technology, vessel operations, and post-harvest handling systems.



The tour concluded at the Central Institute of Freshwater Aquaculture, Bhubaneswar, where students learned about freshwater aquaculture, hatchery operations, biotechnology applications, ornamental fisheries, RAS, and biofloc systems.





TRAINING PROGRAM AT NIFPHATT

NIFPHATT (National Institute of Fisheries Post Harvest Technology and Training) is a national-level institute under the government (Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying). The NIFPHATT training program offered a comprehensive learning experience in the field of fish processing technology. Conducted over a 10-day period from November 25 to December 10, the program covered a wide range of topics essential for understanding modern fisheries processing and management. During the training, we gained practical and theoretical knowledge in post-harvest technology, which provided insights into the handling and management of fish after capture to maintain quality and reduce losses. We also explored various value-addition techniques for fish and fishery products, learning how to enhance their market potential through innovative processing methods. Additionally, the program included detailed sessions on fish preservation methods, equipping us with essential skills to ensure safety, extend shelf life, and maintain product quality. Overall, the NIFPHATT training program proved to be an enriching and highly beneficial experience, offering valuable exposure to key aspects of fish processing technology and its practical applications.



ARTICLES



Application of Black Tea (*Camellia sinensis*) in induced spawning and egg adhesiveness control of *Pangasius* Catfish (*Pangasius sp.*)

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Abstract

Artificial spawning in *Pangasius* catfish (*Pangasius sp.*) is a key aquaculture technique to ensure the production of high quality fry. However, one major challenge in this process is the adhesive nature of the eggs. Sticky eggs tend to clump together, reducing oxygen absorption and increasing the risk of bacterial and fungal infection. Field practices and previous studies have shown that black tea solution (*Camellia sinensis*), clay, pineapple extract (*Ananas comosus* Linn), bilimbi extract (*Averrhoa bilimbi* L.), and Jamaican cherry leaf extract (*Muntingia calabura* L.) can effectively reduce egg adhesiveness. This article describes practical experience in artificial spawning of *Pangasius*, including broodstock selection, GnRH α hormone administration, spawning, and the application of black tea solution to improve fertilization and hatching success.

Keywords: Artificial spawning, *Pangasius*, black tea solution, egg adhesiveness, fertilization rate, hatching rate.

Introduction

Artificial spawning in *Pangasius* catfish (*Pangasius sp.*) is an essential step to ensure a sustainable supply of high quality fry. This species has significant economic value in Southeast Asia, including Indonesia and India. Hormonal induction using GnRH α (Gonadotropin-Releasing Hormone analog) is commonly used to trigger spawning, but a recurring problem is egg adhesiveness. Adhesive eggs can lower fertilization and hatching rates, thus reducing fry production. According to Sukendi et al. (2023) addressed one effective approach to mitigate this issue is immersing fertilized eggs in solutions that remove stickiness. Several treatments have been tested, such as black tea (*Camellia sinensis*) (Baihaki, Asiah and Nuraini, 2024), clay (Slembrouck et al., 2003), pineapple extract (*Ananas comosus* Linn), bilimbi extract (*Averrhoa bilimbi* L.), and Jamaican cherry leaf extract (*Muntingia calabura* L.) (Sukendi et al., 2023). Black tea contains tannins polyphenolic compounds known to bind proteins and hydrolyze glycoprotein layers helping remove adhesiveness. Tannin concentration in black tea can reach up to 30% (Yustiati et al., 2021 in Baihaki, Asiah and Nuraini, 2024), making it an

effective and accessible natural agent for fish hatcheries.

Methodology

The artificial spawning procedure of *Pangasius* catfish involves several key steps: **1. Selection of mature broodstock:** Females with soft, swollen abdomens and males with reddish papillae were chosen.

2. Sex separation: Males and females were kept apart to prevent natural spawning.

3. Hormone dosage determination: The GnRH α dose was calculated based on body weight (0.5 mL/kg for females, 0.3 mL/kg for males). Fish were injected intramuscularly twice at a 6-hour interval using half the total dose each time.

4. Ovulation monitoring: Stripping was performed once ovulation signs appeared.

5. Preparation of black tea solution: Black tea was steeped in warm water to release its extracts, then cooled before use.

6. Fertilization: Eggs and sperm were stripped separately into dry containers and gently mixed using a feather. Fertilized eggs were immersed in the tea solution for several minutes to remove adhesiveness before incubation.

Results and Discussion

Eggs treated with black tea solution showed significantly higher hatching rates compared to untreated eggs. According to Baihaki, Asiah and Nuraini (2024) addressed immersing *Pangasius* eggs in a 10 g/L black tea solution for 4 minutes yielded the best results, with low adhesiveness (12–15%), high fertilization rate (90%), and high hatching rate (63%). The tannins in tea degrade glycoprotein layers, facilitating sperm entry into the micropyle. Similar findings were reported by Žibienė, Žibas and Švirinienė (2017) addressed who observed the effectiveness of tannic acid in reducing carp egg adhesiveness. Maintaining optimal incubation conditions, especially temperature (28–32°C) and pH (7–8) (Arif and Farikhah, 2025) addressed is also crucial for embryo development and minimizing fungal infection.

Conclusion

The result indicate using black tea solution is a practical, eco friendly, and cost effective method to reduce egg adhesiveness and improve hatching success in *Pangasius* breeding. Proper water quality management during incubation further enhances fry survival and overall hatchery performance.



CAMELIA SINENSIS

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Role of antibiotics in sustainable aquaculture

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Abstract

Aquaculture has expanded rapidly to meet global seafood demand, but disease outbreaks remain a major challenge in intensive farming systems. Antibiotics are commonly used to control bacterial infections and improve productivity; however, their excessive use raises concerns regarding environmental pollution, food safety, and antibiotic resistance. This assignment examines the role of antibiotics in aquaculture, outlining their benefits and limitations, and highlights the growing shift toward sustainable disease management practices that reduce reliance on antibiotics while ensuring long-term aquaculture sustainability.

Keywords: Aquaculture; Therapeutics; Sustainable farming; Antibiotics; Antimicrobials

Introduction

Aquaculture has expanded rapidly to meet global seafood demand, but disease outbreaks remain a major challenge in intensive farming systems. Antibiotics are commonly used to control bacterial infections and improve productivity; however, their excessive use raises concerns regarding environmental pollution, food safety, and antibiotic resistance. This assignment examines the role of antibiotics in aquaculture, outlining their benefits and limitations, and highlights the growing shift toward sustainable disease management practices that reduce reliance on antibiotics while ensuring long-term aquaculture sustainability.

Importance of disease management in Aquaculture

Diseases in aquaculture can result in massive economic losses due to high mortality rates, reduced growth performance, and lowered product quality. Pathogens, especially bacteria such as *Aeromonas hydrophila*, *Vibrio* spp., and *Edwardsiella tarda*, are common culprits of infections in fish and shellfish. Since fish in aquaculture systems are often reared in high-density environments, disease outbreaks can spread quickly and cause significant damage. Effective disease management is, therefore, essential for the sustainability and profitability of aquaculture operations.

Role of Antibiotics in Aquaculture

Antibiotics are chemical compounds that kill or inhibit the growth of bacteria. In aquaculture, antibiotics are used for three main purposes:

1. Antibiotics are administered to treat fish that are already infected with bacterial diseases. They are typically incorporated into medicated feeds or, in some cases, applied through immersion or injection.
2. Sometimes antibiotics are given preventively to healthy animals to reduce the risk of bacterial infections, especially during stressful periods like handling, transportation, or sudden changes in environmental conditions.
3. In some regions, antibiotics are used at sub-therapeutic levels to promote faster growth and feed efficiency. However, this practice is increasingly being discouraged or banned due to concerns over antibiotic resistance.

Common antibiotics used in aquaculture

Several types of antibiotics have been used in aquaculture, including:

Oxytetracycline: Broad-spectrum antibiotic commonly used in fish farming.

Florfenicol: Effective against a wide range of bacterial pathogens.

Sulfonamides and trimethoprim: Often used in combination for increased efficacy.

Erythromycin: Used to treat gram-positive bacterial infections.

Enrofloxacin: A fluoroquinolone with broad antibacterial activity.

Benefits of Antibiotics in Aquaculture

The use of antibiotics in aquaculture has provided several key benefits:

1. **Disease Control:** Effective treatment of bacterial infections helps reduce mortality and economic losses.
2. **Improved Production:** Healthy animals grow faster and convert feed more efficiently, improving yield.
3. **Enhanced Food Security:** By stabilizing production, antibiotics contribute to a reliable supply of aquatic food products.

Risks and challenges

Despite their benefits, the use of antibiotics in aquaculture poses several risks. The most pressing concern is the development of antibiotic-resistant bacteria. These bacteria can spread within aquaculture systems and potentially to wild populations, humans, and other animals. This not only reduces the effectiveness of treatments in aquaculture but also poses a serious threat to public health. Improper use of antibiotics or failure to observe proper withdrawal periods can lead to antibiotic residues in seafood. Consumption of such products can be harmful to consumers and may cause allergic reactions or contribute to antibiotic resistance in humans. Antibiotics released into the water can affect non-target organisms and disrupt natural microbial communities. They may persist in sediments and water bodies, causing long-term ecological imbalances. Export markets often have strict regulations regarding antibiotic residues and approved substances. Improper antibiotic use can lead to trade restrictions and damage the reputation of aquaculture producers.

Regulations and monitoring

To mitigate the risks associated with antibiotic use, many countries have implemented strict regulations governing their application in aquaculture. These include:

1. Licensing and approval of antibiotics for specific aquaculture uses.
2. Residue monitoring to ensure compliance with maximum residue limits (MRLs).
3. Record-keeping requirements for antibiotic usage.

4. International bodies such as the World Health Organization (WHO), Food and Agriculture Organization (FAO), and World Organization for Animal Health (OIE) have also developed guidelines to promote responsible antibiotic use in aquaculture.

Alternatives to antibiotics

In response to growing concerns, researchers and industry stakeholders are exploring various alternatives to antibiotics, including:

- a. **Vaccination:** Effective vaccines are now available for several fish diseases, significantly reducing the need for antibiotics.
- b. **Probiotics and Prebiotics:** These promote healthy gut flora in aquatic animals, enhancing disease resistance.
- c. **Phytochemicals:** Plant-derived compounds with antimicrobial properties are being investigated as natural alternatives.
- d. **Improved Management Practices:** Better biosecurity, water quality management, and nutritional strategies can reduce disease.



Conclusion

Antibiotics have played a crucial role in the development and success of modern aquaculture by helping to control bacterial diseases and improve productivity. However, their misuse and overuse present significant challenges, particularly the risk of antibiotic resistance. Balancing the benefits of antibiotics with the need to protect public health, the environment, and the long-term viability of aquaculture requires responsible use, effective regulation, and the adoption of alternative strategies. With continued innovation and cooperation, the aquaculture industry can transition towards more sustainable and resilient practices.

The role of immunostimulants in aquaculture

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Abstract

Traditionally, antibiotics and chemotherapeutics were employed to manage infections, but their excessive use has led to antimicrobial resistance and environmental concerns. Hence, there is a growing need for alternative, eco-friendly approaches to disease prevention. One such promising strategy is the use of immunostimulants, which enhance the innate immune response of aquatic animals, increasing their resistance to pathogens.

Keywords: Aquaculture; Immunostimulants; Sustainable farming; Antibiotics; Antimicrobials

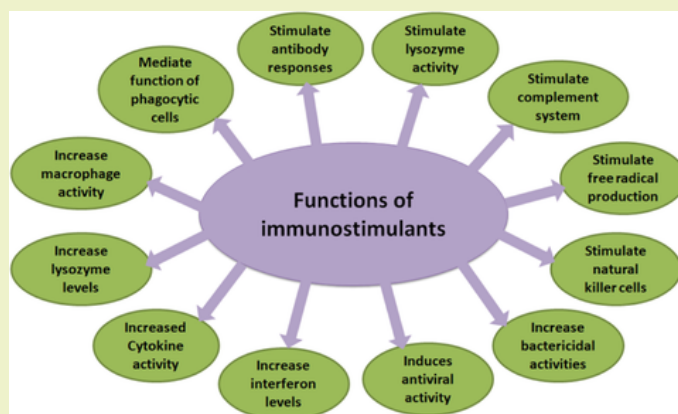
Introduction

Traditionally, antibiotics and chemotherapeutics were employed to manage infections, but their excessive use has led to antimicrobial resistance and environmental concerns. Hence, there is a growing need for alternative, eco-friendly approaches to disease prevention. One such promising strategy is the use of immunostimulants, which enhance the innate immune response of aquatic animals, increasing their resistance to pathogens.

What are immunostimulants?

Immunostimulants are natural or synthetic substances that stimulate the immune system by activating or modulating the functions of immune cells. Unlike vaccines, which trigger a specific immune response to a particular pathogen, immunostimulants activate the non-specific (innate) immune mechanisms, providing broad-spectrum resistance. Immunostimulants may be administered orally through feed, by injection, or by immersion in water. Their use is especially crucial in the early stages of fish development, where the adaptive immune system is not fully functional.

Common types of immunostimulants in aquaculture include: Microbial derivatives: e.g., beta-glucans, lipopolysaccharides Plant extracts : e.g., garlic, turmeric, neem, aloe vera Animal-derived substances e.g., chitin, chitosan, fish protein hydrolysates Synthetic compounds: e.g., levamisole, synthetic CpG oligodeoxynucleotides Probiotics and prebiotics: which modulate gut immunity and microbiota



Mechanism of Action

Immunostimulants work by enhancing various components of the innate immune system, which is the first line of defense in fish and shellfish. The key effects include:

1. Activation of phagocytes such as macrophages and neutrophils, which engulf and destroy pathogens.
2. Increased production of cytokines : signalling proteins that regulate immune responses.
3. Stimulation of lysozyme activity: aiding in bacterial cell wall breakdown.
4. Enhancement of respiratory burst : leading to the production of reactive oxygen species that kill pathogens.
5. Improved complement system function : a series of proteins that assist in clearing microbes.
6. These responses lead to increased disease resistance, faster recovery, and reduced mortality during pathogenic outbreaks.

Benefits of Immunostimulants in Aquaculture

The use of immunostimulants offers numerous advantages over traditional disease control methods:

1. **Disease Prevention:** By priming the immune system, immunostimulants help prevent the onset of diseases rather than treating them after occurrence.
2. **Reduction in Antibiotic Use:** Immunostimulants reduce reliance on antibiotics, thereby mitigating the risks of antimicrobial resistance and residues in aquatic products.
3. **Growth Promotion:** Some immunostimulants enhance nutrient utilization and gut health, leading to better growth rates and feed conversion efficiency.
4. **Stress Mitigation:** Stressors such as handling, transport, and environmental fluctuations suppress immune functions. Immunostimulants help alleviate stress-related immunosuppression.
5. **Environmental Sustainability:** They are biodegradable and eco-friendly, posing minimal risk to the aquatic environment compared to chemical treatments.

Applications in Different Aquatic Species

Finfish (e.g., carp, tilapia, salmon)

Beta-glucans, levamisole, and herbal extracts are widely used in commercial feeds. They have shown improved survival against bacterial infections like *Aeromonas hydrophila* and *Vibrio* spp.

Crustaceans (e.g., shrimp, prawns)

Shrimp rely mainly on innate immunity. Immunostimulants such as chitosan, yeast extracts, and herbal formulations have been effective in controlling white spot syndrome virus (WSSV) and vibriosis.

Mollusks (e.g., oysters, mussels)

Beta-glucans and seaweed-derived compounds are used to boost hemocyte activity, improving resistance to pathogens like *Vibrio* and *Perkinsus* spp.

Challenges and Limitations

Although immunostimulants show considerable potential in improving disease resistance in aquaculture, their practical application faces several limitations. Variability in source material and dosage often leads to inconsistent results, and responses to immunostimulants can differ markedly among species. In addition, the high cost of certain purified compounds restricts their large-scale use. Excessive or prolonged administration may also cause immune imbalance or negatively affect growth. Therefore, continued research is essential to optimize dosages, delivery strategies, and effective combinations to ensure safe and reliable application in aquaculture systems.

Future Perspective

The future application of immunostimulants in aquaculture appears promising, with emerging approaches aimed at improving their efficiency and reliability. Advances in nanotechnology are enabling better absorption and controlled release of immunostimulants. The development of synergistic formulations combining immunostimulants with probiotics, prebiotics, and vaccines is gaining attention. In addition, genomic tools are helping to understand immune gene expression for species-specific applications. Strengthening regulatory frameworks will further support safe, standardized, and responsible use of immunostimulants worldwide.

Conclusion

Immunostimulants represent a sustainable and effective tool for enhancing disease resistance in aquaculture species. By activating innate immune mechanisms, they provide broad-spectrum protection against pathogens while reducing the need for harmful chemicals and antibiotics. Although further standardization and research are needed, immunostimulants are a vital component in the move toward eco-friendly and resilient aquaculture systems.

Phytotherapy as an alternative to antibiotics in aquaculture

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Abstract

Aquaculture contributes significantly to global food security but faces growing challenges from infectious diseases associated with intensive farming practices. Although antibiotics have been widely used for disease control, their indiscriminate application has led to antimicrobial resistance, environmental contamination, and health risks from drug residues. Consequently, there is an urgent need for safer and sustainable alternatives. Phytotherapy has emerged as a promising approach, offering natural disease management solutions while supporting environmentally responsible and sustainable aquaculture practices.

Keywords: Aquaculture, infectious diseases, antibiotics, antimicrobial resistance, phytotherapy, sustainable disease management

Introduction

Aquaculture is one of the fastest-growing food-producing sectors worldwide and plays a vital role in global food security and economic development. However, intensive aquaculture practices have increased the incidence of infectious diseases caused by bacteria, viruses, fungi, and parasites. These diseases lead to reduced growth, mass mortalities, and significant economic losses. Traditionally, antibiotics have been extensively used to control such diseases, but their indiscriminate use has resulted in antimicrobial resistance (AMR), environmental pollution, and risks to human health due to drug residues in fish and shellfish. As a result, safer and sustainable alternatives are urgently required, and phytotherapy has emerged as a promising option.

Phytotherapy in aquaculture

Phytotherapy involves the use of medicinal plants and their bioactive compounds for disease prevention and treatment. Plants produce a wide range of secondary metabolites such as alkaloids, flavonoids, phenolics, tannins, terpenoids, saponins, and essential oils, which exhibit antibacterial, antifungal, antiparasitic, antioxidant, and immunomodulatory activities. In aquaculture, phytotherapeutic agents are commonly administered through feed supplementation, immersion baths, or water application.

Unlike antibiotics, which often act on specific microbial targets, phytochemicals possess multi-target modes of action, thereby reducing the chances of resistance development. Moreover, plant-based compounds are biodegradable, relatively inexpensive, and environmentally friendly, making them suitable for long-term application in aquaculture systems.

Immunomodulatory Effects of Phytotherapy

Fish rely primarily on innate immunity as their first line of defense against pathogens. This includes physical barriers such as skin, mucus, scales, and gills, along with humoral and cellular components like lysozyme, complement proteins, macrophages, and neutrophils. Phytochemicals have been shown to enhance both innate and adaptive immune responses in cultured fish. Dietary supplementation with medicinal plants improves phagocytic activity, increases lysozyme and antioxidant enzyme levels, and enhances gut-associated lymphoid tissue (GALT) function. Improved immune responses increase disease resistance, stress tolerance, and survival rates, contributing to better growth performance and overall fish health.

Phytotherapy and Antimicrobial Resistance

Antimicrobial resistance is a major global concern, with aquatic environments acting as reservoirs for resistant bacteria and resistance genes. Antibiotic residues released into aquaculture systems exert selective pressure on microbial communities, promoting resistant strains that may spread to humans and other animals. Phytotherapy offers a sustainable approach to reducing antibiotic dependence in aquaculture. Plant-derived antimicrobials exhibit broad-spectrum activity and multiple mechanisms of action, which limit resistance development. Incorporation of phytotherapeutic agents into aquaculture practices can significantly reduce antibiotic usage and help mitigate the spread of antimicrobial resistance.

Medicinal Plants Used in Aquaculture

Several medicinal plants have demonstrated effectiveness in aquaculture health management. Commonly used plants include *Azadirachta indica* (neem), *Allium sativum* (garlic), *Ocimum sanctum* (tulsi), *Zingiber officinale* (ginger), *Aloe vera*, *Nigella sativa* (black cumin), and *Tinospora cordifolia* (guduchi). These plants possess strong antimicrobial, antiparasitic, antioxidant, and immunostimulatory properties. Medicinal plants are used in powdered form, aqueous or alcoholic extracts, and essential oils. Powdered forms are most widely used due to their cost-effectiveness and ease of incorporation into feeds, while essential oils are valued for their potency and safety when used at appropriate dosages.

Advantages and Limitations

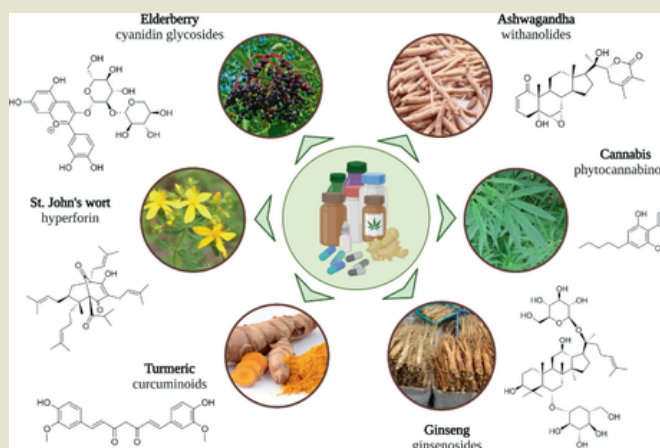
Phytotherapy offers several advantages, including low toxicity, environmental safety, improved immunity, enhanced growth performance, and reduced chemical usage. However, challenges such as variability in phytochemical composition, lack of standardization, and limited large-scale field validation remain. Addressing these issues through standardized formulations and controlled studies is essential.

Conclusion

Phytotherapy represents an effective and sustainable alternative to antibiotics in aquaculture. By enhancing immune responses, improving disease resistance, and reducing reliance on synthetic antibiotics, phytotherapy addresses key challenges such as antimicrobial resistance, environmental contamination, and food safety. With further research and standardization, phytotherapy has strong potential to become an integral component of sustainable aquaculture health management.

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Phage therapy in aquaculture

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Abstract

Aquaculture is a rapidly expanding food production sector, but bacterial infections remain a major constraint, causing high mortality and economic losses. Conventional reliance on antibiotics has resulted in antibiotic resistance and environmental concerns. Phage therapy, which uses bacteriophages to specifically target pathogenic bacteria, has emerged as a promising alternative. This assignment discusses the basic principles of phage therapy, its advantages over antibiotics, current applications in aquaculture, associated challenges, and future prospects as a sustainable disease management strategy.

Keywords: Aquaculture, bacterial infections, phage therapy, antibiotic resistance, sustainable disease control

Introduction

Aquaculture is one of the fastest-growing food production sectors, providing a significant portion of the world's seafood. However, bacterial infections pose a major threat to aquaculture, leading to massive economic losses due to high mortality rates in fish and shellfish. Traditional disease control methods, such as antibiotics, have led to antibiotic resistance and environmental concerns. As a result, alternative treatments like phage therapy (the use of bacteriophages to combat bacterial infections) are gaining attention. Phage therapy offers a targeted, eco-friendly, and sustainable solution to bacterial diseases in aquaculture. This assignment explores the principles of phage therapy, its advantages over antibiotics, applications in aquaculture, challenges, and future prospects.

Definition

Bacteriophages are viruses that specifically infect and kill bacteria. They are the most abundant biological entities on Earth and play a crucial role in regulating bacterial populations in nature. Phage therapy involves using these naturally occurring viruses to treat bacterial infections.

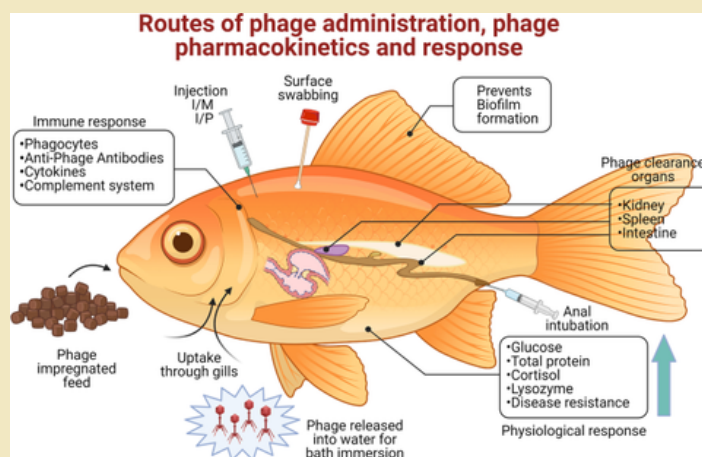
Mechanism of Phage action

1. **Attachment:** Phages bind to specific receptors on the bacterial cell surface.
2. **Genome Injection:** The phage injects its genetic material (DNA or RNA) into the bacterium.

3. **Replication:** The phage hijacks the bacterial machinery to replicate itself.

4. **Lysis:** The host bacterium is lysed (burst open), releasing new phage particles that infect other bacteria.

Since phages are highly host-specific, they target only pathogenic bacteria without harming beneficial microbes, fish, or the environment.



Why Phage Therapy in Aquaculture?

Phage therapy offers several advantages for disease control in aquaculture. Its high specificity allows targeted elimination of pathogenic bacteria without affecting beneficial microbial communities. Phages can replicate at the site of infection, which reduces the need for repeated administration. Unlike antibiotics, phage therapy does not leave harmful residues in fish tissues or the surrounding environment. As naturally occurring components of aquatic ecosystems, bacteriophages represent an eco-friendly and sustainable approach to managing bacterial diseases in aquaculture.

Applications of phage therapy in aquaculture

Phage therapy has shown promising applications in aquaculture for both treatment and prevention of bacterial diseases. It has been effectively tested against several major fish and shellfish pathogens, demonstrating high efficacy under laboratory and field conditions. In hatcheries, phage cocktails can be applied prophylactically through water to reduce disease outbreaks in larval and juvenile stages, particularly in shrimp culture affected by vibriosis. Additionally, bacteriophages can be used for disinfection of water and equipment.

3.Regulatory and commercialization hurdles:

There is a lack of standardized regulatory guidelines for phage therapy in aquaculture, along with limited large-scale production and commercial availability.

Solution: Development of clear regulatory frameworks and investment in commercial-scale production are required.

4.Environmental stability:

Phages may lose activity due to environmental factors such as UV radiation, temperature fluctuations, and salinity changes.

Solution: Encapsulation and protective delivery methods can improve phage stability and effectiveness in aquaculture systems.

Pathogenic Bacteria	Disease	Host Species	Phage Efficacy
<i>Aeromonas hydrophila</i>	Motile Aeromonas Septicemia (MAS)	Carp, Catfish	High
<i>Vibrio harveyi</i>	Vibriosis	Shrimp, Seabass	Effective in laboratory and field trials
<i>Edwardsiella tarda</i>	Edwardsiellosis	Catfish, Carps	Promising results

Challenges of Phage Therapy in Aquaculture

Despite its potential, the application of phage therapy in aquaculture faces several challenges, which are outlined below:

1.Host specificity: Bacteriophages are highly specific and usually infect only particular bacterial strains. While this ensures targeted action, it limits their broad application.

Solution: The use of phage cocktails, which contain multiple phages targeting different strains, can increase treatment effectiveness

2.Bacterial resistance to phages: Similar to antibiotics, bacteria can develop resistance to phages over time.

Solution: Rotating different phages or combining with other disease control strategies can help minimize resistance development..

Future Prospects

The future prospects of phage therapy in aquaculture are encouraging, with emerging strategies aimed at improving its effectiveness and reliability. Phage–antibiotic synergy, where phages are combined with sub-lethal doses of antibiotics, can enhance bacterial elimination while reducing the development of resistance. In addition, advances in genetic engineering enable the development of modified phages, including CRISPR-enhanced phages capable of targeting multiple bacterial strains or carrying antimicrobial genes, thereby improving treatment efficiency and broadening their application potential.

The digital blue revolution: AI integration in aquaculture

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Abstract

The need to have sustainable protein has never been as acute as now when the world population is rapidly approaching 10 billion by mid-century. Conservationist fisheries have reached its limit and aquaculture as the farming of aquatic organisms has become the main force behind fulfilling the seafood requirements of the world. Nevertheless, the industry suffers major impediments: environmental degradation, outbreak of diseases and inefficiencies in operation.

Keywords: Aquaculture, Blue revolution, Aquaculture 4.0, AI automation, sustainable aquaculture, Smart aquaculture

Introduction

India has firmly established itself as a world leader in fisheries industry and now is the second-largest fish producer in the world and it contributes about 8 percent to the output in the world. In FY 2024-25, national fish production has recorded an all-time high of 197.75 lakh tonnes, which is an unbelievable 106 percent increase over the past 10 years. The industry has emerged as a crucial economic activity as it gives 7.43% contribution to Agriculture GVA and livelihoods of about 3 crore individuals are sustained as more than 74.66 lakh jobs have been generated since 2014. India recorded its highest seafood export in the past with Rs. 62,408 crore and this was due to the Pradhan Mantri Matsya Sampada Yojana (PMMSY) which recorded investments worth over Rs. 38,000 crore. The inland fisheries have experienced a boom more than 140 percent but now the attention is moving to deep-sea fishing and climate-resilient aquaculture. Introducing the Digital Blue Revolution. Artificial Intelligence (AI) implementation is changing the face of aquaculture into a data-driven industry with intuition-based trade turning into a thing of the past. The use of AI-based systems is expected to boost the world production by almost 35 percent in 2030.

Present status: The rise of Aquaculture 4.0

The industry today is moving to what analysts term as Aquaculture 4.0.

This is the period of the intersection of the Internet of Things (IoT) and artificial intelligence (AI) that is sometimes called the Artificial Intelligence of Things (AIoT).

- 1. Precision feeding system:** In aquaculture, feed constitutes almost half to three-quarters of the overall operation expenses. At present, smart feeders based on AI are equipped with acoustic sensors and computer vision that help to analyze the behavior of fish in real-time. **How it works:** It works by the cameras recognizing that the fish is sated (slows down or ceases approaching the surface) and stops feeding automatically. **Effect:** This decreases the Feed Conversion Ratio (FCR), lessens the nutrient runoff resulting in algae blooms and conserves thousands of dollars of wasted pellets.
- 2. Real time water quality control:** Any farm is dependent on water. AI models can now read data on IoT sensors of: Dissolved Oxygen (DO), Temperature and pH, Salinity and Ammonia levels. Predictive analytics, which are now part of modern AI systems, will predict oxygen crash hours before it occurs, providing time to the farmer to switch on aerators or to increase or decrease flow rates.
- 3. Automated biomass estimation:** In the past, fish size and weight were determined by manual sampling, which is both time-consuming and imposes a lot of stress (or even death) on the animals.

Current Technologies: Convolutional Neural Networks (CNNs) and underwater stereo cameras now can analyze the size and weight of thousands of fish each minute and more than 95 percent are accurate without ever coming into contact with the water.



AI Tools used in modern Aquaculture

Although the logic is delivered by the underlying technologies (such as Computer Vision), a number of specific AI-powered tools and software platforms have become the industry standard by the year 2026. These are the tools that give the dashboard and the hardware-software integration that is used in day to day activities by the farmers.

1. Biomass & Health Monitoring Tools

Aquabyte: An application that is common and operates underwater cameras and artificial intelligence to deliver the current weight of the fish, the number of sea lice, and the overall welfare of the animal without their physical work.

Tidal (Alphabet of Google): A complex system of underwater sensors that can track the individual fish behaviour and promote optimal feeding using AI, as well as identify the early signs of stress or illness.

XpertSea (XperCount): An intelligent bucket and software system especially in shrimp farming. It relies on computer vision to enumerate, measure the size and weight of organisms in real time in a mobile phone or dedicated hardware.

2. Smart Feeding & Behavioral Tools

eFishery: A leading AIoT tool (originating in Indonesia) that uses smart feeders to sense vibrations and movement. It automatically adjusts feeding schedules and amounts based on real-time hunger levels.

ReelData AI: Specifically designed for Land-based Aquaculture (RAS), this tool provides autonomous feeding and health monitoring by analyzing fish appetite through camera feeds, significantly reducing feed waste.

CageEye: An acoustic-based AI tool that uses "hydroacoustics" (sound) to monitor fish behavior in deep-sea cages, allowing for precision feeding even in murky or deep waters where cameras might fail.

3. Predictive Management & Risk Platforms

Manolin: A data intelligence platform that uses AI to predict disease outbreaks and farm risks. It aggregates data from multiple farms to provide benchmarking and early warning alerts for sea lice or infectious diseases.

Aquawise: A newer, hardware-free AI tool that uses satellite imagery and physics-based AI to monitor water quality and predict algal blooms across large geographic areas.

Umitron: A provider of various AI tools, including Umitron Cell, which allows farmers to remotely monitor and feed fish via a smartphone app using high-definition video and data analytics.

4. Enterprise & ERP Software

Navfarm: A comprehensive farm management software used heavily in India and Southeast Asia. It integrates AI to track the entire lifecycle from hatchery to harvest, including batch management and cost-per-kg analytics.

AquaManager: An ecosystem tool that combines IoT sensor data with AI to provide "Decision Support Systems" (DSS), helping managers decide exactly when to harvest for maximum market value.

Future Prospects: The Horizon of 2030 and Beyond: By 2027, AI will not only be involved in mere monitoring, but this will be fully autonomous farm control.

1. Digital Farm Simulation and Twins

The future step is the development of Digital Twins - virtual copies of real fish farms. As a simulation of a what-if situation (e.g., What happens to the growth when the water temperature is 2 C higher?), by virtualizing it, farmers will be able to optimize their options in a risk-free environment and then implement them in reality.

2. Genetic Enhancement and Smart Breeding

AI is increasing the rate of selective breeding. Through the study of large genomic data sets, AI can be used to determine certain disease resistance markers and increase rates of growth. The next generation breeding initiatives can generate species that are climate-resistant to unique changes in the environment.

3. Autonomous Robotics

We also witness the first steps toward robotic fish (such as the Shoal) and AUVs capable not only of autonomously patrolling nets, finding holes, but also mending them with the help of AIs and mechanical arms. This will eliminate the necessity of human divers which is hazardous and costly.

4. Traceability and Blockchain

Together with the AI, blockchain will guarantee complete transparency. AI will monitor the health, the quality of its feed, and its environmental impact, and it will generate a sort of digital passport of high-quality and sustainable seafood, the journey of a fish, starting with the fingerling and ending with the meal on the plate of a consumer.

Challenges to Widespread Adoption

Despite the potential, several "bottlenecks" remain:

a. High Initial Cost: The capital required for sensors, high-speed connectivity, and AI software remains prohibitive for small-scale farmers in developing nations.

b. Harsh Environments: Electronic sensors often struggle with "biofouling" (algae growth on lenses) and the corrosive nature of saltwater.

c. Data Silos: Many companies treat their data as proprietary, hindering the development of universal AI models that could benefit the entire industry.

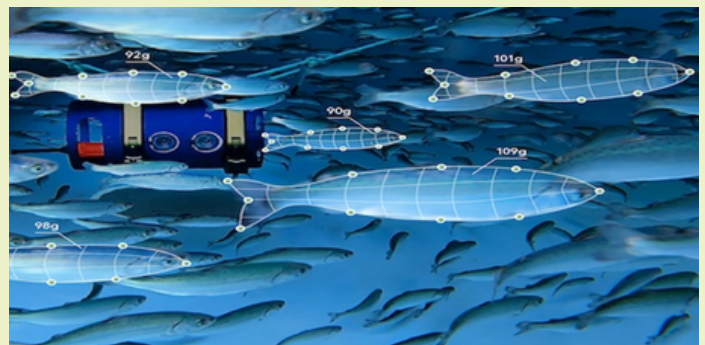
d. Skill Gap: There is a growing need for "Aqua-Technicians"--workers who understand both marine biology and data science.

Conclusion: A Resilient Food Future

Use of AI in aquaculture has ceased being a luxury but rather it has become a necessity to a planet that experiences climate change and food insecurity. The current status is characterized by the efficiency (feeding and monitoring) whereas the future will be characterized by autonomy and sustainability. Moving away from the reactive mode of operation, which is more of a guesswork, to the proactive mode of operation known as precision means that we will be able to feed the world without having to empty our oceans.

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FISHERY NEWS

California opens White Sturgeon catch-and-release recreational fishery with no report card fee, aiming to balance conservation and angler access.



UMass Amherst biologists publish findings on reducing stress in striped bass catch-and-release, including best practices to improve post-release survival.

Student aquaculture research on triploid hybrid striped bass genetics is recognized internationally



WORLD AQUACULTURE 2025 INDIA

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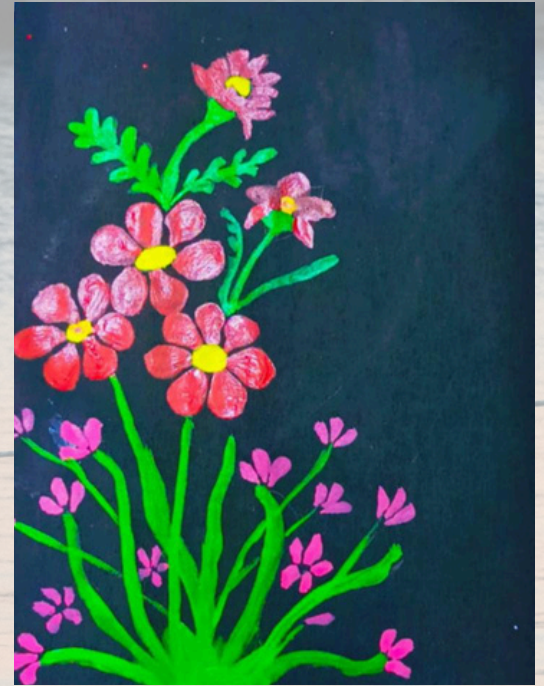
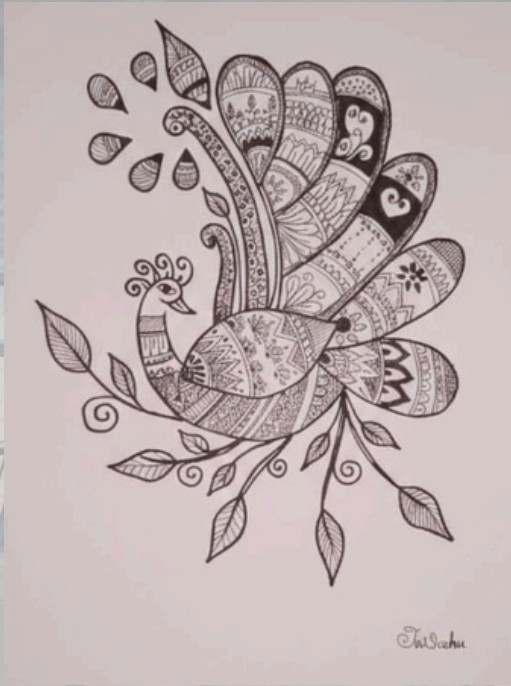
World Aquaculture India 2025 Conference was held in Hyderabad (10–13 Nov 2025) bringing together international aquaculture scientists and industry experts

Spawning biology of yellowtail scad (*Trachurus novaezelandiae*) was characterized in southeastern Australia, providing new reproductive and stock data crucial for small pelagic fishery assessments.

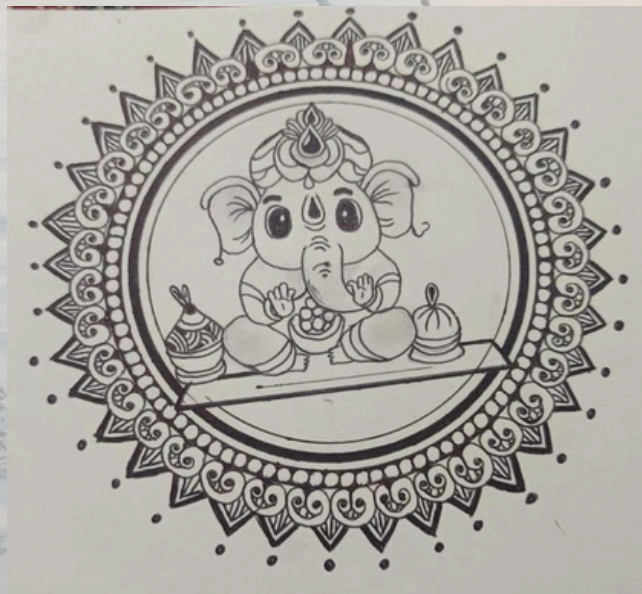


AI-enhanced bioacoustics techniques were introduced for non-invasive lobster sex and age classification

Student activities



TRIDISHA HARBAB BFSC 8TH SEMESTER



DEBADRITA BASU BFSC 2ND SEMESTER

Student activities

STUDENTS PARTICIPATED VIRUTALLY ON INTERNATIONAL CONFERENCE AT TURKEY



BINAYAK MAITI



SOURASHIS SENGUPTA



SOUMILI HALDER