English Monthly from Hyderabad, India

RNI Regn. No. 52899/93

Aqua International

Estd. 1993

Health • Nutrition • Management • Processing

December 2023

Annual Subscription: Rs 800 Foreign $ 100

Inside...

Aqua International

English Monthly Magazine
(Established in May 1993)

Volume 31 Number 08 December 2023

Editor & Publisher
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Website: www.aquainternational.com

Annual Subscription
India : Rs. 800
Foreign Countries : US $ 100
or its equivalent.

Aqua International will be sent to the subscribers in India by Book Post and to the foreign subscribers by AirMail.

Edited, printed, published and owned by M. A. Nazeer and published from BG-4, Venkataramana Apts., 11-4-634, A.C.Guards, Hyderabad - 500 004, India. Printed at Srinivasa Lithographics.
Registered with Registrar of Newspapers for India with Regn. No. 52899/93. Postal Regn. No. L II/ RNP/HD/1068/2021-2023.

NRS PUBLICATIONS
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Subscriptions for Aqua International, English monthly, should be sent to:
The Circulation Department, Aqua International, BG-4, Venkataramana Apartments, 11-4-634, A.C.Guards, Near Income Tax Towers, Hyderabad - 500 004, India. Email: info@aquainternational.in

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Tiger Prawn Cultivation growing in India

World Fisheries Day 2023 celebrated all over

Peptides derived from marine resources have good potential nutraceutical and pharmaceutical properties. Marine biopeptides showed good antibacterial, antifungal, antiviral and anticancer activity. Marine peptides are highly selective to their targets, have a wide range of therapeutic effects, and have a low deposition rate in body tissues. Biopeptides can be utilized as excipients in therapeutic formulations to alter biological activity, target delivery, or transport across cellular membranes in addition to being employed as active components. The development of medicines from bioactive peptides is a novel technique, and it is a new milestone in the pharma industry.

Dear Readers,

The December 2023 issue of Aqua International is in your hands. In the news section, you may find news about ...

World Fisheries Day was celebrated on 21 November 2023 throughout the world. This year, the Day was celebrated on the theme "Build enabling policy environments for small-scale artisanal fisheries" to look at the sustainability factors of the fisheries, fishing industries and also the surrounding sphere which balances the ecosystem. The fishing communities organized a wide array of different colourful activities like rallies, workshops, public meetings, cultural programmes, dramas, exhibitions etc., to mark the celebration of the day.

The Ministry of Fisheries, Animal Husbandry and Dairying, Government of India hosted a Global Fisheries Conference 2023 on 21 - 22 November 2023 at Gujarat Science City, Ahmedabad, Gujarat, aiming to provide a unique platform to foster collaborations for the holistic growth and development of the sector and "Celebrate the Fisheries and Aquaculture Wealth". ICAR-Central Inland Fisheries Research Institute, Barrackpore celebrated World Fisheries Day at 'Pan India'. ICAR-CIFRI conducted three mass awareness camps at Hasnabad, West Bengal, Vazhani Reservoir, Kerala and Sangam, Prayagraj, Uttar Pradesh. Dr B. K. Das, Director, ICAR-CIFRI, attended the conference and presented a key-note address in the Technical Session on "Emerging Challenges and opportunities in Inland Fisheries & Aquaculture". ICAR-CIFRI has distributed fisheries inputs like fish seeds and fish feed to 84 women of the fisherfolk community at Hasnabad, Sundarbans under CIFRI's 'Mission 3000'. Over 350 small-scale artisanal fishers were sensitized on ecosystem health management and the significance of conservation through these awareness programs.

In the past, the price of prawns was kept stable for at least ten days, but the promised processing companies are not implementing it, according to Mr Gajapathiraju and Mr G.K.F. Subbaraju, office bearers of West Godavari district Prawn Farmers Association. They spoke at a community meeting in Bhimavaram. The government intervened 100 count price should be at least Rs 240 as against 30 to 40 earlier community. Minimum rates proposed by the Association are: 30 Count (kg) at Rs 500; 40 Count at Rs 420; 50 Count at Rs 360; 60 Count at Rs 320 and 100 Count at Rs 240.

The aquaculture farmers of Chinaganjam, Guntur District, Andhra Pradesh are on the path of profits with the cultivation of tiger prawns. There is aquaculture cultivation in 20,900 acres of land in Chinaganjam, Vetapalem, Chirala, Bapatla, Karlapalem, Nizampatnam etc in the district. Out of that, Aqua is cultivated in about 6,000 acres of land in Chinaganjam, Pedaganjam, Munnamwari Palem, Pallepalem, Aminnagar, KadaVakuduru, Motupalli, AdavidhiPalem, Rajubangarupalem and other areas of Chinaganjam mandal in which Tiger prawns are being cultivated. Many farmers achieved a count of 18 prawns per kg during the months of harvest. Farmers are getting good yields by following the cultivation techniques from time to time.

To boost fish production and enhance the productivity of aquaculture and fisheries resources, the directorate of fisheries in Goa has submitted a proposal to the Centre under the Pradhan Mantri Matsya Sampada Yojana to adopt

Contd on next page

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Aqua International

Our Mission

Aqua International will strive to be the reliable source of information to aquaculture industry in India.

AI will give its opinion and suggest the industry what is needed in the interest of the stakeholders of the industry.

AI will strive to be The Forum to the Stakeholders of the industry for development and self-regulation.

AI will recognize the efforts and contribution of individuals, institutions and organizations for the development of aquaculture industry in the country through annual Awards presentation.

AI will strive to maintain quality and standards at all times.

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culture fishing. Director of Fisheries, Mr Deepesh Priolkar told that the practice of capture fishing will eventually wane. He said that traditional capture fishing often leads to overfishing and the depletion of fish populations in open sea waters overtime. Additionally, once fish are caught, there is a limited window for preservation. The surplus catch either needs to be exported or regrettably goes to waste. Fish farmers will be invited to attend workshops and seminars of aquaculture. They will also be educated about the various department schemes.

Alvin Anto, a researcher at the ICAR – Central Marine Fisherieries Research Institute (CMFRI), has been awarded the prestigious Hasmukh Shah Memorial Award for Ecological Studies for his research on coral reefs in the Lakshadweep Islands. Anto's work highlights the threats faced by coral reefs from climate change and other human-induced factors. The award, which includes a cash prize of Rs 2 Lakh, aims to recognize individuals who have made significant contributions to addressing sustainability and societal issues.

Uttar Pradesh was honored with the Best State-Inland Fisheries Award at the Global Fisheries Conference 2023 held in Ahmedabad on the occasion of World Fisheries Day. The prestigious award was presented to Sanjay Nishad, the minister of fisheries in UP, along with Rajneesh Dube, ACS, Fisheries, and Prashant Sharma, director, fisheries.

The Parliament of India has given a green signal to Coastal Aquaculture Authority (Amendment) Bill, 2023. The Indian Parliament has approved the Coastal Aquaculture Authority (Amendment) Bill, 2023. The government's goal is to confirm that coastal aquaculture and its related activities are allowed within the Coastal Regulation Zone (CRZ) defined by CRZ notifications. The amendment ensures that registrations granted under the Coastal Aquaculture Authority Act will now serve as valid permissions under the CRZ Notification. This change is aimed at helping small-scale aquaculture farmers by removing the need for CRZ clearances from various agencies. Additionally, the amendment includes a specific provision allowing the establishment of aquaculture facilities like hatcheries and breeding centers within the No Development Zone (NDZ) located 200 meters from the High Tide Line (HTL) of the CRZ.

ICAR-CIBA formed a strategic alliance with M/s. Amiti Empiric Technologies LLP, Karnataka or production of indigenous shrimp larval feed. Quality larval feeds are the central element for successful hatchery operation. At present the larval feeds used in India wholly imported and expensive. In this context, a cost-effective indigenous larval feeds for shrimp is the need of the hour for sustainable aquaculture. Focused research efforts at CIBA over the last five years resulted in development of CIBA Shrimp Larval Feed. In an effort to promote the shrimp larval feed production in line with the Make in India programme of Govt. of India, ICAR-CIBA has signed a MoU for the manufacture of indigenous shrimp larval feed on 6 November 2023 in the presence of Dr Kuldeep K. Lal, Director, CIBA.

Shrimp farming has evolved over the years, and with advancements in technology, the industry has witnessed a significant transformation. One of the key innovations contributing to the efficiency and sustainability of shrimp farming is the integration of automatic feeders. These devices have proven to be instrumental in optimizing feeding practices, improving shrimp growth and ensuring good water quality. Dieticians recommend consuming small portions of food at frequent intervals for improved digestion and metabolism. This concept holds for shrimps as well. Automatic feeders ensure that shrimps receive the right amount of feed at the right time. These systems facilitate dispensing of small quantities of feed at regular intervals, leading to optimal growth, health, efficient resource utilization, and overall enhanced productivity in aquaculture. As the shrimp farming industry continues to embrace technological innovations, automatic feeders stand out as a game-changer, revolutionizing the way we approach and manage shrimp cultivation.

In the Articles section, Eco-Labelling and Traceability, authored by Shivani D. Gowda, Pavankumar P. and Dr Ganapathi Naik, M, Department of Aquaculture, College of Fisheries, Mangaluru, described that Ecolabels guide consumer towards environmental-friendly products. Traceability ensures accountability, supports fish farmers and strengthens trust. Over 400 ecolabels globally, around 50 are related to fisheries and aquaculture. Certification schemes for aquaculture serves as valuable tools to balance economic development, environmental protection and social responsibility, ensuring a sustainable and responsible future for the industry. Ecolabeling and traceability play pivotal roles in promoting sustainability, transparency and informed consumer choices within various industries.

Another Article titled - **Why Thai mangur debarred in Bihar ?,** authored by Anjali kumara, College of Fisheries Kishanganj, Bihar Animal Science University, Bihar discussed that Molecular markers will play a major role in bringing out quality and sustainability to aquaculture. Molecular markers have wide range of applications in aquaculture mainly in genetic identification and discrimination of hatchery stocks, finding out inbreeding events, assignment of progeny to parents using genetic tags. To finding out quantitative trait loci, marker assisted selection for selective breeding trials and assessment of the effect of polyploidy induction and gynogenesis.

Article titled - **Pharmaceutical Potentials of Marine Biopeptides and their Mechanism of action on Bacteria, Virus, and Cancer cells,** authored by Ulaganathan Arisekar, Robinson Jeya Shakila, Rajendran Shalini, T. Surya, B. Sivaraman and G. Jeyasekaran, said that, Peptides derived from marine resources have good potential nutraceutical and pharmaceutical properties, Marine biopeptides showed good antibacterial, antifungal, antiviral and anticancer activity, Marine peptides are highly selective to their targets, have a wide range of therapeutic effects, and have a low deposition rate in body tissues,

Another Article titled - **Microplastics in Aquatic Ecosystems: A New Ecological Niche of Microbes,** authored by Kurapati Nagendrasai stated that Microplastics are small plastic pieces less than five millimetres (1µm to 5mm) long which can be harmful to aquaticlife, Durability of plastics allows the bio film to function as an artificial "microbial reef"compared to other floating objects, Bio film formation can be more specifically alocation-specific process than substrate-specific, Plasmidomes in MP-bio film play a dynamic role in horizontal gene transfer, MP-bio film as semblages resulting from EPS ultimately act as hot spots.

M.A.Nazeer
Editor & Publisher
Aqua International

ICAR Institutes celebrate World Fisheries Day - 2023

World Fisheries Day is celebrated on 21st November throughout the world. This year, the Day was celebrated on the theme "Build enabling policy environments for small-scale artisanal fisheries" to look at the sustainability factors of the fisheries, fishing industries and also the surrounding sphere which balances the ecosystem. The fishing communities organize a wide array of different colourful activities like rallies, workshops, public meetings, cultural programmes, dramas, exhibitions, etc., to mark the celebration of the day.

ICAR- Central Inland Fisheries Research Institute, Barrackpore, Kolkata

ICAR- Central Inland Fisheries Research Institute, Barrackpore celebrated World Fisheries Day on the 'Pan India'. ICAR-CIFRI conducted three mass awareness camps at Hasnabad, West Bengal; Vazhani Reservoir, Kerala and Sangam, Prayagraj, Uttar Pradesh.

Dr. B. K. Das, Director, ICAR-CIFRI, attended the conference and presented key-note address in the Technical Session on "Emerging Challenges and opportunities in Inland Fisheries & Aquaculture".

The Ministry of Fisheries, Animal Husbandry and Dairying (MoFAH&D), Government of India is hosting a Global Fisheries Conference 2023 (GFC-2023) from 21st-22nd November 2023 at Gujarat Science City, Ahmedabad, Gujarat, aims to provide a unique platform to foster collaborations for the holistic growth and development of the sector and "Celebrate the Fisheries and Aquaculture Wealth".

ICAR-CIFRI has distributed fisheries inputs like fish seeds and fish feed to 84 women of the fisherfolk community at Hasnabad, Sundarbans under CIFRI's 'Mission 3000'.

Over 350 small-scale artisanal fishers were sensitized on ecosystem health management and the significance of conservation through these awareness programs.

ICAR-Indian Agriculture Research Institute, Assam

ICAR-Indian Agriculture Research Institute, Assam organised a one-day workshop on "Sustainable aquaculture development for food security in the Northeast region of India".

Shri. Paramananda Chayengia, the Chief Executive Member of Missing Autonomous Council (MAC), Govt. of Assam was the Chief Guest, emphasised for generating awareness among the fish farmers residing in underprivileged areas of the North-East region.

Shri. Khuljit Padun, ALRS, Circle Officer, Gogamukh, Govt. of Assam was the Guest of Honour. He spoke on the adoption of scientific farming practices under the guidance of ICAR-IARI Assam.

Dr. Lohit Kumar Baishya, In-Charge, IARI Assam, urged about the scope and opportunities for sustainable fish farming in the NE Region with special reference to food and nutritional security of the country. He also expressed

the mandates and future action plans of the institute for the development of the agriculture and allied sectors in the country.

Dr. Dilip Kr. Jha, Principal, Gogamukh College, emphasised the importance of skill-based education in India for self-reliance and self-sustenance.

Dr. Debajit Sarma, Head, Div. of Aquaculture, ICAR-CIFE Mumbai, attended the workshop by virtual mode and deliberated on the technologies viz., Bio-floc, RAS, integrated fish farming etc.

About 5000 numbers of quality fish seeds of Jayanti rohu and amur common carp were distributed to the fish farmers along with 500 kg of agricultural lime.

The programme was participated by 50 fish farmers of the region and attended by the fishery development officers, faculty members of adjoining colleges, KVK personnel along with the scientists and staff of IARI Assam.

ICAR-National Bureau of Fish Genetic Resources, Lucknow

ICAR-National Bureau of Fish Genetic Resources, Lucknow, has taken significant strides in raising public awareness about the importance of sustainable fisheries and aquatic biodiversity conservation on the occasion of World Fisheries Day.

ICAR-NBFGR, renowned for its pioneering research

in fish genetics and biodiversity, organised a series of events aimed at educating the public, stakeholders, and young students about the challenges facing the fisheries sector and the importance of preserving aquatic ecosystems. The efforts of the ICAR-NBFGR have not only raised awareness but also fostered a sense of responsibility among various stakeholders towards sustainable fisheries.

Dr. U. K. Sarkar, Director, ICAR-NBFGR, distributed fish seed to fish farmers and State fisheries officials for ranching and emphasised that the bureau plans to expand its research and conservation programmes, focusing on technological innovations and community-based conservation strategies.

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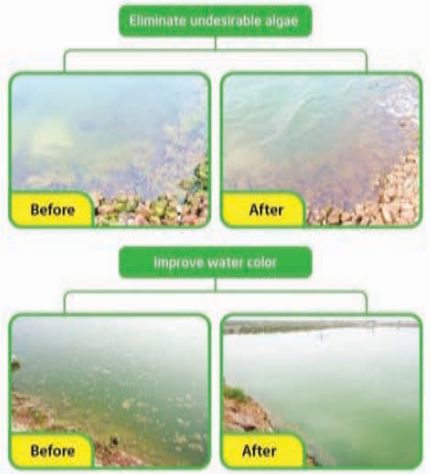
No cultivation is needed. Easily adapt to the changes of surroundings and grow fast in freshwater or seawater culture farming, even under low oxygen environment

3. DECREASE AMMONIA CONTENT

Prevent the accumulation of toxic substances such as NH_3, NO_2, etc.

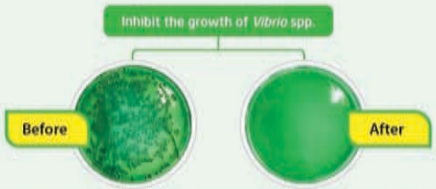
4. IMPROVE WATER COLOR

Improve water color regulate the algae and bacteria balance in water, turning your pond from green to clear



5. ESTABLISH BALANCED POND BACTERIA SYSTEM

Compete nutrition with vibrio and inhibit them to grow. Provide nutrition for probiotics in the pond, to establish a well-balanced farming system.



6. INCREASE AQUACULTURE PRODUCTION

Good quality of water prevents fish/prawn infections, making high profit of production

* COMPOSITION:

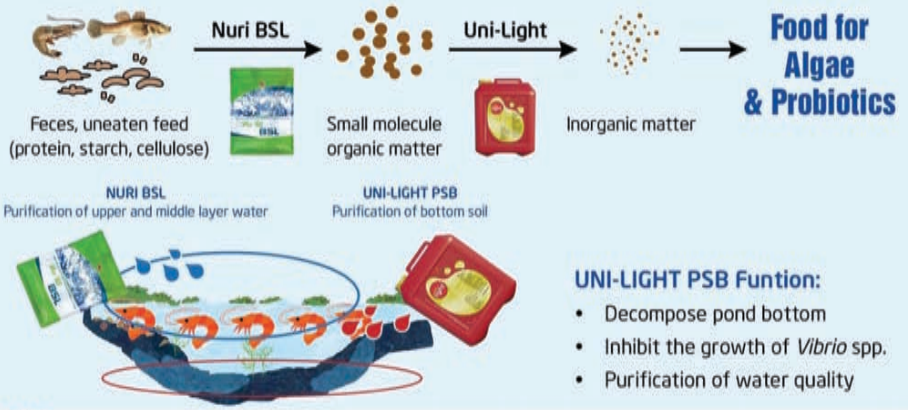
Bacillus spp. > 1x 10^{11} cfu/kg	15%
(Bacillus subtilis, Bacillus amyloliquefaciens, Bacillus licheniformis)	
Carrier (rice bran, corn gluten)	75%
Moisture	10%

* STORAGE:

Keep at dry, well-ventilated condition. Avoid direct sunlight exposure and use as soon as possible once opened for best quality.

* DIRECTION OF USE:

No cultivation is needed. Apply Nuri BSL with water-soluble bag near to the working water wheel or pour into the pond evenly. Recommend apply Uni-Light PSB together with Nuri-BSL on sunny day to achieve a clear pond more efficiently.



UNI-LIGHT PSB Funtion:

- Decompose pond bottom
- Inhibit the growth of *Vibrio* spp.
- Purification of water quality

BSL Dosage:

/10,000 m³ Quantity	10 - 30 pl/m² tiger prawn or < 80 pl/m² Vannamei	For >30 pl/m² tiger prawn or > 80 pl/m² Vannamei	For > 150 pl/m² Vannamei
7 days before stocking	800 g - 1,000 g	1,200 - 1,500 g	1,200 - 1,500 g
Day of stocking	300 g - 500 g	800 g - 1,000 g	800 g - 1,000 g
Every 7 - 10 days after stocking	300 g - 500 g	800 g - 1,000 g	3 - 5 days / use 1,000g - 2,000g

****Dosages can be adjusted according to the water conditions and practices.*

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Implement a minimum price

Resolution in Prawn Farmers Association meeting

In the past, the price of prawns will be kept stable for at least ten days Gajapathiraju and GKF Subbaraju, West Godavari district president and general secretaries of Prawn Farmers' Association in Andhra Pradesh said that the promised processing companies are not implementing it. They spoke at a community meeting in Bhimavaram. The government intervened. 100 count price should be at least 240 as against 30.40 earlier community.

The proposed support price is the minimum price requested counts cost at least Rs 100 and the difference has reduced to Rs 40. It used to be. Now the brokers said that the shrimps are at a low price by buying and exploiting the farmers expressed grief. After that announce the table of minimum support price count wise and the decision to implement it. A decision was made. Unless the support price is met, the crop will go towards break. He said that there is no other option for the cultivators.

Minimum rates proposed by the Association:

Count (kg)	Price (in Rs)
30	500
40	420
50	360
60	320
70	290
80	270
90	250
100	240

Tiger Prawn Cultivation is good

The aqua farmers of Chinaganjam area are on the path of profit with the cultivation of tiger prawns. There is aqua cultivation in 20,900 acres of land in Chinaganjam, Vetapalem, Chirala, Bapatla, Karlapalem, Nizampatnam etc in the district in Andhra Pradesh. Out of that, Aqua is cultivated in about 6,000 acres of land in China Ganjam, Pedaganjam, Munnamwari Palem, Pallepalem, Aminnagar, Kada Vakuduru, Motupalli, Adavidhi Palem, Rajubangarupalem and other areas of Chinaganjam mandal in which Tiger prawns are being cultivated. Many farmers achieved a count of 18 prawns per kg during the months of harvest.

They are getting good yields by following the cultivation techniques from time to time. Yields range from one ton to one and a half tons per acre. Rent, electricity, child for shrimp cultivation during crop season. 400 per kg was spent to raise 18 counts including fodder and other expenses. Some farmers caught shrimps on Saturday and sold 18 counts to the trader for Rs 520. This resulted in a profit of Rs 120 per kg after all costs were eliminated. Farmers are happy as they have made a profit. A farmer from his three ponds.

Four tons of crop yield was achieved. During the week, many people reaped profits from the crops they had grown. Due to the intermittent rains for two days, there was some difficulty in shrimp cultivation. As a result, on Monday, the price of 16 count tiger prawns was Rs 540, 18 count was Rs 500, and the price of 20 count was Rs 480. On Saturday, the price of 18 counts is Rs 520, while on Monday it is Rs 500 price.

Govt for culture fishing practices

Panaji: To boost fish production and enhance the productivity of aquaculture and fisheries resources, the directorate of fisheries has submitted a proposal to the Centre under the Pradhan Mantri Matsya Sampada Yojana (PMMSY) to adopt culture fishing.

"The practice of capture fishing will eventually wane," director of fisheries, Deepesh Priolkar told.

He said that traditional capture fishing often leads to overfishing and the depletion of fish populations in open sea waters overtime. Additionally, once fish are caught, there is a limited window for preservation. The surplus catch either needs to be exported or, regrettably, goes to waste.

"Fishermen often do not gauge the consequences of open sea fishing and how it can eventually deplete the population," he said.

This situation has prompted the directorate of fisheries to advocate for a significant shift towards culture fishing, a sustainable and environmentally friendly alternative that aligns with the objectives of the PMMSY. Culture fishing involves cultivating and breeding fish in controlled environments such as ponds, tanks, and cages, allowing for better management of fish populations and enhanced production.

"There is a lot of scope for culture fishing in Goa. A lot of awareness has to be done on the art of culture fishing as a result," he said.

"Fish farmers will be invited to attend workshops and seminars of aquaculture. They will also be educated about the various department schemes," he added.

Central Marine Fisheries Research Institute's research on coral reefs garners national recognition

Alvin Anto, a researcher at the ICAR – Central Marine Fisherieries Research Institute (CMFRI), has been awarded the prestigious Hasmukh Shah Memorial Award for Ecological Studies for his research on coral reefs in the Lakshadweep Islands. Anto's work highlights the threats faced by coral reefs from climate change and other human-induced factors. The award, which includes a cash prize of Rs 2 Lakh, aims to recognize individuals who have made significant contributions to addressing sustainability and societal issues. The award will be presented at a ceremony in January 2024.

The research on coral reefs being carried out by the ICAR-Central Marine Fisheries Research Institute (CMFRI) has garnered national recognition, with Alvin Anto, a young professional at the institute, securing the prestigious Hasmukh Shah Memorial Award for Ecological Studies for the year 2023 in the research category.

"The award includes a cash prize of Rs 2 Lakh and a certificate of recognition. Anto has been recognised for his extensive research on the resilience of the coral reefs in the Lakshadweep Islands, highlighting the increasing threats these critical ecosystems face from climate change and other human-induced factors," as per a press release.

The Hasmukh Shah Memorial Award, instituted by the Gujarat Ecology Society (GES) and funded by the Kachnar Trust, aims to honour and reward individuals who have made significant >> contributions through research, development, or implementation of innovative environmental, technical, or social solutions that address and mitigate pressing sustainability or societal issues.

"This award is particularly significant as it will help promote the resilience-based management approaches, which are vital for coral reefs. These approaches aim to develop strategies for the preservation, protection, and restoration of these fragile marine habitats," the release stated.

"A passionate ocean enthusiast and a PADI (Professional Association of Diving Instructors) certified dive master, Anto has led several underwater surveys concentrating on the coral reefs and associated marine life along the Indian coast and its islands. His work has been instrumental in providing valuable insights and data that are critical for ongoing conservation efforts. He is also part of CMFRI's team conducting coastal surveys on marine mammals," as per the release.

The award will be conferred during the Hasmukh Shah Memorial Lecture, scheduled for January 5, 2024, at the Federation of Gujarat Industries (FGI) in Vadodara.

Uttar Pradesh Clinches best state-inland Fisheries Award

Uttar Pradesh was honored with the Best State-Inland Fisheries Award at the Global Fisheries Conference 2023 in Ahmedabad on the occasion of World Fisheries Day.

The prestigious award was presented to Sanjay Nishad, the minister of fisheries in UP, along with Rajneesh Dube, ACS, Fisheries, and Prashant Sharma, director, fisheries.

Minister Sanjay Nishad highlighted the state's impressive fish production growth, reaching over 9.1 Lakh Metric Tonnes this year as compared to 8 Lakh Metric Tonnes the previous year.

Additionally, fish seed production has seen a significant rise from around 27,128 Lakh Metric Tonnes to approximately 36,187 Lakh Metric Tonnes.

The state is actively engaged in 31 projects under the PM Matsya Sampada Yojna, with fish ranching initiatives spanning across rivers in 68 districts.

Noteworthy developments include the ongoing construction of an ultra-modern fish mall in Chandauli, valued at over Rs 62 crore. This recognition solidifies Uttar Pradesh's commitment to fostering a thriving and sustainable inland fisheries industry.

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Coastal Aquaculture Authority (Amendment) Bill 2023 passed by Indian Parliament: List benefits for Fishermen

The Parliament of India has given a green signal to Coastal Aquaculture Authority (Amendment) Bill, 2023.

The Indian Parliament has approved the Coastal Aquaculture Authority (Amendment) Bill, 2023. The government's goal is to confirm that coastal aquaculture and its related activities are allowed within the Coastal Regulation Zone (CRZ) defined by CRZ notifications. The amendment ensures that registrations granted under the Coastal Aquaculture Authority Act will now serve as valid permissions under the CRZ Notification. This change is aimed at helping small-scale aquaculture farmers by removing the need for CRZ clearances from various agencies. Additionally, the amendment includes a specific provision allowing the establishment of aquaculture facilities like hatcheries and breeding centers within the No Development Zone (NDZ) located 200 meters from the High Tide Line (HTL) of the CRZ.

The current law allows for a prison sentence of up to 3 years for unregistered coastal aquaculture, which is considered too harsh for a civil matter. An amendment bill aims to replace this with more suitable civil penalties like fines, aligning with the principle of reducing criminal punishment

for civil offences. The amendment also broadens the definition of "coastal aquaculture" to cover all related activities under the law. This clarifies confusion between different aspects of coastal aquaculture and aims to prevent environmentally harmful practices.

Evolvement of Coastal Aquaculture

Coastal aquaculture has evolved beyond just shrimp farming to include eco-friendly activities like cage culture, seaweed culture, etc. These activities can bring revenue and employment opportunities, particularly for coastal communities and women. The amendment seeks to include these activities within the scope of the Coastal Aquaculture Authority Act to promote and regulate them effectively.

The government aims to enhance the ease of doing business in coastal aquaculture by refining operational procedures through amendments to the Coastal Aquaculture Authority. The amendments include changes to the registration certificate process for ownership or activity size changes, reissuing certificates in cases of damage or loss, and allowing for delayed

Ambiguous administrative matters involving the authority's Member Secretary and functioning in the Chairperson's absence are clarified for better efficiency and accountability under the Amended Act. The amendments grant explicit authority for the Coastal Aquaculture Authority to establish committees comprising experts, stakeholders, and public representatives to effectively carry out its responsibilities.

Facilities for Fishermen

To ensure successful coastal aquaculture, disease prevention is crucial. The government plans to establish facilities like hatcheries, broodstock multiplication centres, and nucleus breeding centres to produce genetically improved and disease-free stocks.

These facilities can only be set up in areas with direct seawater access, and provisions will be made in the Act to discourage the use of antibiotics and pharmacologically active substances in coastal aquaculture.

The government plans to incorporate international best practices like aquaculture area mapping, adopting Good Aquaculture Practices, ensuring product quality and safety, and streamlining business processes while maintaining environmental protection principles through appropriate provisions in the Act. These measures aim to boost sustainable production, traceability, competitiveness, entrepreneurship, and exports in coastal aquaculture. This, in turn, will lead to consistent income and employment growth in rural coastal areas.

The Amendment Bill includes new provisions to empower the Coastal Aquaculture Authority in better regulate coastal aquaculture-related activities for environmental

compliance. These provisions entail setting standards for effluent emission from aquaculture units, holding owners accountable for demolition and environmental damage costs based on the Polluter Pays Principle, and prohibiting aquaculture in ecologically sensitive areas. Due to advancements in technology and cultural practices, the pollution potential of shrimp farming has notably decreased. The sector is now ready for a significant advancement by diversifying species and expanding into new areas, facilitated by the policy flexibility provided by the amendments to the Coastal Aquaculture Authority Act of 2005.

How Coastal Aquaculture Authority (Amendment) Bill 2023 Will Be Helpful?

The Lok Sabha has recently taken a notable stride in advancing aquaculture and enhancing the business environment by approving a modified bill. This bill, directed at legalizing specific actions associated with coastal aquaculture, incorporates a range of crucial clauses.

Decriminalizing Aquaculture Activities

The modified bill's primary emphasis is on eliminating the criminal nature of violations linked to activities in coastal aquaculture. This action is projected to offer solace to individuals involved in aquaculture endeavours and enhance the business-friendly atmosphere within this field.

The bill suggests substituting potential prison sentences of a maximum of three years with a fine of Rs 1 lakh for specific transgressions connected to coastal aquaculture. This shift in penalties is designed to create a more favourable regulatory landscape for the smooth functioning of aquaculture activities.

Surge in Shrimp Output and Elimination of Minor Offense Imprisonment

Between the fiscal years 2013-14 and 2022-23, there has been a notable upswing in shrimp production, escalating from 322,000 tonnes to a remarkable 1,184,000 tonnes. This substantial increase underscores the expansion possibilities within the aquaculture industry.

Matsya Sampada Yojana: Elevating the Fishing Industry

Matsya Sampada Yojana constitutes part of the government's endeavors to uplift the fishing sector. This plan involves a substantial investment of Rs 20,050 crore. Its goal is to modernize and enhance the productivity of the fishing industry, aligning seamlessly with the bill's intention of fostering aquaculture.

Encouraging Progressive Aquaculture Methods

A key element of the legislation focuses on endorsing novel and more ecologically sound approaches to aquaculture. Specifically, the bill promotes methods like cage farming and cultivating seaweed. These inventive techniques not only add variety to aquaculture methodologies but also contribute to the overall sustainability of the sector.

ICAR-CIBA partners with 'Amiti Empiric Technologies' for production of Shrimp Larval feed

Chennai: ICAR-CIBA formed a strategic alliance with M/s. Amiti Empiric Technologies LLP, Karnataka or production of indigenous shrimp larval feed. Quality larval feeds are the central element for successful hatchery operation. At present the larval feeds used in India wholly imported and expensive. In this context a cost-effective indigenous larval feeds for shrimp is the need of the hour for sustainable aquaculture. Focused research efforts at CIBA over the last five years resulted in development of CIBA Shrimp Larval Feed. In an effort to promote the shrimp larval feed production in line with the make in India programme of Govt. of India, ICAR-CIBA has signed a MoU for the manufacture of indigenous shrimp larval feed on 6th November, 2023 in the presence of Dr Kuldeep K. Lal, Director CIBA. According to him this effort will undoubtedly improve the economic benefits, contribute to innovation and growth and encourage sustainability and competitiveness in the aqua feed sector in the longer run. He also expressed his wish that it should be a long-lasting and beneficial journey to share both sides' experiences. Mr Mohan Reddy , CEO, Amiti Empiric Technologies. narrated his hatchery and farming experience and shared the encouraging trial results obtained with CIBA Shrimp Larval Feed and his intention to take this technology to benefit the stakeholders and making an import substitute for the existing shrimp larval feeds. Dr K. Ambasankar, Principal Scientist and team leader for the feed technology, briefed the significance of this MoU and outlined the genesis of this initiative. He stressed that this technology would benefit the aquaculture sector in long run. The event was organized by the Institute Technology Management Unit (ITMU) of ICAR-CIBA. Earlier, Dr P.K. Patil, Principal Scientist & Officer in-Charge, ITMU greeted the gathering and briefed the framework of the approach of this program and proposed vote of thanks.

Revolutionizing Shrimp Farming: The Role of Automatic Feeders

Shrimp farming has evolved over the years, and with advancements in technology, the industry has witnessed a significant transformation. One of the key innovations contributing to the efficiency and sustainability of shrimp farming is the integration of automatic feeders. These devices have proven to be instrumental in optimizing feeding practices, improving shrimp growth, and ensuring good water quality.

Precision Feeding – Optimal Shrimp Growth

Dieticians recommend consuming small portions of food at frequent intervals for improved digestion and metabolism. This concept holds for shrimps as well. Automatic feeders ensure that shrimps receive the right amount of feed at the right time. These systems facilitate dispensing of small quantities of feed at regular intervals, leading to optimal growth, health, efficient resource utilization and overall enhanced productivity in aquaculture.

Optimized Feed Conversion – Maximizing Profit Margins

Efficient feed conversion is essential for the economic viability of shrimp farming. Automatic feeders dispense feed in a controlled manner, preventing overfeeding. The ability to adjust feeding schedules based on shrimp behavior and environmental conditions further enhances feed conversion efficiency.

Better water quality and pond bottom – a stride towards sustainability

By dispensing controlled amounts of feed at scheduled intervals, these devices prevent overfeeding, a common cause of water pollution. Excess uneaten feed can lead to increased ammonia levels and degraded water quality and pond bottom. Automatic feeders contribute to a more precise and regulated feeding process, ensuring that shrimp consume the provided feed efficiently. This not only minimizes waste but also helps prevent the accumulation of harmful substances in the water. As a result, the use of automatic feeders promotes a healthier aquatic environment, reducing the risk of water-related issues and supporting sustainable shrimp farming practices.

Enhanced Labor Efficiency – Strategic utilization

Manual feeding can be a time-consuming and labor-intensive task, especially in large-scale shrimp farms. Automatic feeders alleviate the need for constant human supervision, allowing farmworkers to focus on other critical aspects of shrimp farming, such as water quality management, disease control, and overall farm maintenance. This enhanced labor efficiency not only reduces operational costs, but also ensures that human resources are utilized more strategically.

Eruvaka Automatic Feeder – PondMother

Eruvaka PondMothers are known for their precision and robustness. Covering 38,000+ Ha globally, PondMothers have ***improved Average Weekly Growth (AWG), survival, biomass harvested, FCRs, and carbon footprint across tens of thousands of harvests.*** This, in turn, reduces the production costs for the farmer. The distinguishing features of PondMother are:

1. ***Solar-powered***
   PondMothers are solar-powered with 4 of days battery backup. You never have to worry about powering up your device.
2. ***Two models to suit your needs***
   PondMother variants are float-based and pole-based.
   The float-based version can be placed anywhere in the pond. This helps in ensuring that the pond bottom in the feeding zone is not depleted of minerals across cultures. For smaller ponds or where it is difficult to feed without a catwalk, the pole-mount version is more suitable.
3. ***User-friendly with minimal maintenance***
   PondMother has a very simple design with user-friendly controls to enable you to self-service the feeder without the need for any intervention.
4. ***Remote monitoring and control***
   Via our app, PondLogs, you can monitor and control feeding from anywhere in the world.

As the shrimp farming industry continues to embrace technological innovations, automatic feeders stand out as a game-changer, revolutionizing the way we approach and manage shrimp cultivation. *For more information, please visit www.eruvaka.com or reach out to us at info@eruvaka.com*

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Zoea & Mysis:
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Stagewise control of *Vibrio sp.* results in remarkable reduction of *Vibrio sp.* load in post larval tanks. This results in high health seeds.

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BEST APPROACH TO CONTROL PATHOGENIC VIBRIOS

V PHAGES HATCHERY	✓✓
PROBIOTIC	✓
SANITISER	✗
DISINFECTANT	✗✗
ANTIBIOTICS	✗✗✗

One Health unified approach for balanced welfare of people, animals and ecosystems.

ONE HEALTH APPROACH

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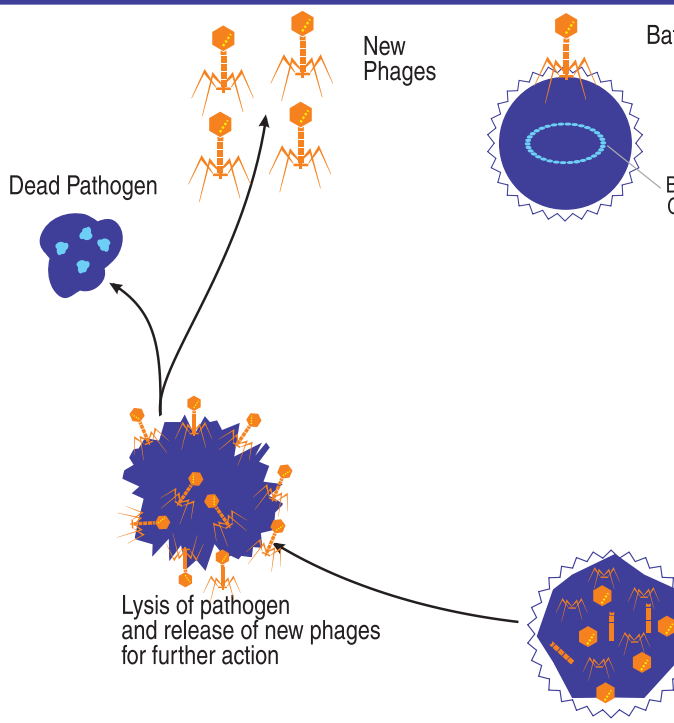
they are safe on aquatic animals, people and ecosystem
resistant to antibiotics and incr

"V PHAGES" cocktail targets against most common pathog

• ***Vibrio parahaemolyticus*** • ***Vibrio alginolyticus*** • ***Vibrio h***

100 % Natural | Pathogen specific approach | V
Easy & Safe to use | Do

ILLUSTRATION OF ACTION OF PHA



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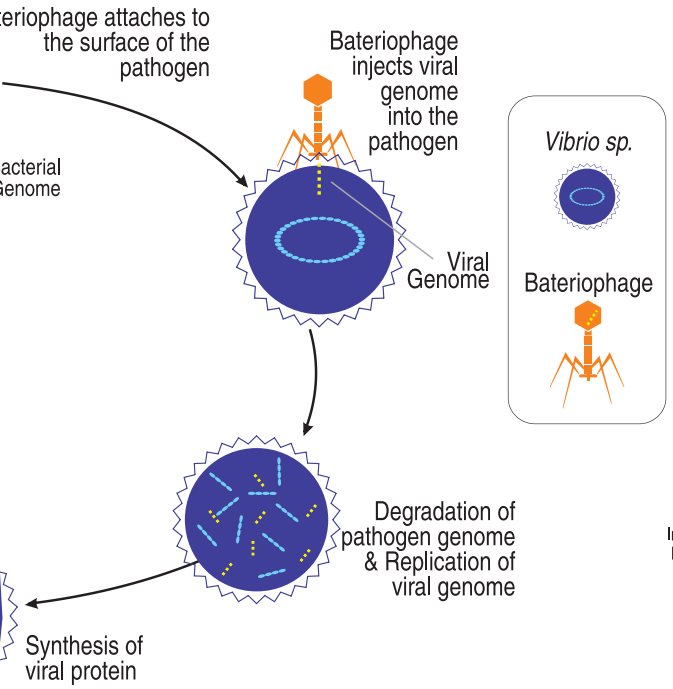
GE ON A TARGET VIBRIO BACTERIA



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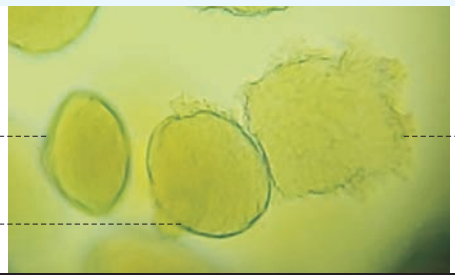
- Prevents sudden crop loss and extends Life of Pond during critical profit-making period.
- Enhances Probiotic performance.

Works as an Alternative to Antibiotics and complies with International Seafood export regulations.

Stages of *Vibrio sp.* colonies infected with Bacteriophages & Progressive Lysis observed on an Agar plate, under Stereo Microscope



Colony 1 in Stage 1: Intact Colony may be infected or yet to get infected.

Colony 2 in Stage 2: Phage infected Colony showing Partial lysis.

Colony 3 in Stage 3: Phage infected Colony Completely lysed, cell contents with multiplied phages spreads out in search of their host.

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Spotlight on the Aquaculture Africa 2023 (Zambia) as Conference programme is announced

Africa: It is less than a month until Zambia meets the world for the 2nd Aquaculture Africa Conference scheduled for 13-16 November 2023 in Lusaka. Themed *"Resilient value chains in the blue economy"* AFRAQ23 is expected to bring together over 700 industry, academic, government, development partner delegates from several countries in Africa and across the world to connect and celebrate achievements in the aquaculture developmental journey, but also to find solutions to some of the challenges impacting the sustainability of the sector.

Within the blue economy drive, aquaculture is increasingly important as an environmentally sustainable way to meet global demand for blue foods – bearing in mind the continent's vast inland waters and coastlines which are largely untapped and have great potential to contribute to the nutrition and socio-economic development needs of the region.

The conference scientific and technical programme which is under finalisation is largely packed with multi-sessions that resonate to the conference theme of "sustainability", balancing global and African perspectives – thanks to the efforts as led by renowned Programme Chairs, Professor Peter Britz (Rhodes University, South Africa) and Prof Cyprian Katongo (University of Zambia).

The first keynote address *"The evolution and development of aquaculture in Zambia – from an industry perspective"* will feature Zambia's aquaculture value chain development journey, from being a small producer decades ago, to one of the top and fastest aquaculture producing countries in Africa today. The presentation will be delivered by Mr Fisho Patrick Mwale, Chairman of the Aquaculture Development Association of Zambia (ADAZ); an entrepreneur and investment adviser – who is also the co-founder and pioneer of Yalelo Ltd – currently the largest freshwater aquaculture venture in Sub-saharan Africa.

Africa is currently experiencing massive investment in aquaculture that has led to the growth of the industry on various water bodies. This growth and intensification of production has resulted into disease situations being documented for the first time in various parts of the continent. The effective development and implementation of aquatic animal health programmes is paramount to the sustainability of the sector. Dr Hang'ombe Bernard Mudenda, a renowned fish disease professional from the School of Veterinary Medicine at University of Zambia will deliver a keynote speech on the subject matter, with special emphasis on recent developments in Africa. Dr Mudenda has over the years worked with FAO, WOAH, Africa Union and other partner organisations on elements of building capacity on aquatic animal health and biosecurity in Africa. The World Aquatic Veterinary Medical Association (WAVMA) and their associates in Africa will subsequently feature a number of technical sessions on aquatic animal health at AFRAQ23.

Aller Aqua, the AFRAQ23 gold sponsor will sponsor and convene technical sessions on select African country industry experiences on aquaculture, aquafeeds development and farmers forums. As in Egypt last year (AFRAQ21), Aller Aqua will once again feature a large exhibition booth showcasing their brand, products, services and activities in Africa.

What is most unique at AFRAQ23 is the presence of a number of developmental organisations who will be hosting a number of special side-sessions and workshops covering some key thematic areas. On 15th November 2023, the FAO in collaboration with World Bank and Aquaculture Network for Africa (ANAF) will be hosting a special "Africa day" session focusing on crucial topics for advancing the aquaculture sector in Africa, including relevant global and regional processes, technologies and innovations, investment, trade, and value chains as well as partnerships. Various speakers from FAO, partner organisations and projects actors in Africa will be present at this event.

The American Soybean Association's World Initiative for Soy in Human Health Program (WISHH), another silver sponsor to AFRAQ23 has organised a Fish Farmers' Panel Discussion – where

▸▸

Gassen Plus

Bon Ammonia and obnoxious Gasses

Shrimp / Fish performs all their body functions and growth in water. Good quality water and proper D.O. levels determines the success or failure. Good quality water, optimum D.O. level is of prime importance for health and growth of Shrimp / Fish.

Irregular water exchange, excess and leftout feed, dead algae, fecal matter, increases the organic load at the pond bottom. Accumulation of such waste absorbs available oxygen, creating anaerobic condition which leads to pollution of pond bottom. Polluted pond bottom and unhealthy environmental conditions triggers the release of toxic gasses like Ammonia, H_2S, Methane, etc, The toxicity of Ammonia, Hydrogen Sulphide, Methane attributed mainly due to unionized form. As the concentration in water increases, ammonia excretion by aquatic organism diminishes and the level of ammonia in blood and in other tissues increases. Ammonia increases oxygen consumption by tissues, damage gills and reduces the ability of blood to transport oxygen, and increases the disease susceptibility. To eliminate / overcome the above problems 'GASSEN PLUS' Yucca Schidigera, it contains Steroidal"Saponin" which help to reduce ammonia and other noxious gasses such as H_2S, Methane, etc., Microbial enzyme "Urease' Production inhibited by Saponin which leads to an increases D.O. and reduction of BODand COD levels.

Bacterial strains such as Bacillus Subtilis, Nitrobactor, Nitrasomonas, rapidly converts ammonia into Nitrates, Nitrites and finally non-toxic Nitrogen. Hydrogen Sulphide converts into Sulphates, Sulphites and finally non-toxic Sulphur, Methane into Non-toxic carbon. This conversion reduces the obnoxious gasses in the pond bottom. Reduction of this gasses improve the D.O. level in the water and bottom.

COMPOSITION:
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ALOEVERA
BACILLUS SUBTILIS
BACILLUS POLYMIXA
BACILLUS LICHENIFORMIS
NITRASOMONAS
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STABILIZERS

DOSAGE : 1 Kg per Acre or consult your Aqua Technician For Specific Usage & Dosage

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operators of small and medium sized enterprises (SMEs) will discuss some elements of developing and strengthening aquaculture value chains for SMEs. WISHH will be bringing a group of SME aquaculture operators from Ghana, Nigeria, Tanzania as well as experts from the USA.

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) has also taken up silver sponsorship role to AFRAQ23. GIZ is implementing a *Programme for Sustainable Fisheries and Aquaculture* in nine countries (Zambia, Malawi, Uganda, Madagascar, Mauritania, India, Cambodia, Mozambique and Ghana) and will convene sessions on *Aquaculture Adaptation to Climate Change* and *Education for Aquaculture: Development and implementation of tailor-made training concepts*.

The WorldFish – another silver sponsor, which has various projects in Zambia and other African countries will feature strongly at AFRAQ23 where, in collaboration with state and non-state actors in Zambia they will host a special session entitled '*Thriving Food Systems Through Innovative Financing*'. The Director General of WorldFish, Dr Essam Yassin Mohammed is expected to grace the Opening Ceremony of AFRAQ23.

One of the biggest sessions at AFRAQ23 is on *Aquaculture Finance and Investment*. The Africa Union Development Agency (AUDA-NEPAD) as led by Dr Bernice Mclean (Head of Blue Economy) will once again team up with AquaSpark in hosting the session - building up on momentum, and lessons learnt out of the inaugural and overwhelmingly attended *Finance and Investment session* at the AFRAQ21, Egypt. Various other organisations and institutions such as Grand Fish Feed Ltd, SADC, COMESA, University of Zambia and others will be hosting several other sessions as listed on the program grid.

The WAS African Chapter (WAS-AC) will also take the opportunity to physically launch its *Africa Student Forum* following recent WAS student policy and strategy changes. A number of exciting social networking opportunities will be outlined for African students. WAS-AC will also conduct its inaugural *honors and awards ceremony* during the Opening Ceremony and Annual Business Meeting - where WAS membership and partners and all those interested in the Chapter's activities are invited.

The technical and scientific programme and diverse parallel sessions will be complemented by a major international trade show, while the farmers forums provide an opportunity for producers from around Zambia and Africa to share information on challenges, techniques and new developments. A field trip has been planned to some of the active aquaculture sites in Zambia at Siavonga/ Lake Kariba and around Lusaka.

No doubt, the conference - which will be held at a majestic setting at Mulungushi International Conference Centre, Lusaka will aim to cater to the broad range of interests in aquaculture - providing a learning, information-sharing and networking opportunity for entrepreneurs, business, scientists, technical specialists, educators, students, policy-makers and public officials. There is just something for everyone there!

The conference is hosted by the Government of Zambia through the Ministry of Fisheries and Livestock. Aller Aqua is the Gold sponsor. WISHH, GIZ and World Fish are silver sponsors. Various other session sponsors, collaborators and media partners will be listed in the programme book, which is under finalisation. The draft programme grid and sessions at a glance are available here.

Conference details:
Venue: Mulungushi International Convention Centre (MICC) https://www.micc.co.zm/

Dates: 13-16 November 2023

Registration: Register online here or visit at www.was.org (Aquaculture Africa 2023).

Exhibition and trade show: Register online at www.was.org or contact mario@marevent.com

Issued by: WAS-AC and AFRAQ23 Organising Committee

Media contact: africanchapter@was.org

Mumbai Research Centre of ICAR-CIFT organizes training cum demonstration programme on "Hygiene and Handling Value addition of fish and fishery product" under Scheduled Caste Sub Plan

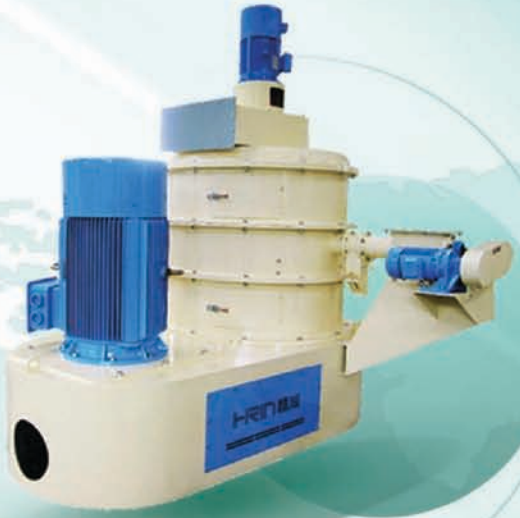
Participants engaged in fillet preparation, Preparation of battered and breaded fish products

Mumbai Research Centre of ICAR-CIFT Organizes three days training cum demonstration programme for the SC community of Maharashtra. The program, entitled "Hygiene and handling Value addition of fish and fishery product", was conducted from 31st October to 2nd November 2023 under Scheduled Caste Sub Plan (SCSP) scheme at Wadkhal, Pen Taluka, Raigad, Maharashtra. The program was initiated and supported by Dr George Ninan, Director, ICAR-CIFT, Kochi, Dr A. Suresh, Principal Scientist and Nodal officer of SCSP, ICAR-CIFT, Kochi and Dr Asha K K, Principal Scientist and (SIC) Scientist in Charge MRC of ICAR-CIFT, Vashi, Navi Mumbai.

Dr Abhay Kumar, Scientist and program coordinator conducted the training cum demonstration program on ''Hygiene and handling Value addition of fish and fishery product''. In this program demonstration how to maintain hygiene during handling the fish cleaning and cutting to make fillet and preparation of different value-added fish products such as fish pickles, fish ball, fish cutlets, fish fingers, and butterfly shrimp etc. The trainees were also given a chance to prepared customized fish products based on the regional preferences of the ingredients. A total of 20 participant from of Wadkhal, Pen Taluka, Raigad, Maharashtra benefited from the program. A training leaflet was distributed on the participant during inauguration function. The participants were from Savitribai phulemahila bacha gud, Ambedkar Nagar, Wadkhal, Pen Taluka, Raigad, Maharashtra groups, and provided processing equipment like Insulated fish bags (Developed by CIFT), Ice boxes, Meat mincer, sealing machine, weighing balance, presser cooker, Gas stove and Mixer etc.) to help them start a small food venture shortly.

Participants with prepared fish pickle, breaded and battered products with processing equipment

Professional Feed Machinery Manufacturer



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Totally enclosed spraying space, Precision & Efficient spraying proportion widely ranged from 2%-30%.

Eco-Labelling and Traceability

Shivani D. Gowda, Pavankumar P. and Dr Ganapathi Naik, M

Department of Aquaculture, College of Fisheries, Mangaluru, Karnataka – 575 002.

Email: shivanidgowda15@gmail.com

Eco-labelling

Ecolabels and related certification schemes are market-based management mechanisms which are designed to influence the purchasing decisions of consumers and the procurement policies of retailers of fish and fish-based products, and to reward producers using responsible fishing practices. They are "seals of approval" given to products that are deemed to have fewer negative impacts on the environment than functionally or competitively similar products and are becoming significant features of international fish trade and marketing.

There are about 400 ecolabels concerning different products in operation in the world, of which nearly 50 are related to fisheries and aquaculture. Though the impact of ecolabels is not uniform across markets, species or product types, their importance has been increasing in the context of ensuring food safety, quality and environmental sustainability.

Global Eco-labelling Network (GEN) defines an ecolabel as "a label which identifies overall environmental performance of a product (i.e., goods or service) within a product category based on life cycle considerations." An ecolabel is a mark, logo, a label or a product endorsement affixed to a seafood product at the point of sale that implies to a purchaser that the product has been produced through ecologically sustainable procedures, and is from a source that is well managed. Ecolabels are normally applied as labels or tags, such as a recognisable logo to a seafood product as a product endorsement at the point of retail sale. Where individual products are small or where they are marketed in a combined or processed pack (such as a canned product), the label may be applied to the pack rather than the individual product itself.

Objectives of Eco-labelling and Certification Schemes

1. Communicate verifiable and accurate information.
2. Encourage demand and supply of eco-friendly products and services.
3. Reduce ecosystem degradation.
4. Stimulate market-driven continuous environmental improvement.

Categories of ecolabels based on the attributes used for certification

- **Single attribute ecolabels** which typically focus on the protection of one single species such as 'Dolphin Safe Tuna' label.

- Resource oriented **multiple attribute ecolabels** that focus on sustaining the reproductive

- Ecolabels guide consumer towards environmental-friendly products.
- Traceability ensures accountability, supports fish farmers and strengthens trust.
- Over 400 ecolabels globally, around 50 are related to fisheries and aquaculture.
- Certification schemes for aquaculture serves as valuable tools to balance economic development, environmental protection and social responsibility, ensuring a sustainable and responsible future for the industry.

capacity of fish stocks by limiting overfishing and adverse effects on marine ecosystem, such as 'MSC ecolabel'.

- **Multiple attribute ecolabels** that focus on environmental aspects in the whole life cycle of the product, such as the Swedish 'KRAV' ecolabel.

Schemes of Eco-labelling

1. **First party labeling schemes:** These are established by individual companies based on their own product standards. The standards might be based on criteria related to specific environmental issues known to informed consumers through the media or advertising. This form of eco-labeling can also be referred to as 'self-declaration.'
2. **Second party labeling schemes:** These are established by industry associations for their members' products. The members elaborate certification criteria, sometimes by drawing upon external expertise from academia and environmental organizations. Verification of compliance the industry, or employment of external certifying companies.
3. **Third party labelling schemes:** These are usually established by a private initiator independent from the producers, distributors and sellers of the labelled products as consumer.

Broad range of Eco-labelling schemes in Aquaculture

a) Scheme promoted by retailers

Several retailers have begun developing standards aimed at sustainable production. In most cases retailers have joined together in formulating the labelling and certification standards as this will reduce cost of auditing and certification.

Currently only a limited number of retailer-promoted labelling schemes are available for aquaculture products. Examples are GLOBALGAP, Safe Quality Food and Carrefour.

b) Schemes promoted by Aquaculture industry

The aquaculture industry has an interest in promoting sustainable aquaculture products in general; better performing practices can serve as a good example for the industry. It is the most organised group of producers who can agree on and establish industry-led labelling schemes. Examples are Global Aquaculture Alliance (GAA), Shrimp Seal of Quality (SSOQ), Siges-Salmon Chile and Scottish Salmon Producers Organisation.

c) Schemes promoted by Governments

Governments in exporting countries have a clear interest in promoting a sustainable aquaculture industry and promoting it among buyers in both national and international markets. In order to mitigate the adverse impact of aquaculture on environment, many governments have adopted Eco-labelling as a means of ensuring sustainable aquaculture. Examples are Thai Quality Shrimp, Vietnam GAP and Hong Kong Accredited Fish Farm Scheme.

d) Schemes promoted by NGOs

Non-Governmental Organisations with interest in conservation, environment, fair-trade etc play a key role in developing labelling schemes for aquaculture industry. Many environmental NGOs like WWF have developed Eco-labelling schemes for aquaculture. It is often mentioned that NGO-established schemes are "truly" third party schemes as there is often less conflict of interest. Examples are Aquaculture Stewardship Council (ASC), Aquaculture Certification Council (ASC), Marine Aquarium Council (MAC) and International Organisation for Standardisation (ISO).

Important Aquaculture Certification Schemes

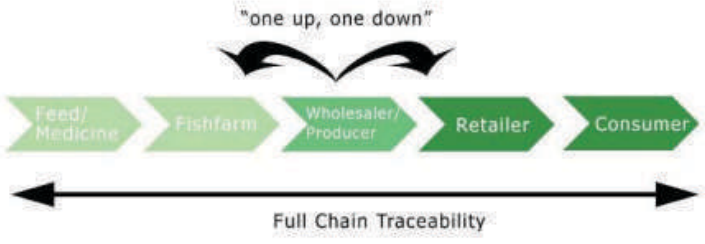
Sl. No	Schemes	Program	Logo
1.	Global Aquaculture Alliance (GAA)	First voluntary Best Aquaculture Practices (BAP) standards.	
2.	GLOBAL GAP	Established in 1997 by Euro-Retailer Producers Working Group (EUREP).	

3.	Aquaculture Stewardship Council (ASC)	Co-founded by WWF and Dutch Sustainable Trade Initiative (IDH) in 2009.	
4.	Friend of the Sea (FoS)	Italy-based fisheries and aquaculture certification scheme.	
5.	Naturland (Germany)	Pioneering standard organisations in the field of organic aquaculture development.	
6.	Bio Suisse (Switzerland)	Guidelines for organic aquaculture (trout-2001)	
7.	Debio (Norway)	Performs auditing and certification assignments of organic production	

Traceability

Traceability is the ability to trace the origin of a product at any step of the supply chain, in order to ensure food safety, support sustainable fish farms and fisheries and to fight illegal activities and fraud. As a result of the complex, globalized supply chains and the many different species in aquaculture, it becomes increasingly difficult to ensure traceability.

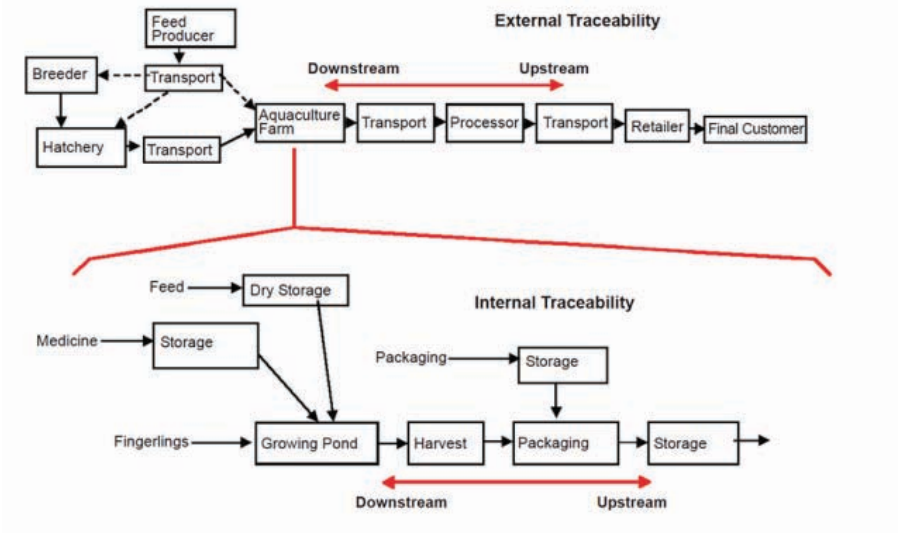
In a nutshell, traceability is the ability to systematically identify a unit of production, track its location and describe any treatments or transformations at all stages of production, processing and distribution. According to the International Organization of Standardization (ISO), traceability can also be defined as the ability to trace the history, applications, or location of that which is under consideration.



Types of traceability

a. Internal traceability systems allow one to trace what happens to a product within a business' operation. This type of record keeping is already legally required throughout the seafood industry, as it is essential for keeping track of inventory, purchasing and other in-house accounting.

b. **External traceability systems** enable one to trace what happens to a product through all parts of the supply chain, or part of the supply chain outside of one business entity. It requires more complex information-sharing systems, and allows one to trace what happens to a product through all parts of the supply chain, or part of the supply chain outside of one business entity.



Systems of traceability

1. Paper traceability

The simplest traceability system is what is traditionally known as a paper trail. Using paper traceability, written data follows the product through the supply chain. These pieces of information are often stored on shipping receipts, import/export permits or product invoices. Using paper traceability may be inexpensive and feasible for small businesses with a limited product line and a large amount of storage space. However, as businesses become larger, handle more products and engage with trading partners along a longer supply chain, paper systems can become unwieldy and unreliable.

2. Electronic traceability

These systems allow product data to be managed using computers. Large amounts of information can be stored, managed, and even traded through an electronic network, often making use of multiple databases. Electronic record keeping is advantageous for many businesses; accounts are precise, quickly accessible, and require little space. Seafood companies that are interested in full external traceability will likely require the sophistication provided by computerized systems. Electronic traceability can be achieved using several different tools. Most are either web-based or module-based.

a. Web-based systems

These store information on databases that are accessed via the internet. In this way, information can be uploaded, downloaded and queried remotely by authorized partners along the supply chain. Web-based systems offer a practical and efficient method for recording and quickly accessing traceability information from all parts of the supply chain. Web-based traceability systems can be relatively cost-effective. Expenses usually include an installation fee, a subscription fee or a per-unit or per-record fee.

b. Module-based systems

For this system specialized software must be installed in computer networks at various. Module-based systems can also often interact with web-based traceability systems. Modules may allow companies tight control over their traceability information, but installation and upkeep can be costly, especially if new software and/or hardware must be installed over a lengthy supply chain.

Tools for traceability

Three crucial tools for full external traceability include identifiers, carriers and readers.

a. **Identifiers** are codes that can be scanned through a reading device. These codes allow data to be registered, encrypted and stored in a centre. GS1 standards are the most widely used product identifier standards for food products. While individual companies may also produce proprietary identifiers, these are usually useful only for internal traceability.

b. **Carriers** are the physical tags that hold the identifier data. These tags may take the form of a bar code or a Radio Frequency Identification tag (RFID). Bar codes have been widely used in the food industry since the 1970s, and are familiar to most people as a small digital image of lines and spaces affixed to retail items, identification cards and mail. RFID technology is a way for retailers to identify items using radio waves.

Bar Code

RFID

c. Readers are either stationary (e.g., installed at a loading dock) or hand-held devices used to record and interpret the information stored on carriers and register products.

Problems with low traceability

i. Mislabelling
ii. Illegal practices
iii. Lower consumer trust

Benefits of high traceability

i. Food safety
ii. Sustainability
iii. Transparency

In conclusion, ecolabeling and traceability play pivotal roles in promoting sustainability, transparency and informed consumer choices within various industries. Ecolabels provide a straightforward way for consumers to identify environmentally-friendly products and encourage businesses to adopt more sustainable practices. They empower consumers to align their purchasing

decisions with their values, fostering a demand for greener options and ultimately driving positive change across supply chains.

Traceability, on the other hand, ensures accountability and integrity in supply chains by enabling the tracking of products from their origin to the consumer's hands. This not only aids in verifying the accuracy of eco-friendly claims but also helps prevent environmental degradation, unethical practices and human rights abuses. The implementation of traceability systems strengthens consumer trust, reinforces corporate social responsibility and stimulates innovation for more sustainable production processes. By doing so, we can contribute to a more environmentally conscious and ethically responsible world, where products and their origins are easily traceable and sustainable choices become the norm rather than the exception.

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Why Thai mangur debarred in Bihar ?

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The walking catfish (*Clarius gariepinus*is) a species of freshwater is a 3 to 5 foot long air-breathing catfish native to Southeast Asia. It is named for its ability to walk and wiggle across dry land, to find food or suitable environments. This fish normally lives in slow -moving and often stagnant waters in ponds, swamps, streams and rivers, as well was in flooded rice paddies or temporary pools that may dry-up. This fish need to be handled carefully when fishing it due to its embedded sting or thornlike defensive mechanisms hidden behinds its fins.

- Molecular markers will play a major role in bringing out quality and sustainability to aquaculture.
- Molecular markers have wide range of applications in aquaculture mainly; in genetic identification and discrimination of hatchery stocks, finding out inbreeding events, assignment of progeny to parents using genetic tags.
- To finding out quantitative trait loci, marker assisted selection for selective breeding trials and assessment of the effect of polyploidy induction and gynogenesis.

Within Asia, this species has been introduced widely. It has also been introduced outside its native range where it is considered as invasive species. It consumes the food supplies of native fish and preys on their young. It is also regarded as an invasive species because they can destroy fish farm. It is a common inexpensive food item prepared in a variety of ways. It is offered by street vendors, especially grilled or fried.

Magur contains different nutritional elements such as moisture 78.25%, carbohydrates 5.53%, fat 1.06%, protein 14.15%, and ash 1.42%. Magur fish is gaining popularity among growers. Method of culture is easy. It can be grown in an adverse environment such as fewer levels of oxygen and high-water temperature. It can survive in polluted water as well. Despite a good nutritional value the fish has banned in many countries. These omnivorous magur fish prey on every single aquatic species. Not all species of magur are not equally invasive but the African catfish and Thai magur are banned in many countries because of their extremely invasive nature. Magur fish is banned in India since 2000 after several harmful impacts on indigenous fish is reported.

Why was the Thai Magur fish banned ?

Culture of prohibited exotic "thai magur" continues evicted onto the Indian platter despite a ban by the national green tribunal. The presence of these species in any water body destroys its ecological balances. It is a cannibal species that impacts the indigenous biodiversity and in turn reduces the food bases for aquatic birds. It is also believed to be carcinogenic. Thai Magur are fed rotten meat with spinach which pollutes the water bodies and carries diseases like Argulosis, commonly known as fish lice. Its consumption can increase chances of cancer. Its flesh contains 80% iron and lead that causes several serious diseases. It also contains heavy metals such as arsenic, cadmium, chromium, mercury, that causes heart related problems etc.

Why is Thai Magur still in Market ?

The growth rate of Thai magur is very high, yeilding high returns for breeders in a short time. If a local variety gains 300gm in six months, a Thai Magur grows up to a Kg within the same time. Further Input cost of breeding carp in a 1-hectare pond can be between Rs. 1.5 lak and Rs. 2 lakh in a year If a breeder switch to Thai Mahur, the yield can double because it is fast-breeding species. The fish can grow even in muddy water between the rains. Its grow 3-5 feet weigh 3-4 kg within 2-3 months. These characteristics make the cultivation of the fish easy, highly profitable and economical for farming.

In Motihari district of Bihar fisheries officer punished those sellers who sales this species in market for 6 months jail or fine with 500 ₹. In-spite, of several legal measures and bars, the species is being cultivated illegally and its sales are popularly mainly for its surviving capabilities. They are being cultivated in unhygienic condition and have enough potential to make people sick their breeding centers being destroyed.

Pharmaceutical Potentials of Marine Biopeptides and their Mechanism of action on Bacteria, Virus and Cancer cells

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Abstract

Bioactive substances with the potential for use in industry and nutraceuticals can be abundant in marine bioresources. New mechanisms of action have been discovered due to several clinical trials testing new chemotherapeutic drugs originating from marine sources. It is well known that a variety of cyclic peptides and their analogues produced from marine sources have biological characteristics such as anticancer, antitumor, antibacterial, antifungal, antiparasitic, anti-inflammation, anti-proliferative, anti-hypertensive, cytotoxic, and antibiotic activities. These substances, such as cyclic oligopeptides, cyclic lipopeptides, cyclic glycopeptides, and cyclic depsipeptides, exhibit various activities and modes of action depending on their structural constitution. Dolastatins, soblidotin, didemnin B, aplidine, salinosporamide A, kahalalide F, and bryostatin 1 are now undergoing clinical studies and have recently reported improvements in the use of the aforesaid cyclic peptides. These cyclic peptides are potential new medications found and synthesized from marine sources.

Introduction

Recently, the multiple positive benefits of bioactive peptides produced from marine sources have

- Peptides derived from marine resources have good potential nutraceutical and pharmaceutical properties.
- Marine biopeptides showed good antibacterial, antifungal, antiviral and anticancer activity.
- Marine peptides are highly selective to their targets, have a wide range of therapeutic effects, and have a low deposition rate in body tissues.
- Biopeptides can be utilized as excipients in therapeutic formulations to alter biological activity, target delivery, or transport across cellular membranes in addition to being employed as active components.
- The development of medicines from bioactive peptides is a novel technique, and it is a new milestone in the pharma industry.

received attention. Additionally, several studies have found that marine peptides have a range of anti-infective properties, including antimicrobial, antifungal, antimalarial, antiprotozoal, anti-tuberculosis, and antiviral properties (Lee et al., 2017; Kang et al., 2015). Numerous structurally varied and bioactive secondary metabolites have been discovered during the last few decades from marine plants, animals, and microorganisms research. However, many infectious disorders brought on by bacteria, fungi, and viruses have few effective therapies. Therefore, it is important to continue finding new antimicrobial peptides and to consider all potential alternatives. There is an abundant supply of bioactive natural compounds in the marine environment, many of which have different structural or chemical properties from those found on terrestrial. Bioactive substances are abundant in marine creatures. Recent discoveries of novel metabolites from marine species have tremendous biological effects. These findings might result in novel pharmacological drugs derived from marine metabolites (Lee et al., 2017). Cyclic peptides are one of the understudied types of bioactive peptides with a marine origin that shows significant promise in the pharmaceutical industry (Kang et al., 2015).

The oceans can significantly assist in identifying prospective medicinal agents, which comprise more than 70% of the earth's surface. Several substances discovered in marine creatures during the past few decades have promising pharmaceutical properties (Kang et al., 2015). Therefore, it is believed that marine species might be a source of important and innovative physiologically active compounds for the formulation of therapeutics. Marine peptides have drawn much interest because they might improve health and prevent illness (Lee et al., 2017). Marine peptides are particular protein fragments that serve as sources of nitrogen and amino acids and have a wide range of possible pharmacological uses. These peptides are derived from marine bacteria, fungi, fish, mollusks, crustaceans, crabs, algae, and fish. Based on their structural characteristics, amino acid content, and patterns, bioactive marine peptides have been demonstrated to exhibit a range of bioactivities, including anti-tumor, antiviral, anticoagulant, antioxidant, immunoinflammatory effects, and other therapeutic capabilities (Kang et al., 2015).

Antibacterial, antiviral and anticancer activity of peptides and their mechanisms

The marine sponge Discodermia kiiensis provided discodermin A, which was later expanded to include B-D variations. These tetradecapeptides prevent the growth of starfish embryos. Additionally, the methanolic extract of these species demonstrated notable antifungal and antibacterial action. Additional research on discodermin A revealed that it is linked to the permeabilization of plasma membranes, most likely as a result of having six consecutive hydrophobic amino acids at the N-terminal in contrast to other known peptides with the same action. Furthermore, discodermins F through H are cytotoxic to vascular smooth muscle cells and have antimicrobial, antifungal, and antibacterial activities. Vancomycin was subjected to an antibacterial experiment by Kumar et al. (2014), and they discovered that this intracellular metabolite had a stronger antimicrobial impact on the development of gram-positive bacteria (Lee et al., 2017).

S. aureus, S. typhi, P. aeruginosa, and *T. rubrum* were all susceptible to vancomycin, and the inhibition zones for each had diameters of 25, 21, 18, 11, and 15, respectively. Vancomycin also demonstrated antifungal action against *T. rubrum* and *A. niger,* with inhibition zones of 14 mm in diameter (12 mm inhibition zone) (Zhang et al., 2012). Currently, infections caused by gram-positive bacteria are treated with vancomycin, a glycopeptide antibiotic. It is also a great choice for treating bacteria that are resistant to a variety of antibiotic compounds. Vancomycin's

N-19 terminus binds to the D-alanine-D-alanine residues of the UDP-N-acetylmuramyl pentapeptide at the Cterminus, which is the peptidoglycan precursor found at the outside of the cytoplasmic membrane in bacteria. This binding serves as the scaffold for the antibiotic's activity. Vancomycin primarily prevents peptidoglycan precursors from being attached to the peptidoglycan chain by inhibiting the transglycosylase enzyme. This glycosylation process prevents the formation of cell walls.

Sun et al. (2011) investigated the in vitro antibacterial effects of fijimycins A-C against three MRSA strains of *Staphylococcus aureus*. According to the findings, etamycin A, fijimycin A, and fijimycin C all showed potent antibacterial activity against all tested MRSA strains at concentrations of 4-32 g/mL, however, fijimycin B only moderately reduced the growth. This suggests that the fijimycin group's -phenylsarcosine molecule may be crucial to the antibacterial action. An investigation comparing the antibacterial activity of the stereoisomers fijimycin A and etamycin A revealed that the replacement of D- for L—phenylsarcosine had no impact on enhanced anti-MRSA activities.

Certain cyclic peptides produced by marine creatures also have antiviral properties. The cyclic peptides papuamides A and B obtained from sponges of the genus Theonella inhibited infection of human T-lymphoblastoid cells with an EC50 of around 4 ng/ml. Numerous anti-HIV medications now on the market target HIV reverse transcriptase or protease and have negative side effects such as toxicity and treatment resistance. Until the medication wears off or the virus undergoes rapid mutation, the virus may remain dormant in memory T cells. It is crucial to note that papuamide A prevents viral entrance in order to function. Papuamide A exerts direct control over the virus without affecting important envelope glycoproteins like CD4 or HIV gp120 (Kang et al., 2015). Papuamide A prevents the spread of viruses during an early stage of the viral life cycle. The viral membrane's phosphatidylserine is the target of papauamide B, which prevents the entrance of viruses. Papuamides C and D are less effective than A and B for preventing HIV entrance. *Theonella swinhoei* and *Theonella mirabilis*, both from Papua New Guinea, generate papuamides A through C. Separate research found that the marine sponge *Melophlus sppapuamide* C-F from butanol extract was lethal to brine shrimp, with LD50 values ranging from 92 to 106 g/mL. Microspinosamide, an additional cyclic depsipeptide from the sponge Sidonops microspinosa, reduced the cytopathic effects of HIV-1 infection in an XTT-based in vitro experiment.

Discobahamins A and B isolated from Theonella sp. exhibited limited antifungal efficacy against Candida albicans yeast growth. These cyclic peptides share structural similarities with keramamides B–D and orbiculamide A, Hymenamides A and B shown antifungal activity against Cryptococcus neoformans and Candida albicans, respectively. Zhang et al. (2012) used the CLSI broth microdilution technique and amphotericin B as a positive control to examine the antifungal activity of microsclerodermins J, K, A, and B against *C. albicans, A. fumigatus,* and *C. neoformans*. Compared to microsclerodermins A and B, microsclerodermins J and K are less effective.

The four substances are effective antifungal agents in immunocompromised hosts. In another study, microsclerodermin A had an inhibitory impact on nuclear factor kappa B and promoted apoptosis in pancreatic cancer cells by lowering chronic inflammation mediated by NF kB. When tested against Candida glabrata, lobocyclamides B and C demonstrated poor antifungal efficacy with a 6 mm zone of inhibition and 8 mm zone of inhibition, respectively. Interestingly, a combination of lobocyclamides A and B (1:1) showed notable synergism and had greater action (MIC 10–30 g/mL) than the individual compounds [30]. It is assumed that the macrocyclic structure of the methyl ester from halicylindramide B is essential for its cytotoxic and antifungal effects because it demonstrated little cytotoxicity and only minimal antifungal activity. Halicylindramide D exhibited antifungal action against *Mortierella ramanniana* and cytotoxic activity targeting P388 murine leukemia cells, according to subsequent research on the halicylindramides D and E isolated from *Halichondria cylindrata* (Kang et al., 2015).

Marine peptides under in clinical trials

There are various instances of recent developments in the use of the aforementioned technologies to find and create innovative marine-derived pharmaceuticals. Vancomycin is one antibiotic, for instance, that is used to treat a variety of bacterial illnesses. There are now clinical studies for other cyclic peptides. On tumor cell lines, dolastatins had strong apoptotic and growth-inhibiting effects. Phase I and II clinical trials using dolastatins were unsuccessful due to their insufficient ability to treat prostate cancer. Dolastatin 10, a cyclic peptide from the dolastatin family, provided a better starting place for future clinical research and synthetic therapeutic production. Dolastatins 10 and 23 stop cells from progressing through the metaphase by inhibiting the microtubules. They also trigger apoptosis by phosphorylating Bcl-2, a known death receptor (Kang et al., 2015).

Under the direction of the NCI, didemnin B was examined in preclinical and clinical studies (phase I and phase II) against a range of human malignancies, such as renal cell carcinoma, epithelial ovarian cancer, breast cancer, small cell lung cancer, myeloma, and lymphoma. The eukaryotic translation elongation factor (eEF1A), involved in protein synthesis, is the chemical target

of didemnin B. It is the first known chemical substance directly derived from a marine source and has entered clinical studies. Trials were unsuccessful due to significant side effects, and clinical research was discontinued to create a didemnin B counterpart with more potent anticancer efficacy (Kang et al., 2015).

Phase II investigations are now being conducted, and aploidine (plitidepsin) is well tolerated in clinical trials with little toxicity. Aplidine's mode of action includes early oxidative stress induction, cell cycle arrest, and antiangiogenic activity. Aplidine was evaluated in phase II clinical study to treat advanced renal cell carcinoma, advanced small cell lung cancer, and advanced medullary thyroid carcinoma. The findings demonstrated that aplidine's anticancer impact in those experiments was quite limited. Aplidine and dexamethasone are being tested in phase III clinical study for multiple myeloma that has relapsed or become resistant to treatment (Kang et al., 2015).

Salinosporamide A went into phase I clinical trials for multiple myeloma three years after it was discovered. Intense academic and industry research has attracted salinosporamide A due to its proteasome inhibitory function, which contains substantial biological activity and a very intriguing structure (Zhang et al., 2012). Salinosporamide A has recently undergone more than 10 syntheses to clarify its structure-activity connections and oncological origins. Salinosporamide A is a successful example of contemporary drug discovery since it was produced and biosynthesized using all available research methods in pharmacology, medicinal chemistry, and natural product chemistry (Lee et al., 2017).

In phase I studies, patients with malignant melanoma, lymphoma, and ovarian cancer demonstrated antitumor activity for bryostatin 1, one of the bryostatin family's most prevalent and well-studied chemicals. The activation of protein kinase C, which causes the differentiation of many cancer cell lineages, is linked to bryostatin 1's antitumor effect. A large phase II clinical study is now evaluating bryostatin 1. However, it manifested certain adverse effects in the earliest clinical trials, including myalgia, local phlebitis, tiredness, nausea, and thrombocytopenia. In advanced solid tumours such as renal cell carcinoma, non-small-cell lung cancer, and malignant melanoma, bryostatin 1 did not exhibit any discernible objective anticancer action, while being thought to promote cell differentiation in individuals with refractory chronic lymphocytic leukemia (Lee et al., 2017).

Conclusion

Pharmacologically active natural products can be found in abundance in marine species. Over the past 50 years, there has been a significant development in our understanding of the chemistry of marine natural products. The use of marine cyclic peptides in biological research on particular targets is advantageous and encouraging. Cyclic peptides from various marine species have various chemical compositions and pharmacological characteristics. Recent therapeutics for many cancers and disorders have benefited tremendously from discovering and developing marine cyclic peptides and their derivatives (Kang et al., 2015). Many of these substances are now utilized in therapeutic settings. Marine peptides have intrinsic activity and the capacity to prevent infection, despite being largely unexplored. Marine peptides are extremely selective to their targets, have a wide range of therapeutic effects, and have a low deposition rate in body tissues. Peptides derived from marine sources also have a lower likelihood of unintended negative side effects. Marine peptides are often harmless and non-toxic since they are made of metabolically acceptable amino acids. Marine peptides can be utilized as excipients in therapeutic formulations to alter biological activity, target delivery, or transport across cellular membranes and be employed as active components. Comprehensive research on anti-infective peptides will help develop new pharmaceuticals. Marine peptides are a rich source of bioactive chemicals that may be used for pharmaceutical industry research and development.

Acknowledgment

A Special thanks to Fisheries College and Research Institute, Tamil Nadu Fisheries University, Thoothukudi, for providing the necessary facilities to prepare this article

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Microplastics in Aquatic Ecosystems: A New Ecological Niche of Microbes

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- Microplastics are small plastic pieces less than five millimeters (1 µm to 5 mm) long which can be harmful to aquatic life.
- Durability of plastics allows the biofilm to function as an artificial "microbial reef" compared to other floating objects.
- Biofilm formation can be more specifically a location-specific process than substrate-specific.
- Plasmidomes in MP-biofilm play a dynamic role in horizontal gene transfer.
- MP-biofilm assemblages resulting from EPS ultimately act as hotspots.

1. Introduction

In the present scenario, microplastics are a concern of major environmental issue because of their acute to chronic toxicity towards aquatic organisms, human health, and their association with harmful microbiota. Microplastics (1 µm to 5 mm) in the environment are classified mainly as "primary" or "secondary" based on their original size (Germanov et al. 2018). However, most of the primary microplastics are directly synthesized and used in personal care products such as toothpaste and other cosmetics contributing directly to microplastic pollution (Zhang et al. 2018). Secondary microplastics are derived by the breakdown of macroplastics (> 2.5 cm) or mesoplastics (5 mm–2.5 cm) by various biotic factors like microbial composition and abiotic factors such as sunlight (photodegradation), weathering (mechanical breakup), erosion, and water activity (Akdogan and Guven. 2019; Cole et al. 2011; Ganesh et al. 2020; Law 2017; Sharma and Chatterjee 2017; Worm et al. 2017). Regardless of their origin, microplastics are now found globally in almost all environments. They are accumulating at a faster rate in aquatic environments, such as lakes and rivers, which act as "plastics reservoirs" from their watershed sources (Koelmans et al. 2019; Zhang et al. 2018). These can even accumulate in fish and shellfish growing in such waters and can cause severe health risks to humans when these fish and shellfish are consumed.

Microplastics simply do not exist as inert surfaces in the nutrient-poor water body but can also adsorb nutrients and organic matter from the water body which can provide a suitable substratum for microbial biofilm formation on their surfaces. These Microplastic biofilms can therefore be regarded as a new microbial niche in the environment,

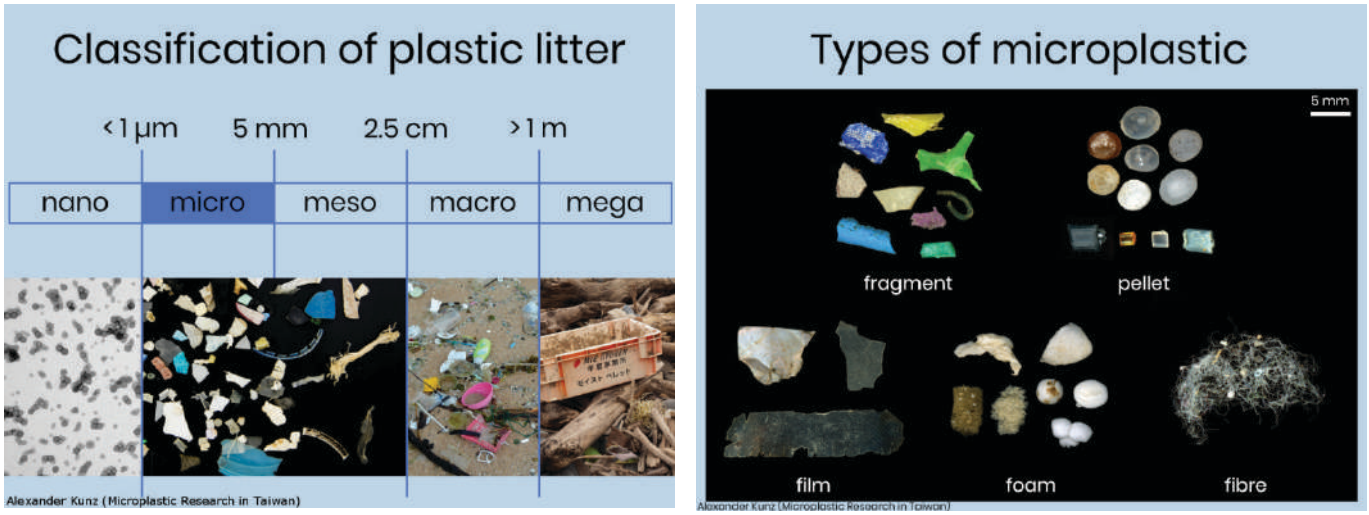

Figure 1: Classification and various types of Microplastics in Aquatic Environment (Image Source: https://microplasticresearch.wordpress.com/what-is-microplastic/

particularly in pelagic waters (Arias-Andres et al. 2018a; Arias- Andres et al. 2019; Dussud et al. 2018; Frere et al. 2018; Galloway et al. 2017; Kettner et al. 2019; Kettner et al. 2017). This article aims to underline the new ecological niche of microbes associated with microplastics in aquatic environments pertaining to highlighting the formation of microbial biofilms, community composition, function and ecological roles.

2. Biofilms Formation on Microplastics: Plastisphere

MPs are less dense than a piece of wood which makes them more buoyant in water. The release of MPs into the water bodies will result in the long-range transport of MPs leading to the global distribution and contamination of remote areas. In addition, MPs also serve as a vector for microbes and facilitate the transport of algal species and bacterial assemblages (assemblages of bacterial species with archaeal and pico-eukaryotic microorganisms) from one place to another in the aquatic environment **(**Allouzi et al. 2021**).** Plastic debris of macro- or micro-size scale is biofouled by various autotrophic and heterotrophic microorganisms including bacteria, fungi, unicellular algae and other multicellular macro-organisms. The abundance of plastics in marine and fresh-waters of various size fragments provides a substrate for aquatic microbes to attach and colonize, forming a biofilm that is a **syntrophic consortium** of microorganisms sticking to the plastic surface (Arias-Andres et al. 2019). The simulated ecosystem of microbial biofilms encompassing the plastic surface is termed the **'plastisphere,'** which was originally used to describe the life on MPs collected from the subtropical gyre in the North Atlantic Ocean (Arias-Andres et al. 2019). Microbial communities, including bacterial and fungal species covered with a matrix of extracellular polymeric substances (EPS) produced by the microbes, form a 'biofilm' **(**Atugoda et al. 2021**).** The durability of plastics allows the biofilm to function as an artificial "microbial reef" compared to other floating objects in the aquatic ecosystem (Bayo et al. 2020**).** Biofilms consist of different microorganisms co-inhabiting and benefiting from each other as symbionts. MPs not only provide surfaces for biofilm formation but also release dissolved organic carbon (DOC) from the slowly decomposing polymers into the surrounding waters, which enhances the growth and activity of the heterotrophic microorganisms in the plastisphere (Bradney et al. 2019). MPs in aquatic

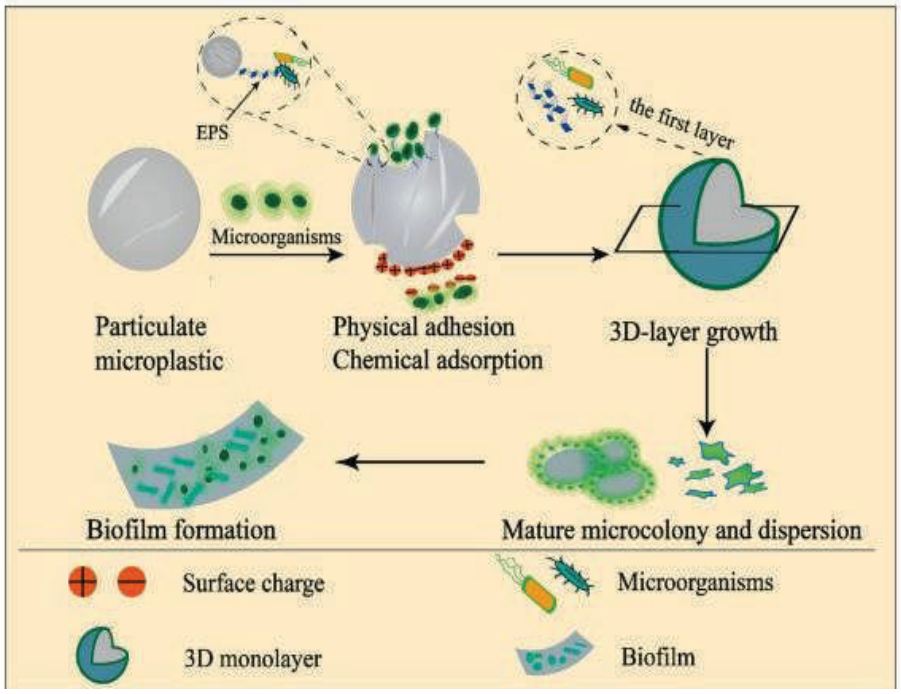

Figure 2: Formation of Biofilm over Microplastic (Source: Sooriyakumar et al., 2022)

environments can act as localized hot spots for microbial activity, specifically in marine ecosystems and can influence global biogeochemical carbon dynamics (Bryant et al. 2016).

3. Biofilm-formation and factors influencing the process

The solid surface of plastic debris can provide a suitable substratum for sessile organisms including environmental and microbial colonizers. Microbes associated with the plastisphere include various microbial groups with diverse physical and chemical properties that are characteristic of sessile, free-living consortia of microbes (Mammo et al. 2020). Any type of biofilm formation and its development is specific to the location, time and substrate (Fig. 2).

The formation and development of the microbial community structure of microplastic biofilms to a large extent depend on "location-specific", "time-specific" and "substrate-specific" characteristics. Biofilm formation can be more specifically a location-specific process than substrate-specific (Frere et al. 2018; Harrison et al. 2018). During the early development of biofilm, the microbial cell size, abundance, and carbon biomass can fluctuate but these parameters are stabilized in mature biofilms (Hossain et al. 2019). Microbial interactions with MP particles can be either active or passive. In the case of active interaction, MPs are utilized as a carbon source by the microorganisms.

Microbial growth and community composition of the plastisphere depend on various factors, such as MP characteristics (e.g., polymer type, morphology), temporal conditions (e.g., succession) and environmental conditions. Among all these factors, the polymer type is extensively studied and also there is a significant role of surface roughness and hydrophobicity of MP particles which can influence the microbial community structure. The highest microbial community composition was observed in aged MPs due to the high surface area, roughness and polarity of the particles (Rai et al. 2021). Other factors like the shape and size of plastic have no critical influence on microbial structure and composition. EPS plays a vital role in the formation of hetero-aggregates in the plastisphere with other natural particles like clays and particulate organic matter in the aquatic environment.

4. Microbial communities of microplastic biofilms

Microbial community composition represents mainly bacteria, fungi and other microscopic organisms. Among all these communities microbial pathogens are gaining more attention because certain microplastic biofilms exhibit selective enrichment of certain bacterial pathogens. For example, *Vibrio sp*. was more abundant in microplastic biofilms than in natural seston (Frere et al. 2018; Kesy et al. 2019), while common human intestinal pathogens, e.g. *Arcobacter sp*. were also enriched in microplastic biofilms (McCormick et al. 2016). Plant pathogens, e.g. *Agrobacterium sp.;* nosocomial pathogens, e.g. *Chryseobacterium sp*.; and fish pathogens, e.g. *Flavobacterium sp.* were found to be abundant in low-density polyethylene (LDPE) microplastic biofilms (Gong et al. 2019). In addition, two opportunistic human pathogens (*Pseudomonas monteilii* and *P. mendocina*) and one plant pathogen (*P. syringae*) were exclusively found in microplastic biofilms (Wu et al. 2019). Although other fungal and eukaryotic pathogens can also be enriched indicating the potential of MPs to select for and enrich both pathogenic prokaryotic and eukaryotic microbes. In one study, pennate diatoms and *Bacillus sp*. were the most abundant members of the microbial community on marine microplastics, followed by coccoid bacteria, centric diatoms, and dinoflagellates (Carson et al. 2013). In contrast, another study found that cyanobacteria were the main photoautotrophic microorganisms in marine plastics biofilms.

(Oberbeckmann et al. 2014). Stramenopiles dominated polystyrene and polyethylene terephthalate biofilms. Viridiplantaea and Stramenopiles were the main eukaryotic taxa-dominated polyethylene biofilms (Debroas et al. 2017). Ascomycota and Basidiomycota were the main fungal groups on plastic debris from the North Sea and the Baltic Sea (De Tender et al. 2017). Fungal filaments and spores were also found on microplastic biofilms formed in sediments of the Vitória Bay estuarine system (Neto et al. 2019). Such studies indicate that microplastic biofilms offer a unique and novel niche for aquatic microbes with potential consequences for aquatic food webs, biogeochemical processes and animal and plant pathogenicity.

5. Genomics of Plastisphere

MPs provide unwavering support for unique microbial communities and antibiotic resistance genes (ARGs), which was established by Wu et al. (2019) using 16S rRNA gene sequencing and network analysis. MP-biofilm organization displays a unique feature in which plasmids, called plasmidomes, play a dynamic role in horizontal gene transfer (Rai et al. 2021). Microorganisms colonizing the MP surface have high rates of genetic exchange (Wright et al. 2020), resulting in genetic mutation and high microbial diversity (Roager and Sonnenschein. 2019). A higher rise in the horizontal gene transfer rate of ARGs was observed on biofilm MP-linked microbial assemblages in comparison to free-living microbes (Arias-Andres et al. 2018).

6. Functions and ecological role of microbial communities

One of the potential functions of microbial communities on microplastics is the degradation of plastic polymers. It is proposed that *Alteromonadaceae* and *Burkholderiales* in poly 3- hydroxybutyrate-co-3-hydroxyhexanoate (PHBH) biofilms are the major groups of bacteria capable of degrading PHBH (Morohoshi et al. 2018a; Morohoshi et al. 2018b). In addition, *Erythrobacter spp*. in microplastic biofilms can also degrade hydrocarbons (Curren and Leong 2019), while *Alcanivorax borkumensis* growing in microplastic biofilms plays a key role in low-density

polyethylene(LDPE) degradation (Delacuvellerie et al. 2019). Metabolic pathway analysis shows that microorganisms embedded in microplastic biofilms have lower "cell motility", but greater "xenobiotic biodegradation and metabolism" potential (Jiang et al. 2018). From an ecological point of view, microplastic biofilms are the aggregation of multiple microbes, and the biofilm mode of growth is generally resistant to adverse environmental conditions such as UV rays, excess heat, and drying or toxic metals. The antibiotic and metal-resistance genes in microplastic biofilms are comparatively higher in abundance than in the water body, indicating that the microplastics could provide a repository for antibiotic- and toxic metal– resistant microorganisms (Yang et al. 2019). Thus, microbial interactions in the plastisphere have an effect on biogeochemical cycles and food web dynamics in aquatic ecosystems.

7. Toxic effect of MPs on aquatic organisms

Plastic-related contaminants may have harmful effects because of the physical stress brought on by the direct attachment of plastic particles to cells, such as adsorption, or indirectly by the release of chemicals connected to plastic (Rummel et al. 2017). According to Zhang et al. (2017), exposure to MP polyvinyl chloride decreased *Skeletonema costatum* growth, chlorophyll content, and photosynthetic efficiency, providing proof of the harmful effects of MPs on marine microalgae. MP toxicity varies with plastisphere size (Wang et al. 2021a). Artemia franciscana, a brine shrimp, died after 14 days of exposure to seawater due to the formation of nano-sized aggregates in amino-modified polystyrene nano-plastics, while Dunaliella tertiolecta's growth was hampered. Similar to this, it caused brine shrimp exposed to amino-modified polystyrene nano plastics to activate an apoptotic pathway. On the other hand, according to the same study, the toxicity of the plastic for brine shrimps and microalgae was lowered by carboxyl-modified polystyrene nano-plastics with micro-sized aggregates (Bergami et al. 2017). Similar findings were reported by Zhang et al. (2017), supporting the idea that MP toxicity is influenced by the size of the MP. The MP surface area, which can change due to weathering, facilitates the leaching of contaminants and promotes the adsorption of pollutants (Bolan et al. 2020). In low- density biofilm formation, MP fragments remain on the water surface for prolonged durations. The zooplanktons, filter feeders, and planktivorous creatures are all severely adversely affected by these suspended particles (Li et al. 2019). On the other hand, the production of high-density biofilms would lead to the sedimentation of MPs, which has harmful consequences for the creatures that live on deep seabeds. With the ability of sinking MP aggregates to adsorb toxic pollutants, a detoxification effect is produced for organisms residing on the surface waters but the toxic effect is transferred to the benthic organisms (Zhang et al. 2017).

Conclusion

The use of plastics cannot be completely suggested to avoid in our daily lives in the present scenario but we should manage their use, disposal, and treatment as they are persistent in the environment causing pollution. Microplastics in both terrestrial and aquatic environments serves as host for various group of microbes. The hydrophobic property of microplastic fragments supports the growth of microbes that can form biofilms. Microplastic characteristics and environmental conditions affect the microbial composition of biofilms. In a biofilm, the association between MPs and microbial communities can influence the environmental impacts of plastic fragments. Microbial habitation on microplastics facilitates the degradation of MPs and the release of DOC into the surrounding waters. The microbe-microbe and microbe-substrate interactions have a potential impact on the biogeochemical cycles and food web dynamics in the ecosystems. Therefore, these points confirm that microplastic biofilms as a new microbial niche in the environment have a positive impact on the environment through the degradation of microplastics which in turn influences global biogeochemical carbon dynamics and have some toxic effects on aquatic organisms to a certain extent.

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***More references can be provided on request**

Postal Regn. No. HD/1068/2021-2023
Published on 7 December 2023