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Inside...

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CLFMA & other bodies of the industry should work to promote production of Soya, Maize and other Grains in India

Dietary supplementation of organic acids and their salts as growth promoter has been proven in animal feed and well documented. Aqua feed sector has equally benefitted with this novel additive though it was lately introduced. However, unlike animal feed, the use of acidifier in aqua feed needs a different approach due to diversified feeding habit and wide variation in structure of the digestive system and physiological function. Dietary organic acids can stimulate secretion of pancreatic enzymes, lower gastric pH, inhibit pathogens, act as a source of energy, improve mineral utilization and enhance nutrient digestibility, which could lead to enhanced growth performance of shrimp.

Dear Readers,

The June 2024 issue of Aqua International is in your hands. In the news section you may find news about ...

Indian Aquaculture industry is facing the issue of high feed cost due to increase in the prices of raw materials for the feed like Soyabean etc. About 70 per cent of expenditure in aquaculture farming is on feed. If feed raw materials are available in sufficient quantity at a reasonable price, the Shrimp and Fish farmers can run the farms comfortably and profitably. If farmers are unable to use all the raw materials in feed due to high raw material prices it will impact on the quality of Shrimp and Fish, and productivity will come down.

There is a need of making feed raw materials available in good quantity and that is possible when Soyabean and other grains production is increased in India. USA is producing 390 Million Metric Tonnes of Corn annually with one crop per year, Brazil 120 MMT and India only about 30 MMT annually. Similarly Soyabean production is also very low. With this small production of 30 MMT Maize in the country, can you meet its requirement by livestock and other industries. We should take the figures of Corn production in USA and take measures to increase Soyabean production in India.

CLFMA of India being the body basically for the livestock feed industry along with PFI and other bodies of poultry industry should discuss with Union and State Agriculture Ministries, Universities and Research institutes on increasing Maize, Soyabean and other needed grains production. Instead of networking meetings, the bodies of the poultry industry should focus on reducing cost of production of egg and chicken through effective steps like increasing production of grains and encourage agriculture farmers who produce Maize, Soyabean and other grains.

.....

Despite its lack of coastline, shrimp production has proved lucrative for a small but significant number of farmers in Punjab for nearly a decade, but many farmers are now facing an uphill struggle. Saroop Singh is a shrimp farmer at a remote Ratta Tibba village in Sri Muktsar Sahib District of Punjab, around 400 kilometers from Delhi. The 38-year-old has been involved in Vannamei Shrimp farming since 2017 and produces around 45 tonnes annually from his 6 hectares of ponds. According to Dr Singh, many experts believe that the Green Revolution could have resulted in the high salinity. During the 1960s, the government focused on increasing crop production, which resulted in the massive use of chemical fertilisers. These five districts were low-lying areas and this could have resulted in the deposit of salt but it could be just one of the reasons. Farmers do not use ground water but prefer to use canal water for irrigation purposes

CLFMA of India organised seminars on *Surging Ahead Towards the Next Level: Contributing to the Five Trillion Economy*, and *Feed Ingredients: Supply, Price and Alternatives* at Coimbatore, Ludhiana and Pune in May 2024. CLFMA Chairman Mr

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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Suresh Deora, Dr Niteen V. Patil, Vice Chancellor of MAFSU and others addressed the seminar. Dr Dinesh Bhosale, Mr R. Ramkutty, Mr Daljeet Singh Gill, Dr A.P.S. Sethi, Mr Sanjit Padhi, Dr N.V. Kurkure, Mr Reece H. Cannady, Mr Divya Kumar Gulati and others took active part.

West Bengal Government prepared to tackle cyclone 'Remal' and safeguard fishermen in South 24 Parganas Kolkata: The cyclonic storm 'Remal' made landfall between the coast of Bangladesh and adjoining areas of South 24 Parganas district, West Bengal in morning of May 26.

The Coalition for Sustainable Aquaculture (CSA), which has endorsed the SEA food Act is headed to Washington DC to advocate for a science-based, stakeholder-led legislative approach to develop a thriving, well-regulated US open ocean aquaculture industry. Hawaii is one of the few states in the US that has embraced offshore aquaculture Blue Ocean Mariculture upto 90 percent of the seafood consumed in the US is imported, and half of that is farmed. The development of open ocean aquaculture can help meet the growing demand for home grown seafood and add stability to the domestic seafood supply chain, but the US currently lacks a comprehensive federal regulatory framework with the requisite strong standards needed for sustainable, equitable and profitable open ocean aquaculture.

A new paper describes the complex dynamic interplay between *Aeromonashydrophila* bacterium and its environment in aquaculture settings. Fish infected with *A. hydrophila* can develop ulcers, tail rot, fin rot, and haemorrhagic septicaemia, which causes lesions that lead to scale shedding, haemorrhage in the gills and anal area, exophthalmia and abdominal swelling.

In the Articles section – Small Fish, Big Impact: The Role of Small Indigenous Species in Ensuring Food Security and Nutrition in Northeast India authored by Mr Chandan Debnath, discussed that India faces a severe hunger and malnutrition crisis, with over a quarter of the global hungry population residing in the country. Despite economic growth, malnutrition rates remain alarmingly high, especially among children. The 2022 Global Hunger Index Report placed India at the 107th position, a decline from its 2021 ranking of 101st, and behind its neighbours Pakistan, Bangladesh and Nepal. A staggering 25% of the global hungry population resides in India. Despite a 50% increase in GDP since 1991, over one-third of the world's malnourished children are in India. With over 70% of the planet covered in water, fish and fisheries have the capacity to address global challenges and contribute to food and livelihood security.

Another Article titled *Role of Gut Health in Managing Challenging Environment in Shrimp, authored by* Dr Raghavendrudu, Product Manager, Skretting India said that Optimum nutrient utilization is the key for accelerating the growth of shrimp and augmenting the production potential. Consumer preference for the antibiotic-free shrimp and fish products attracted the scientists to find out natural growth promoter, as an alternative to antibiotic growth promoters in aqua feed. Dietary supplementation of organic acids and their salts as growth promoter has been proven in animal feed and well documented. Aqua feed sector has equally benefitted with this novel additive though it was lately introduced. However, unlike animal feed, the use of acidifier in aqua feed needs a different approach due to diversified feeding habit and wide variation in structure of the digestive system and physiological function. Dietary organic acids can stimulate secretion of pancreatic enzymes, lower gastric pH, inhibit pathogens, act as a source of energy, improve mineral utilization and enhance nutrient digestibility, which could lead to enhanced growth performance of shrimp.

Another article titled FLOCponics: Integration of Biofloc technology with Aquaponics, authored by Ms M. Divya and S. Felix, discussed that FLOCponics, an innovative integration of biofloc technology and aquaponics stands at the forefront of sustainable agricultural practices. This groundbreaking approach revolutionizes traditional aquaculture and hydroponics by integrating the principles of biofloc systems, where microbes aggregate into flocs, with the symbiotic relationship between fish and plants in aquaponics. At its core, FLOCponics represents a closed-loop ecosystem where fish waste serves as a nutrient source for plants, while the plants, in turn, purify the water for the fish. This technique optimizes resource utilization, minimizes waste and enhances productivity, marking a significant stride towards eco-friendly and efficient food production. The introduction of biofloc technology into aquaponics creates a synergy that not only conserves water and reduces environmental impact but also promises increased yields and improved biosecurity.

Another article titled Cultivation of Infusoria: A step-by-step guide for fish farmers, authored by Mr Nayan Chouhan,' Mr Bhavesh Choudhary and Mr Anil Singh Shekhawat said that Aquaculture has been supported worldwide due to its contribution to an economy, human food, and a decent meal for people (Hussain et al., 2011). Aquaculture is an incredibly cheap and successful protein compared to other sources (Sahu et al., 2000). The major carps and other common cyprinids are the most cultivated in the culture of aquaculture, which have the highest production around the world. However, in the complex and multi-factorial world of aquaculture, such an important species for growing fish in the initial stages of development as infusoria should also be specifically mentioned as they serve as an ideal starter food for initial stages of fish larvae. Infusoria or tiny living beings are irreplaceable in the culture of aquaculture in the initial stages of development of fish larvae (Hirata et al., 1998). *Paramoecium*, *Fabrea*, *Euplotes* and *Stylonychia* are the main forms of freshwater infusoria. These microscopic organisms are food for many young fish and invertebrates and play an important role in their early growth and development.

Results in Shrimp, Fish and Crab farming can be achieved as per specifications when the pond management guidelines are followed. Farmers and Integrators have to give sufficient time and attention to farm management and check the developments there to ensure results. When you invest your hard earned money into it, a little more care and attention can prevent losses and help in profitable farming all the time.

Readers are invited to send their views and comments on the news, special feature and articles published in the magazine which would be published under "Readers Column". Time to time, we shall try to update you on various aspects of Aquaculture sector. Keep reading the magazine Aqua International regularly and update yourself. Wish you all fruitful results in your efforts.

M.A.Nazeer
Editor & Publisher
Aqua International

CLFMA OF INDIA along with Broiler Co-ordination Committee organize Seminar on 'Surging Ahead' on May 3 at Coimbatore

Coimbatore: CLFMA of India organized a successful seminar along with BCC at The Residency Tower, Legend Hall, Avinashi Road, Coimbatore, on Friday, May 3rd, 2024 from 06:30 pm onwards. The theme of the seminar was **"Surging Ahead Towards the Next Level: Contributing to the Five Trillion Economy."**

Mr R. Ramkutty, Zonal President – South of CLFMA, extended a warm welcome to all participants at the seminar. He provided insights into the challenges confronting the poultry industry.

Following this, Mr Suresh Deora, Chairman of CLFMA of India, introduced the theme "Surging Ahead" and extended a gracious welcome to all attendees.

The Presidential address and moderation of the deliberations were carried out by Mr R. Lakshmanan, Chairman of BCC and Managing Committee Member of CLFMA of India.

CLFMA Dy. Chairman Mr Divya Kumar Gulati introduced Mr Reece H. Cannady, Director of the US Grains Council. He delivered an insightful presentation titled "Emerging Trends and Challenges in Grains." Overall, the presentation provided a comprehensive overview of the current trends and challenges in the grains market, with a focus on corn, ethanol, DDGS, and freight logistics.

CLFMA Hon. Secretary, Mr Abhay Shah introduced Mr Amit Sachdev, Regional Consultant at the US Grains Council. He presented an in-depth analysis titled "India Corn Outlook." Overall, Mr Amit Sachdev's presentation provided valuable insights into the current dynamics and future prospects of the corn market in India, addressing key factors such as demand drivers, supply challenges, and potential areas for development.

CLFMA Treasurer Mr Nissar F. Mohammed introduced Mr Jaison John, India Team Lead at USSEC & Managing Committee Member of CLFMA OF INDIA. Mr Jaison John emphasized that rising raw material prices will lead to higher food prices and potentially lower food quality. He suggested that importing genetically modified (GM) raw materials could be one viable solution. He delivered a comprehensive presentation titled "Protein Meals: Present, Future Trends, and Challenges." In his presentation, he highlighted India's progression towards maturity in food demand and outlined strategies to address protein challenges, particularly through initiatives like the Soy Excellence Centre program. He also discussed the expansion of US soybean crush capacity and the expected impact on soybean meal production. Additionally, he touched upon the National Oil Mission and rapeseed production scenarios, providing comprehensive insights into the future of protein meals in India.

Mr R. Ramkutty, CLFMA South Zone President introduced Dr T. Bina, Director of the Happy Valley Business School. She delivered a compelling presentation titled "Professionalism in Family Business." Throughout her presentation, she delved into the

intricate life cycle of family businesses, exploring various stages and challenges. Dr T. Bina supplemented her insights with enlightening case studies that exemplified real-world scenarios and lessons learned within family-owned enterprises.

The Question-and-Answer session concluded on a high note, characterized by its interactivity and engagement. Following this enriching exchange, Mr Divya Kumar Gulati, Deputy Chairman of CLFMA of India, delivered a gracious Vote of Thanks, expressing gratitude to all participants for their active involvement and contributions. Subsequently, the seminar transitioned seamlessly into a dinner session, fostering continued networking among the attendees. Overall, the seminar was a resounding success, with nearly 75 members and delegates in attendance, reflecting the enthusiasm and interest surrounding the event.

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2. HIGH ACTIVITY OF SPORES

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

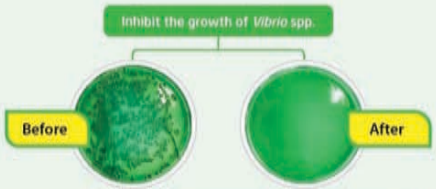
Prevent the accumulation of toxic substances such as NH_3, NO_2, etc.

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:

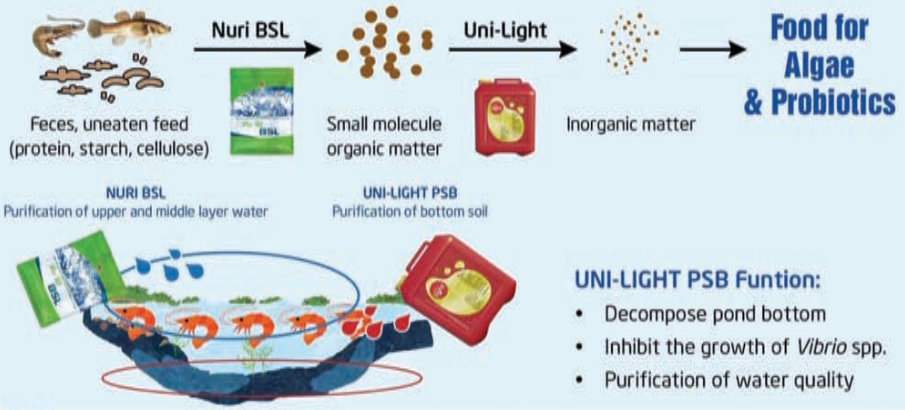
Bacillus spp. > 1x 10^{11} cfu/kg	15%
(Bacillus subtilis, Bacillus amyloliquefaciens, Bacillus licheniformis)	
Carrier (rice bran, corn gluten)	75%
Moisture	10%

* 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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CLFMA OF INDIA in collaboration with the Dept of AN, GADVASU organize Seminar on 'Feed Ingredients: Supply, Price and Alternatives' on May 11 at Ludhiana, Punjab

Ludhiana: CLFMA OF INDIA hosted a seminar on "Feed Ingredients – Supply Price and Alternatives" on May 11, 2024, in collaboration with the Department of Animal Nutrition, GADVASU, in Ludhiana. The event was supported by the Progressive Dairy Farmers Association, the All Feed Millers Association of Punjab, and the Animal Nutrition Society of India.

Mr Suresh Deora, Chairman of CLFMA OF INDIA, delivered the Welcome Address and introduced the association to all participants. Mr Daljeet Singh Gill, President of PDFA, discussed "Opportunities for Dairy Farmers of Punjab." Mr Ashok Kumar, President of AFMA, addressed the "Challenges for Feed Millers in Punjab." Dr A.P.S. Sethi, Secretary of ANSI, explained how ANSI can support both the industry and farmers.

Dr Rameshwar Singh, Hon'ble Vice Chancellor of Bihar Animal Sciences University, graced the seminar as the Guest of Honour. He extended an invitation to the dairy farmers of Punjab to train their counterparts in Bihar and discussed maize production in the state. Dr Inderjeet Singh, Hon'ble Vice Chancellor of GADVASU, attended as the Chief Guest and spoke about the potential of GM crops, promising full support from the university.

Mr S. V. Bhave, Past Chairman of CLFMA OF INDIA, discussed "Recent Trends in the Biofuel Industry." Mr Sanjit Padhi, Advisor to the All India Distillers Association, addressed the availability of DDGS in India. Dr Ruchika Bhardwaj, a millets breeder from PAU, highlighted the importance of millets in animal feeds. Dr Amit Sharma, Assistant Professor at GADVASU, provided detailed insights on the use of DDGS in animal feeds. The seminar concluded with Mr Divya Kumar Gulati, Deputy Chairman of CLFMA OF INDIA, delivered the vote of thanks.

Dried Distillers Grains with Solubles (DDGS) is a valuable protein source produced by ethanol manufacturers using rice or maize. Rice DDGS contains 43-45% protein, while maize DDGS contains 26-28% protein. It can be used in animal feeds at levels of 1-5%. For optimal use, DDGS should have a moisture content of no more than 11%, be free from aflatoxins, and not be over-processed.

Dr Udeybir Singh Chahal, Head and Professor, Department of Animal Nutrition and President, ANSI played an important role in organizing the event. Dr Dinesh Bhosale was the Master of the Ceremony. Approximately 150 participants from various sectors attended the event.

CLFMA Organizes Seminar on 'Feed Ingredients: Supply, Price and Alternatives' on May 17 at Pune

Pune: On May 17, 2024, CLFMA OF INDIA hosted a seminar titled "Feed Ingredients – Supply Price and Alternatives," commencing at 10:30 am. Dr Dinesh Bhosale, Past Chairman of CLFMA OF INDIA, served as the Master of Ceremony. He began by introducing Mr Suresh Deora, Chairman of CLFMA OF INDIA, the Chief Guest, Dr Niteen V. Patil, Hon'ble Vice Chancellor of Maharashtra Animal & Fishery Sciences University (MAFSU), Nagpur, and Mr Divya Kumar Gulati, Deputy Chairman of CLFMA OF INDIA.

The Seminar opened with a Welcome Address by Mr Suresh Deora. He introduced the event's theme and warmly welcomed the Chief Guest and all attendees.

The Keynote Address was delivered by Dr Niteen V. Patil, who highlighted the essential collaboration between the Livestock Industry and the University.

Mr S. V. Bhave, Past Chairman of CLFMA OF INDIA, delivered the Opening Remarks. Subsequently, Speaker Mr Sanjit Padhi, Advisor to the All India Distillers Association, presented on the availability of DDGS in India, explaining its details comprehensively. Mr Nagaraj Meda, Managing Director of Transgraph, Hyderabad, discussed raw material availability and price forecasting. Dr N. V. Kurkure, Director of Research at MAFSU, Nagpur, explored the potential of DDGS in animal feed. Mr Reece H. Cannady, Director of the U.S. Grains Council, delivered an insightful presentation titled "Global Grains Outlook Including Maize, Sorghum, and Millets," providing a thorough overview of the global grains market.

The presentations were well-received and appreciated by all participants. The seminar concluded with an interactive and engaging Question-and-Answer session.

Mr Divya Kumar Gulati, Deputy Chairman of CLFMA OF INDIA, delivered a gracious Vote of Thanks, expressing gratitude to all participants including CLFMA Staff for their active involvement and contributions. The seminar was deemed a resounding success, with nearly 108 members and delegates in attendance, reflecting the high level of enthusiasm and interest in the event.

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3rd Aquaculture Africa Conference 2024

Aquaculture continues to increase its importance to Africa's economies in a number of ways - in providing sustainable and nutritious food to the continent's fast-growing populations, to jobs and improved livelihoods. The WAS initiated the annual Aquaculture Africa Conferences (AFRAQs) which have been a great success, starting in Egypt (2022) and in Zambia (2023). These annual meetings brought together a wide variety of aquaculturists from the commercial, academic, government sectors and NGO sectors to celebrate the sector's achievements, but also to find solutions to some of the challenges the sector faces. Tunisia will host the 3rd Aquaculture Africa Conference (AFRAQ24) on 19-22 November 2024, at its majestic city of Hammamet – a popular holiday destination on the Mediterranean coastline.

Tunisia is currently amongst Africa's top aquaculture producing countries and also one of the world's fastest average annual growth rate. The country is the second biggest aquaculture producer country in North Africa region, after Egypt and is looking forward to expand the sector owing to the competitive advantages on its blue economy domain.

In addition to appraising Tunisia's fast-growing aquaculture sector, bringing AFRAQ24 to the country is expected to inspire the African French and Arabic communities. It is expected to be a gateway platform to connect Africa to European aquaculture actors.

Dr Constantinos Mylanos, Director at the Institute of Marine Biology

Programme Themes

3rd Aquaculture Africa Conference (AFRAQ24) technical program will aim to cover developmental issues including latest research and developmental aspects on aquaculture in Africa. The thematic plenary and technical parallel sessions will comprise submitted oral and poster presentations in English, French, Portuguese and Arabic. AFRAQ24 will feature an international trade exhibition, industry forums, student sessions and activities, satellite workshops (and training sessions) and various meetings/forums on aquaculture development in Tunisia and Africa. The international conference will be centred around the theme "Blue Farming: New Horizons for Economic Growth", and will feature lessons learnt from Tunisia and other countries on the role sustainable aquaculture continues to play in building sustainable food systems for economic growth.

A renowned global aquaculture researcher from the Mediterranean region, Dr Mylonas, who is the Director at the Institute of Marine Biology, Biotechnology and Aquaculture - Hellenic Center for Marine Research in Greece, will deliver an opening key note address at Aquaculture Africa Conference AFRAQ24. The speech will focus more on emerging issues, innovations and technological advancements on fish reproduction in the Mediterranean – with special emphasis on major species of interest.

West Bengal Government prepare to tackle cyclone 'Remal' and safeguard fishermen in South 24 Parganas

Fishing boats anchored safely at Budge Budge-II Block

Kolkata: The cyclonic storm 'Remal' made landfall between the coast of Bangladesh and adjoining areas of South 24 Parganas district, West Bengal in morning of 26/5/2024. The OSD and Ex-Officio Joint Secretary, Department of Disaster Management and Civil Defence, Govt of West Bengal issued Warning message on 20/5/2024; the Regional Meteorological Centre (RMC), Kolkata also issued message in same matter, which is Weather warning for fishermen of West Bengal for next five days commencing from 20/5/2024. Following the letter of Ex-Officio Joint Secretary, the letter of Dy. Commandant was appended, in connection with 'Formation of low pressure area over south-west Bay of Bengal' around 22/5/2024. In case of low pressure turns towards West Bengal, the coastal population may be alerted on all measures for safety of coastal assets which may be taken as per Standard Operating Procedures. As precautionary measures that may be adopted, the path of low pressure and weather predictions needs to be monitored closely; all fishing vessels and villages may be alerted through fishery associations; fishing vessels may be recalled by AM 21/5/2024 for safety; mechanism for accounting of boats may be activated; Disaster response teams in coastal areas to be standby; the Indian Meteorological Dept and other web-based weather sites should be closely monitored for impending deterioration in cyclonic weather along West Bengal coast.

In this context, the Director of Fisheries, West Bengal issued letter on 21/5/2024 to Assistant Director of Fisheries (ADF) and ADF (Marine) of three coastal districts of West Bengal, including South 24 Parganas. It was mentioned that due to squally weather with gusty surface wind speed exceeding 45 km per hour very likely along and off West Bengal coast from 24/5/2024, the sea condition are likely to be rough to very-rough. Fishermen are advised not to venture into the sea from 24/5/2024. Boat owners and concerned persons with fishing boat/ vessel shall not go to the sea for fishing till weather clearance. Letter was sent by ADF, South 24 Parganas to all Block Development Officers (BDOs) and Fishery Extension Officers (FEOs) of all Blocks of this district on 22/5/2024 as Fishermen warning. Letter icw Weather warning was received at ADF's end from RMC, Kolkata; all coastal and marine fishermen made aware about Weather Warning for five days commencing from 20/5/2024. Fishermen are advised not to venture into the sea from 24/5/2024 till further notice. Fishermen out at the sea are advised to return to the coast (fishing harbour, fish landing centre) before 23/5/2024.

ADF, South 24 Parganas hold Meeting with all Block FEOs on 26/5/2024 in online mode regarding preparedness for upcoming cyclonic storm 'Remal'. Special Bulletin No. 15 issued by RMC, Kolkata under Indian Meteorological Dept, Ministry of Earth Sciences, Govt of India, in the matter of Cyclone warning for West Bengal coast: Red

Miking at a GP in Kakdwip Block

Miking at a GP in Patharpratima Block

Miking at a GP near seashore in Kakdwip Block

Message. According to it, severe cyclonic storm Remal over north Bay of Bengal moved nearly northwards with a speed of 6km per hour during past 6 hours, intensified into a cyclonic storm with a maximum sustained wind speed of 110-120km per hour gusting to 135km per hour, that lay centred over North Bay of Bengal on 26/5/2024, about 270km south-east of Sagar islands of South 24 Parganas, 390km south-southeast of Digha and 310km south-southeast of Canning town. The Deep Depression over East Central Bay of Bengal moved nearly northwards with a speed of 17km per hour during past 6 hours on 25/5/2024, lay centred at about 440km south-southeast of Sagar islands and 480km south-southeast of Canning. An urgent meeting was held on 22/5/2024 and 26/5/2024 by Hon'ble District Magistrate, South 24 Parganas from DM's Conference Hall in online mode to review the preparedness of severe potential cyclone 'Remal', being formed in Bay of Bengal. Nodal officers of district line Departments, CESC, Nodal officers of Police district, Sub-Divisional Officers and BDOs attended this Meeting.

All river-faring and sea-faring fishing boats had been anchored safely, all marine Gram Panchayats in all marine Blocks were sensitized about the incoming situation; Control Rooms kept open both at District-end and Block-end. Circular was received from the Disaster Management Division, Ministry of Home Affairs, Govt of India in connection with Items and norms of assistance from the State Disaster Response Fund and the National Disaster Response Fund for the period 2022-2023 to 2025-2026. It was letter of Director DM-1, dated 10/10/2022. In Fishery part, it was written about Assistance to fishermen for repair/replacement of non-mechanized boats and damaged/lost nets during incidences of climatic hazards like Remal (cyclonic storm). It was Rs 6000.00 for repair of partially-damaged boats only; Rs 3000.00 for repair of partially-damaged net; Rs 15000.00 for repair of fully-damaged boats and Rs 4000.00 for replacement of fully-damaged net. Amount of input subsidy for fish seed farm to small and marginal fish farmer beneficiaries is Rs 10000.00 per hectare water body.

The Indian Meteorological Dept issued an advisory for West Bengal fishermen and a red alert for those in Bay of Bengal. Marine fishermen community are requested to be attentive to future forecasts issued by Dept of Meteorology. From late evening of 27/5/2024, according to authentic sources, condition will slowly

Miking at Herambagopalpur GP, Patharpratima Block

improve and normalize in Kolkata and south Bengal, 'Remal' will weaken and no longer be able to create disaster nor damage. Moderate to heavy rain and strong wind will continue to persist. Previously, cyclonic storm Amphan was ravaging and caused massive damage in rural South 24 Parganas as both the time of super cyclone and spring tide coincided. But it was not in case of 'Remal'. With active involvement of FEOs at Block-level and other Block-level officials, on 25/5/2024, awareness and necessary information was spread through 'Miking' along narrow roads on moving battery-operated three-wheeler 'Toto rickshaw' in different Gram Panchayats in all marine and brackishwater Blocks in South 24 Parganas. Local villagers residing in mud & clay-built thatched homes on or near to river embankments and coastline were repeatedly requested and advised to take shelter at Flood Centres, safe 'pucca' (concrete) homes and ICDS centres on two days 26/5/2024 and 27/5/2024. Passenger ferry service across rivers will remain closed temporarily. No one should stand near to large trees and tall electricity columns (supporting overhead power lines) on roadside. During miking, riverine and sea-going fishermen were repeatedly urged and cautioned not to go for fishing in estuary and open sea. Genuine information compiled and presented by Subrato Ghosh.

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:
YUCCA SCHIDIGERA
ALOEVERA
BACILLUS SUBTILIS
BACILLUS POLYMIXA
BACILLUS LICHENIFORMIS
NITRASOMONAS
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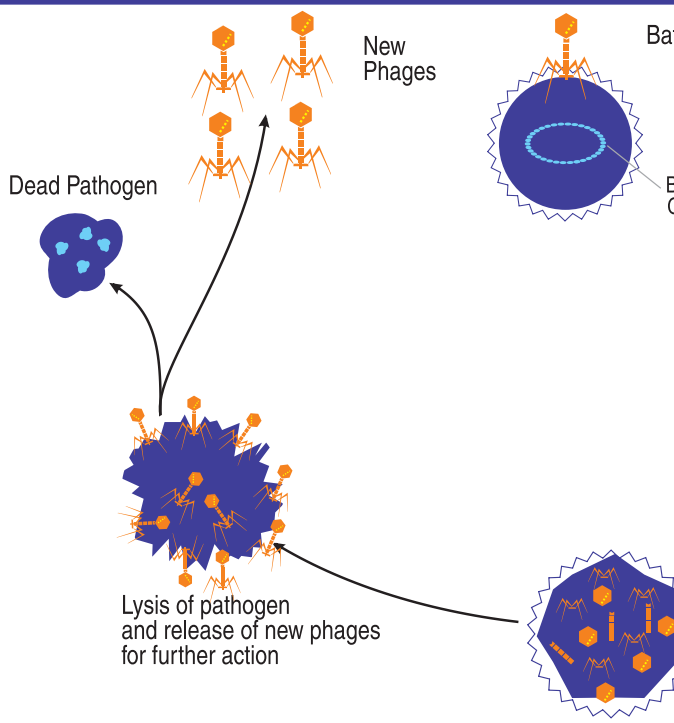
they are safe on aquatic animals, people and ecosystem
resistant to antibiotics and incr

"V PHAGES" cocktail targets against most common pathog

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

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

ILLUSTRATION OF ACTION OF PHA



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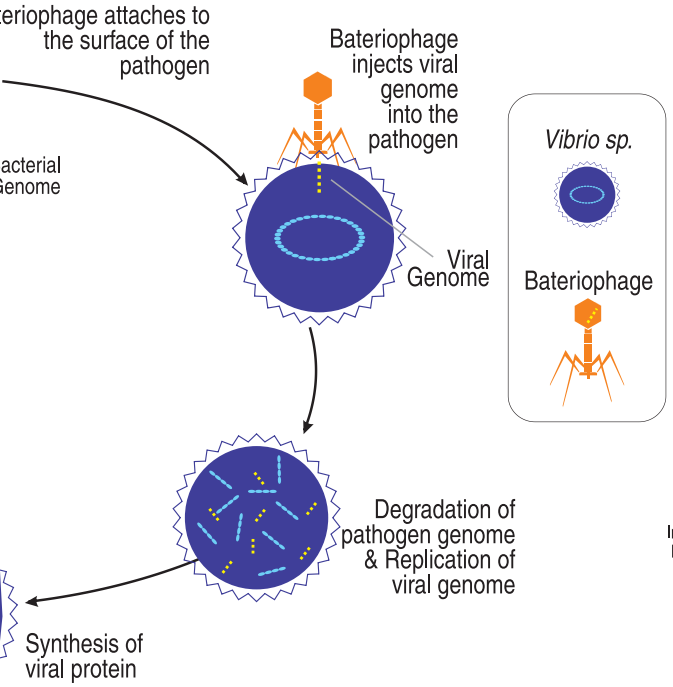

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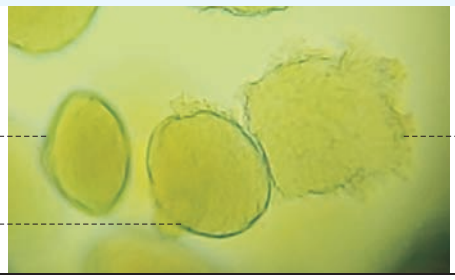
Stages of *Vibrio sp.* colonies infected with Bacteriophages & Progressive Lysis observed on an Agar plate, under Stereo Microscope



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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Coalition takes offshore aquaculture agenda to Washington

Recently, the Coalition for Sustainable Aquaculture (CSA), which has endorsed the SEAfood Act, is headed to Washington DC to advocate for a science-based, stakeholder-led legislative approach to develop a thriving, well-regulated US open ocean aquaculture industry.

Hawaii is one of the few states in the US that has embraced offshore aquaculture Blue Ocean Mariculture Up to 90 percent of the seafood consumed in the US is imported, and half of that is farmed. The development of open ocean aquaculture can help meet the growing demand for homegrown seafood and add stability to the domestic seafood supply chain, but the US currently lacks a comprehensive federal regulatory framework with the requisite strong standards needed for sustainable, equitable, and profitable open ocean aquaculture.

"We are working to ensure safe and environmentally responsible access to valuable nutritious (and delicious) resources, and we hope to talk to many offices about how the SEAfood Act can play an important role in the US's safe, sustainable seafood industry," said CSA member Dr Chris Vogliano, co-founder and director of Global Research at Food and Planet.

The CSA is committed to ensuring Americans have access to sustainable, locally sourced seafood, and making sure we grow it here and do it right. The coalition's diverse membership consists of chefs, fishers, seafood

Kanpachi at a farm run by Blue Ocean Mariculture, off the coast of Hawaii

farmers, industry, and environmental advocates, including new members: the Charter Fisherman's Association, sustainable seafood advocate Emily De Sousa, and future leader Paul Grech.

There are real concerns about open ocean aquaculture, which is why the CSA is committed to working with lawmakers and other partners to chart a science-based and stakeholder-led approach.

The CSA is advocating for the SEAfood Act because they believe it will:

- Charge the Government Accountability Office with producing a report that details permitting, monitoring, and regulatory options for governing open ocean aquaculture in the US.
- Direct the National Academies of Sciences, Engineering, and Medicine to complete a study on the scientific basis for efficient and effective regulation of open ocean aquaculture.
- Authorise the National Oceanic and Atmospheric Administration (NOAA) to create an open ocean aquaculture assessment programme that prioritises research and transparency using on-the-water projects and are operated in partnership with land and sea grant institutions.
- Create a grant programme, under NOAA, for minority-serving educational institutions to establish aquaculture centers of excellence that meet the needs of a growing domestic and sustainable aquaculture industry including developing or enhancing undergraduate and graduate aquaculture curriculum, career development, and extension programmes.

Support from the fishing sector

Although some parts of the fishing sector have historically been opposed to aquaculture development, CSA members say that they want members of Congress and their staff to know that US aquaculture can and should develop as a complement to wild fisheries so that more domestic seafood can be made available for more Americans.

"As fishermen, we value the ability to provide and access delicious seafood. Developing US aquaculture is an opportunity to offer Americans more protein-rich seafood, but it needs to be done through a transparent process with stringent regulations that allow consumers to feel confident in what they buy and feed their families," said Captain Jim Green, president of the Charter Fisherman's Association.

Coalition members will have the opportunity to share their unique experiences and relevant concerns with decision-makers. CSA chefs and seafood industry members want to ensure that they, their customers, and their communities have access to nutritious and sustainably sourced seafood for generations.

"Our company is investing in wild, local West Coast seafood, but a key factor we can do so is because the US has such strong federal fisheries management," said Peter Adame, communications and sustainability director for Lusamerica, a seafood wholesaler based in California and

Washington. "We're excited to be in DC because we want to see the same strong management reflected with aquaculture."

Fresh insights into Aeromonas hydrophila in aquaculture

A new paper describes the complex dynamic interplay between Aeromonas hydrophila bacterium and its environment in aquaculture settings.

Fish infected with A. hydrophila can develop ulcers, tail rot, fin rot, and haemorrhagic septicaemia, which causes lesions that lead to scale shedding, haemorrhages in the gills and anal area, exophthalmia and abdominal swelling.

Published in Aquaculture International, the study, which was published under the title of "Aquaculture and Aeromonas hydrophila: a complex interplay of environmental factors and virulence", confirms the close connection of environmental conditions in shaping the prevalence and pathogenicity of A. hydrophila in aquaculture environments. Water quality, temperature, pH levels, and high ammonia concentrations exacerbate A. hydrophila infection by compromising host immunity and creating favourable conditions for bacterial proliferation. Oxygen concentration and nutrient availability complexly influence the spread and virulence of this pathogen.

The review - whose authors include Fish Site contributor Yomna Elshamy - emphasises the importance of adopting integrated approaches in managing A. hydrophila in aquaculture systems. By implementing comprehensive strategies that include biosecurity measures, environmental monitoring, and probiotic interventions, aquaculture stakeholders can reduce the risk of A. hydrophila outbreaks and protect the health and productivity of aquatic populations, thereby ensuring the sustainability and growth of the aquaculture industry

A tilapia infected with Aeromonas bacteria

The review has been hailed as a valuable resource for researchers and aquaculture practitioners seeking to deepen their understanding of the dynamic interactions between aquaculture environments and A. hydrophila.

The authors hope that the insights it offers will allow stakeholders to develop disease prevention and control strategies, and they highlight the need for improved management practices and innovative solutions to mitigate the impact of these pathogens on the aquaculture industry.

Can India's landlocked shrimp farmers succeed?

Despite its lack of coastline, shrimp production has proved lucrative for a small but significant number of farmers in Punjab for nearly a decade, but many farmers are now facing an uphill struggle

A group of shrimp farmers in the Punjab

Saroop Singh is a shrimp farmer at a remote Ratta Tibba village in Sri Muktsar Sahib District of Punjab, around 400 kilometers from Delhi.

The 38-year-old has been involved in Vannamei Shrimp Farming since 2017 and produces around 45 tonnes annually from his 6 hectares of ponds.

Although the state is landlocked it is home to around 350 shrimp farmers, with a collective production of 2,500 tonnes annually, spread across 526 hectares.

"Unlike other Indian states of West Bengal, Andhra Pradesh and Odisha, we do not have any coastline but have still managed to do shrimp farming due to areas where the water is salty over the past several years. We tried several crops in this land but nothing worked as the ground water was salty and not fit for any type of cultivation. But shrimp farming has come as a blessing for us over the past several years," Singh explains.

Shrimp farming in Punjab is mainly restricted to five south-western districts – Sri Muktsar Sahib, Fazilka, Mansa, Bathinda and Faridkot – that are low-lying and have saline groundwater that is not fit for agriculture.

Dr Prabjeet Singh, deputy director of Krishi Vigyan Kendra (KVK), who has been hailed as one of the pioneers of shrimp farming in the state, says that 1.51 lakh hectare of land in the five districts is unfit for traditional farming.

"The state government, along with Guru Angad Dev Veterinary and Animal Sciences (GADVASU) where I was formerly attached, started trials of shrimp farming in 2014 and 2016 in the villages here, which was very successful. Buoyed by the success, the state government began to encourage farmers to start shrimp farming commercially. The aim was to convert the zero earning land into a productive source of livelihood for farmers," says Dr Singh.

Freshly harvested shrimp grown in Punjab

According to Dr Singh, many experts believe that the Green Revolution could have resulted in the high salinity.

"During the 1960s, the government focused on increasing crop production, which resulted in the massive use of chemical fertilisers. These five districts were low-lying areas and this could have resulted in the deposit of salt but it could be just one of the reasons. Farmers do not use ground water but prefer to use canal water for irrigation purposes," he notes.

Whatever the reason some local farmers have benefitted.

"We are happy that shrimp gives us manifold income than traditional crop farming. Our production cost is around Rs 230 ($2.75) per kg and we sold the produce at almost double the price in 2022 when the demand was very high. We stock seed in April and harvest by November. There has been no outbreak of diseases here so far," added Saroop.

The state government offers a subsidy of up to 60 percent for new shrimp producers.

"We offer subsidies for digging ponds and seed and feed to the first time farmers. The seed is generally procured from Andhra Pradesh in South India," points out Jasvir Sharma, director of fisheries, Punjab.

Saroop Singh, a shrimp farmer in Sri Muktsar Sahib District

Freshly harvested shrimp grown in Punjab

Challenges to the sector

However, despite significant success, many farmers complain that they are grappling with numerous issues that have been discouraging them from continuing further in farming shrimp.

"Shrimp farming is a profitable venture but we urgently need a processing unit so we don't have to sell our produce right after the harvest at a lower price. We are privately constructing the unit along with some farmers but need the financial support of the state government to complete the project," explains Rupinder Pal Singh, 35, a shrimp farmer in Jandwala Charat Singh village.

Rajveer Singh, 28, a young farmer and trader also pointed out that the exports to countries like USA and China that are the major consumers of shrimp have been badly hit due to growing competition from Ecuador – whose exports have been growing significantly in the last five years.

"The USA is a major market for India but we are facing strong competition from Ecuador, as it is providing shrimp at a lower cost. This has not only led to the decline demand but have also been demotivating farmers from continuing further. The situation has reached to such an extent that farmers are forced to sell the produce even less than the production cost because of less demand and no processing units," he observes.

Saroop Singh, a shrimp farmer in Sri Muktsar Sahib District

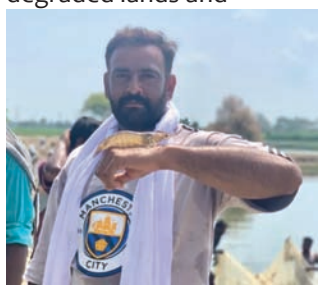
Rupinder Pal Singh, a shrimp farmer in Jandwala Charat Singh village

According to a recent report, India witnessed a 12 percent reduction in shrimp export volumes to the US between September 2021 and 2022, which Ecuador enjoyed a rise of 11 percent during the same period.

India is still expected to see a surge of 5 percent revenue growth in shrimp exports in the current financial year but that has been due to a strong demand by China, whereas it is still facing a strong competition in USA due to Ecuador.

Dr Meera D Ansal, dean of the College of Fisheries in Punjab conceded that Punjabi shrimp farmers are losing enthusiasm. "Ecuador surpassed India in 2021 in shrimp production, which affected India's shrimp export to its biggest importer US and farmers in Punjab suffered huge losses in 2022 due to shrimp price crash. Annual production is not just enough to set up a commercial scale processing unit in the state, while small scale processing-cum-storage units can be established in Public-Private Partnerships (PPP) to support the sector," she argued.

"Like the Coastal Aquaculture Authority (CAA) of India for regulating aquaculture in coastal areas, a similar authority needs to be enforced for monitoring aquaculture development in inland saline areas in an eco-responsible and equitable manner. Further, shrimp farming shall be promoted only in zero earning salt-affected degraded lands and not in fertile agriculture land by extraction deep underground saline water, which may lead to salinisation of adjoining fertile lands and affect livelihood of farmers cultivating those lands," she added.

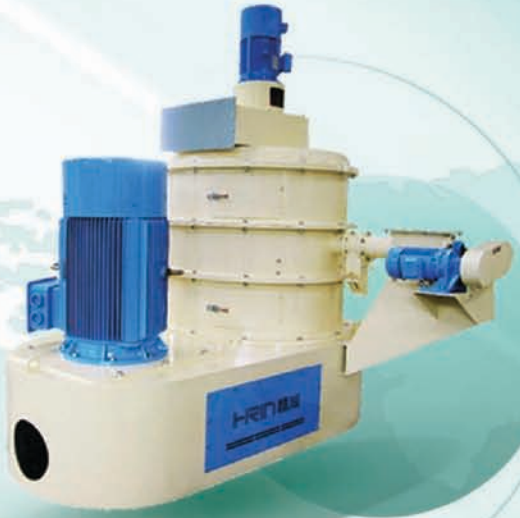


Rupinder Pal Singh, a shrimp farmer in Jandwala Charat Singh village

Dr Ansal further conceded that the shrimp consumption remains relatively low in this part of country and argues that it is essential to educate the local population about the nutritional qualities of shrimp to counteract export losses.

Source: The Fish Site.

Professional Feed Machinery Manufacturer



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FLOCponics: Integration of Biofloc technology with Aquaponics

M. Divya and S. Felix

College of Fisheries Science, St. Devasahayam Institute of Fisheries Science and Technology, Midalam, Kanyakumari.

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Introduction

FLOCponics, an innovative integration of biofloc technology and aquaponics, stands at the forefront of sustainable agricultural practices. This groundbreaking approach revolutionizes traditional aquaculture and hydroponics by integrating the principles of biofloc systems, where microbes aggregate into flocs, with the symbiotic relationship between fish and plants in aquaponics. At its core, FLOCponics represents a closed-loop ecosystem where fish waste serves as a nutrient source for plants, while the plants, in turn, purify the water for the fish. This technique optimizes resource utilization, minimizes waste, and enhances productivity, marking a significant stride towards eco-friendly and efficient food production. The introduction of biofloc technology into aquaponics creates a synergy that not only conserves water and reduces environmental impact but also promises increased yields and improved biosecurity. FLOCponics stands as a beacon of sustainable agriculture, poised to reshape how we cultivate food in a world seeking innovative solutions for feeding a growing population while preserving our planet's delicate balance.

Biofloc technology

Biofloc technology (BFT) stands as a pioneering solution in aquaculture, fostering dense microbial communities to transform waste into valuable resources. Through this innovative system, organic matter and excess nutrients are converted into protein-rich aggregates called bioflocs, serving as a natural feed source. Beyond waste management, BFT enhances water quality by reducing ammonia and nitrite levels, creating a healthier environment for aquatic organisms. Its implementation minimizes the dependency on external feeds, curbing production costs, and space-efficient designs make it viable for intensive aquaculture setups. BFT's sustainable principles underscore its potential to revolutionize aquaculture, offering a cost-effective, eco-friendly, and efficient approach to fish farming while minimizing environmental impact.

BFT has different and well-known advantages. However, it is an advanced system that is not applicable to all aquaculture species and should only be used commercially under adequate expert supervision. A few examples of BFT disadvantages in relation to other aquaculture technologies are (i) the necessity for intense monitoring of the physical chemical parameters of the water; (ii) continuous dependence on electricity and (iii) the need for specialized labour. Moreover, accumulation and high (toxic) concentration of nutrients such as nitrate and phosphate as a result of high fish/shrimp stocking density and lack of water renewal may affect the efficiency and stability of the system in the long-term. In this way, its integration with hydroponic vegetable production (in a FLOCponics system) could be an alternative to minimize these problems.

Aquaponics

Aquaponics, a sustainable and symbiotic system, combines aquaculture and hydroponics in a closed-loop ecosystem. In this innovative method, fish waste provides nutrients for plants, which in turn, purify the water for the fish, creating a harmonious cycle. This self-sustaining approach maximizes resource utilization, conserves water (up to 90% less than traditional agriculture), and allows for space-efficient cultivation in vertically stacked systems. By eliminating the need for chemical fertilizers and pesticides, aquaponics produces organic, high-yield crops while fostering a balanced environment where fish and plants thrive together. Despite challenges in maintaining equilibrium within the system, the promise of aquaponics as an environmentally friendly, scalable, and efficient method positions it as a frontrunner in sustainable food production systems for the future.

Some aquaponics areas still require research and development to reach their full potential. A few experiments have recently been undertaken on how to recover and use the nutrients from RAS water-sludge for plant growth. Each aquaponics system and species require its own set of water conditions, nutritional balance, and pest management. Fulfilling

these requirements is usually the main technical challenge faced by traditional coupled systems. In addition, commercial aquaponics is highly dependent on specialized labour, due to the need for multidisciplinary knowledge to run the system.

FLOCponics- Integration of biofloc technology and aquaponics

The integration of biofloc technology with aquaponics can create a sustainable and efficient system for cultivating both fish and plants. Aquaponics combines aquaculture (raising aquatic animals) and hydroponics (growing plants in water) in a symbiotic environment. When biofloc technology is introduced into this system, it can offer several advantages:

i) Nutrient cycling and utilization:

Biofloc systems, rich in organic matter and microbial life, produce nutrient-dense water containing nitrogen compounds and other elements derived from microbial activity and animal waste. In aquaponics, this nutrient-rich water acts as an organic fertilizer for plants. The plants absorb and utilize these nutrients, effectively filtering the water before it returns to the fish tanks. This closed-loop system optimizes resource utilization and minimizes the need for external inputs, enhancing sustainability.

ii) Water quality management:

Biofloc technology promotes a healthy aquatic environment by maintaining water quality. Beneficial microorganisms within biofloc help convert harmful compounds (ammonia, nitrites) into less toxic forms (nitrates). The filtered and cleaner water is then circulated into the hydroponic system, offering an ideal growth medium for plants. This symbiotic relationship between biofloc and aquaponics ensures a continuous supply of nutrient-rich water while supporting optimal conditions for both fish and plants.

iii) System efficiency and production:

Integration with biofloc technology can increase the overall efficiency and production capacity of aquaponics. By supporting higher fish stocking densities without compromising water quality, biofloc systems generate more nutrient-rich water for plants. This increased nutrient availability can potentially lead to higher yields of vegetables, herbs, or other crops cultivated in the hydroponic component of the system.

iv) Environmental sustainability:

Combining biofloc technology with aquaponics contributes to sustainability by minimizing waste and resource utilization. It reduces reliance on external chemical fertilizers and optimizes the use of nutrients present in the system. The integration promotes a balanced ecosystem where the waste produced by one component (fish) becomes a valuable resource for another (plants), minimizing environmental impact.

v) System management and monitoring:

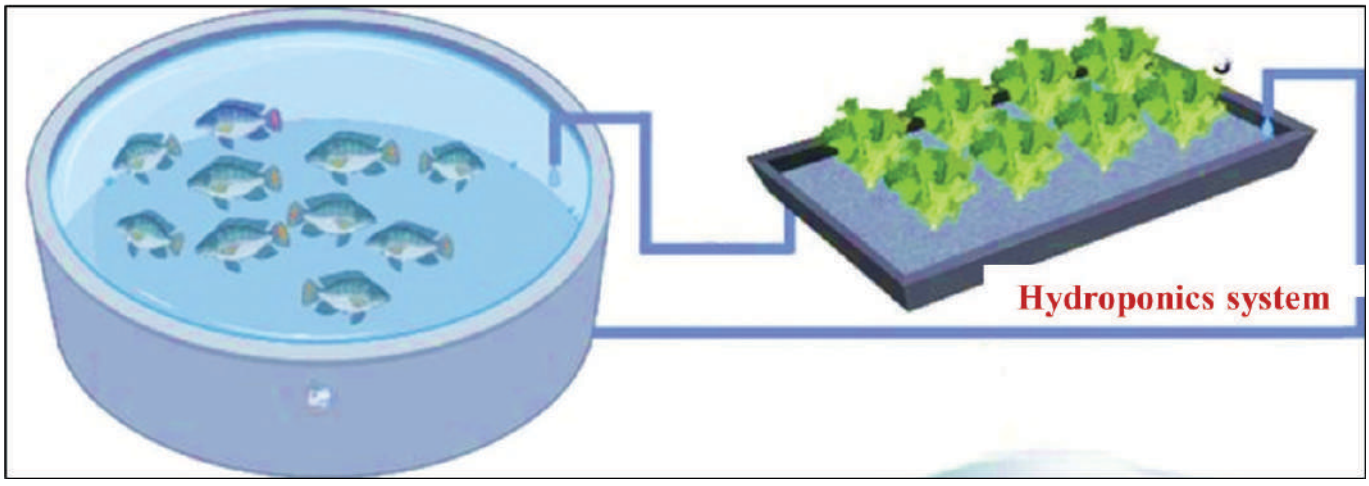
Continuous monitoring is required for successful integration and management practices. Regular testing and adjustments of water parameters (pH, ammonia, nitrate levels) are crucial to ensure optimal conditions for both fish and plants. Maintaining proper aeration, filtration, and temperature control is essential for the well-being of the entire integrated system. Additionally, maintaining a balance between fish stocking densities and plant growth rates is vital for sustained productivity. Balancing the needs of fish, microorganisms, and plants in an integrated biofloc aquaponics system is key to maximizing benefits while ensuring a healthy and productive environment.

Advantages of FLOCponics

FLOCponics, or FLOcculation-based Aquaculture System, offers several advantages :

FLOCponics uses a recirculating system that significantly reduces water consumption compared to traditional aquaculture. It optimizes water usage by reusing and purifying water within the system.

- The system utilizes organic matter and waste produced by fish as nutrients for plants, creating a symbiotic relationship where fish waste serves as fertilizer. This minimizes waste output and creates a more sustainable cycle.
- The process of flocculation helps in clarifying and purifying the



water by aggregating suspended particles, making it clearer and healthier for both fish and plants.

- FLOCponics facilitates faster plant growth due to the nutrient-rich water sourced from fish waste. This can lead to higher crop yields compared to traditional soil-based agriculture.
- These systems can be set up vertically or in compact spaces, making them suitable for urban environments or areas with limited space for traditional agriculture.
- By minimizing water usage and waste, FLOCponics reduces the environmental impact associated with traditional aquaculture practices. It also minimizes the risk of pollutants entering natural water bodies.
- Closed-loop systems like FLOCponics can better control and prevent disease outbreaks among fish populations, reducing the need for antibiotics or chemicals, which contributes to a healthier overall system.

Challenges and Future Directions

FLOCponics, merging aquaculture and hydroponics, faces critical challenges and promising future prospects. Balancing nutrient exchange between fish and plants without compromising either's health remains a core challenge. Ensuring optimal water quality, managing energy consumption, and scaling up for commercial viability pose significant hurdles. However, the future of FLOCponics holds promise through technological advancements. Innovations in automation for system monitoring and adjustments could streamline operations while minimizing labor. Additionally, advancements in waste management and nutrient cycling could further optimize resource utilization, enhancing sustainability and economic feasibility. Education and market expansion efforts will play a crucial role in driving wider acceptance and adoption of FLOCponics, contributing to sustainable food production practices globally.

Conclusion

FLOCponics presents a promising and innovative approach to aquaculture and hydroponics by merging both systems into a sustainable and efficient closed-loop system. Its advantages in water conservation, waste reduction, improved water quality, increased yield, space efficiency, reduced environmental impact, and biosecurity make it an attractive option for modern agriculture. However, successful implementation requires careful consideration of initial setup costs, maintenance demands, and the need for technical expertise. Addressing these challenges can unlock the full potential of FLOCponics, offering a sustainable solution to meet the growing demand for food production while minimizing environmental impact. As research and technology advance, FLOCponics holds significant promise in shaping the future of agriculture by providing a more efficient and environmentally friendly way of producing food.

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Small Fish, Big Impact: The Role of Small Indigenous Species in Ensuring Food Security and Nutrition in Northeast India

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India faces a severe hunger and malnutrition crisis, with over a quarter of the global hungry population residing in the country. Despite economic growth, malnutrition rates remain alarmingly high, especially among children. The 2022 Global Hunger Index Report placed India at the 107th position, a decline from its 2021 ranking of 101st, and behind its neighbours Pakistan, Bangladesh, and Nepal. A staggering 25% of the global hungry population resides in India. Despite a 50% increase in GDP since 1991, over one-third of the world's malnourished children are in India. With over 70% of the planet covered in water, fish and fisheries have the capacity to address global challenges and contribute to food and livelihood security. Fish are crucial for global nutrition, with the potential to improve the well-being of millions; currently they provide 16.6% of the global population's animal protein intake, benefiting billions of people. To harness their potential in eradicating hunger and malnutrition, fisheries must be supported and developed responsibly, which includes regulation, environmental protection, and social responsibility. Supporting sustainable fisheries is essential for realizing their positive impact on health and nutrition worldwide.

Challenges Faced by Northeast India

The states of Northeast (NE) India face multiple challenges, including socio-economic instabilities, ecological vulnerabilities, and a lack of alternative livelihood options to cope with climate change impacts. Most of these challenges are inherent in nature. Fisheries are crucial in addressing the region's livelihood, hunger, food insecurity, and malnutrition challenges. Over 95% of the population in NE India relies on fish for protein, but there is a significant gap between production (518,380 MT) and requirement (561,430 MT). The Indian Council of Medical Research (ICMR) recommends a per capita fish consumption of 11 kg annually for nutritional security, which is yet to be achieved in the region.

The Potential of Small Indigenous Fish Species

Focusing on small indigenous fish species (SIS) can help ensure food security in rural areas. The SIS refer to fish that reach a size of 25-30 cm as adults. Previously disregarded by fisheries by saying 'fish of no importance to fisheries', they are now recognized as important in literature. SIS thrive in diverse habitats such as rivers, ponds, and paddy fields. However, their numerous bones make them less popular among urban consumers who prefer larger species with fewer bones. This preference for safer-to-eat fish and the focus on fast-growing large species in urban markets have led to the loss of natural habitats for SIS. The transformation and destruction of these habitats have impacted the availability and popularity of SIS. Consequently, their potential contribution to food security and livelihoods remains underutilized. SIS have gained recognition in programmes such as Scaling Up Nutrition and 1000 Days, which focus on the role of fish as a

rich animal-source food for growth, development, and overall well-being. In countries like Bangladesh and Cambodia, SIS make up 50-80% of all fish consumed during the production season.

Diversity and Potential Species in Northeast India

In India, there are a total of 2,319 species of finfish, with 838 species inhabiting freshwater ecosystems. Among these, 450 species come under SIS. The NE region of India has the highest diversity of SIS, thanks to its extensive aquatic resources, including Rivers/Canals (42,691.67 km), reservoirs (18,258.87 ha), ponds and tanks (150,422.5 ha), wetlands (183,704.8 ha), and other water bodies (530,610 ha). NE India ranks 6th among the 25 global hotspot regions identified for freshwater fish biodiversity.

Within the NE region, there are 267 fish species belonging to 114 genera, 38 families, and 10 orders, accounting for about 31.8% of the country's freshwater fish species. Assam has the highest number of fish species (217), followed by Arunachal Pradesh (167), Meghalaya (165), Tripura (134), Manipur (121), Nagaland (68), Mizoram (48), and Sikkim (29). Around 31 species of fish in the region are endemic. Out of the documented small fish species, 104 are highly important for food and livelihood security, as well as the ornamental fish trade. Among these, 62 species are valued as food fish, while 42 species are sought after for ornamental purposes. Many of these food fish species are dual-purpose fish, i.e., have food value as well as ornamental value and contribute millions of dollars to the ornamental fish trade in the region, accounting for 85% of the total ornamental fish production in the country.

The potential SIS found in NE India include *Amblypharyngodon mola, A. microlepis, Notopterus notopterus, Puntius sarana, P. ticto, P. chola, Chela bacaila, Nandus nandus, Esomus danricus, Glossogobius giuris, Danio devario, Brachydanio rerio, Pseudoambasis ranga, Chanda nama, Lepidocephalus sp., Botia sp., Rasbora sp., Salmophasia sp., Eutropichthys sp., Goniolosa manmina, G. chapra, Anabas testudineus, Channa marulius, C. striatus, C. punctatus, C. gachua, C. bleheri, C. aurantimaculata, C. stewartii, Clarius batrachus, Heteropneustes fossilis, Mystus seenghala, M. aor, Notopterus notopterus, Ompok bimaculatus, O. pabda, O. pabo, Ailia coila*, and more. Many of these species are cultivable and fetch competitive prices. Some are currently being cultured on a small scale through natural seed collection. They can also be incorporated into composite culture with carps for increasing overall pond fish production by 10 to 15%. These species are often self-recruiting, hence thinning of their populations in 3-4 months interval is necessary. If farmers miss the stocking of main crops in a particular season, they can still ensure some harvest by stocking these fish. This provides an opportunity for small farmers to enjoy the fish, using large carps as a cash crop and small fish for domestic consumption.

Nutritional Importance of Small Indigenous Fish Species

Small fish are rich in nutrients, providing a supplemental source of vitamins and minerals like calcium, phosphorus, vitamin A, iron, and zinc when consumed whole, including the head, organs, and bones. The vitamin A in small fish is primarily found in the eyes and viscera, in forms such as dehydroretinol and retinol, though the proportions vary by species. It's crucial to note that sun drying can destroy the vitamin A content in fish, so proper precautions should be taken.

Two species of the Esomus genus, *E. danricus* (Indian flying barb/Darkina) and *E. longimanus* (Mekong flying barb), are rich in iron and zinc, with high bioavailability. Their iron content is attributed to the presence of haem iron, complex-bound non-haem iron, and inorganic iron. The fish protein in these species may also enhance the absorption of non-haem iron and zinc in the human diet. Small fish consumed with their bones are excellent sources of calcium, comparable to milk in bioavailability. Utilizing small fish could address micronutrient deficiencies in rural populations. For instance, producing just 3 kg of vitamin A-rich mola (*A. mola*) per pond per year in the estimated 0.4 million ponds in NE India could meet the annual recommended intake for 0.6 million children.

Bangladesh, India's neighbor in the NE region, has made remarkable progress in harnessing the potential of small fish for food and livelihood purposes. A study conducted in rural northern Bangladesh in 1997 found that during the peak fish production season, small fish intake met approximately 40% of the vitamin A and 32% of the calcium requirements for an average household. Mola, a highly abundant small fish in Bangladesh, contains over 2500 µg RAE of vitamin A per 100 g of fish; thus, consuming 140 g of the fish would fulfill a child's weekly vitamin A needs, considering the recommended daily allowance of 500 µg. Bangladeshi women have long believed that specific small fish species offer benefits for eye protection, pregnancy, and lactation. In Cambodia, a daily traditional meal comprising rice and sour soup made with *E. longimanus* can satisfy 45% of a woman's daily iron requirement. Just 20 grams of the fish help in meeting a child's daily iron and zinc needs. Unlike small fish, large fish have lower micronutrient content since only the edible parts are consumed, excluding bones, viscera, and organs.

Debnath et al. (2014) conducted a nutritional analysis of small indigenous species (SIS) in Tripura, revealing significantly higher levels of micronutrients compared to major carps. This finding underscores the potential of SIS in addressing prevalent nutritional deficiencies in NE India. For example, SIS varieties like Colisa, Mola, and Darkina boast 85% to 165% more copper and zinc (9.6-13.7 mg/100g) than major carps (4.8-5.2 mg/100g). These minerals

play crucial roles in immune function, growth, and development, making SIS an invaluable dietary addition where deficiencies are common. Moreover, SIS are rich in iron, ranging from 10.2-99.7 mg/100g, surpassing Catla's levels (9.2 mg/100g) by 11% to 982%. Iron deficiency, particularly prevalent among tribal populations in NE India, contributes to high rates of anemia. The abundance of iron in SIS, particularly in the more readily absorbed haem form, positions them as an effective strategy against anemia-related challenges. Additionally, SIS serve as potent sources of manganese, with levels ranging from 1.1-5.1 mg/100g, surpassing major carps (0.39-0.77 mg/100g) by 142% to 1205%. Manganese is vital for bone formation, reproduction, and nervous system function. Integrating SIS into diets can bolster manganese intake, especially in regions with limited dietary diversity.

Small fish are invaluable sources of macronutrients, offering high-quality protein and essential minerals in significantly higher proportions compared to many major carp species. For instance, dry Darkina contains a crude protein content of 67.5%, which is notably higher than rohu (61.2%) and mrigal (65.6%). During periods of relative deficiencies in essential amino acids, small indigenous species (SIS) can serve as a valuable supplementation option. Moreover, small fish like Mola, Darkina, and Puti are rich in potassium, with levels ranging from 0.65-0.95%, representing a substantial difference compared to major carps (0.33-0.52%) and Bata fish (0.42%). This higher potassium content supports various bodily functions, including nerve, muscle, and heart functioning, as well as sugar metabolism and oxygen metabolism in the brain. Furthermore, Mola, Darkina, Puti, and Colisa exhibit higher calcium content, ranging from 0.38-1.66%, compared to major carps (0.06-0.28%). Similarly, phosphorus levels in SIS range from 0.20-0.54%, with Colisa containing 0.54%, representing a significant difference over major carps. This higher calcium and phosphorus content in SIS contributes to vital bodily functions such as blood clotting, bone and teeth calcification, and energy release through adenosine polyphosphates activity.

Importance in Safeguarding Livelihoods

SIS holds a significant and inseparable position in the lives, livelihoods, health, and overall well-being of the people in NE India. Rural communities heavily rely on small fish to meet their daily protein needs. They possess traditional knowledge regarding the best locations, timing, and methods for catching SIS and cleaning, and cooking these small fish. They have developed ingenious techniques to harvest them in substantial quantities for local consumption and markets. Additionally, they know how to process and store the fish through value addition to ensure availability during lean seasons.

SISs have huge importance in rural nutrition, livelihoods, and food security, however, research efforts dedicated to the sustainable utilization and proliferation of these small fish resources have been limited. Many of these species are facing the risk of extinction due to factors such as scientific aquaculture practices and intensive agriculture. While small-scale aquaculture of species like *A. mola, E. danricus, Puntius sophore, Osteobrama cotio,* and *Gudusia chapra* has shown promising results in experimental settings, commercial cultivation is hindered by the lack of quality stocking materials and location-specific technologies. Captive breeding protocols have been developed for several of these species, but large-scale propagation is necessary.

Considerable efforts have been made to promote and conserve small fish species in NE India. ICAR, Tripura Centre, for instance, has prioritized species such as mola (*A. mola*), kanla (*N. notopterus*), darkina (*E. danricus*), puti (*P. sophore*), colisa (*C. fasciata*), etc for Tripura. Composite culture of major carps with the incorporation of these small fish has demonstrated 5-10% additional production.

Challenges and Way Forward

The aquatic environments of NE India are facing significant threats to biodiversity and ecosystem stability. Various strategies and priorities have been proposed to address this crisis. To achieve sustainable utilization of SIS resources, appropriate planning for conservation and management strategies is of utmost importance. It is essential to prioritize the protection of these species and their habitats while ensuring their responsible and sustainable use to safeguard their availability for future generations. The knowledge of indigenous fish species and the communities that rely on them is of utmost importance for ecosystem and habitat conservation, as well as for identifying important genes and genomes. In India, out of the 104 small indigenous fish species documented, six species are currently endangered, and 16 are considered vulnerable. The management of small fish is an area that requires dedicated attention and effort to address issues related to their promotion and conservation.

The ICAR-NEH has been actively engaged in efforts to conserve and improve the small indigenous species (SIS) in the area. However, there is still a notable research gap in preserving and promoting these vital resources, particularly in light of global warming. Research and development focused on expanding aquaculture using SIS through hatchery production need to be strengthened. It is important to prohibit indiscriminate and harmful fishing practices that damage young and juvenile fish, and regulations on fishing gear and mesh size should be enforced to safeguard the broodstocks of SIS. Immediate actions are required to establish repositories and accessions of genetic resources and identified fish varieties. Existing laws and regulations must be effectively enforced to prevent unnecessary killing of fish. Conservation and enhancement of the current gene pools of small fish

in floodplains, natural depressions, rivers, and other relevant water bodies can be achieved by establishing and maintaining fish sanctuaries, aquaculture perks, etc., in fishing areas. Stringent measures should be implemented to prevent the introduction of exotic fish species unless fully justified and supported by comprehensive environmental impact assessments. With available technology for seed production and culture of these SIS, farming practices need to be popularized and expanded to ensure the overall prosperity of fisheries and food and livelihood security in NE India. Public awareness campaigns are essential to promote the conservation of SIS.

Amblypharyngodon mola, a potential SIS *(photograph: ICAR, Tripura)*

Notopterus notopterus, a potential SIS under composite culture *(photograph: ICAR, Tripura)*

Glossogobius giuris *(Photograph: Dumbur Reservoir, Tripura)*

Ompok bimaculatus (a high value catfish and the State fish of Tripura is also fall under SIS)

Channa spp. & indigenous Anabas testudineus

Mystus sp. & Heteropneustes fossilis

Puntius sophore

Colisa fasciata, a dual purpose fish

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Role of Gut Health in Managing challenging environment in Shrimp

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Optimum nutrient utilization is the key for accelerating the growth of shrimp and augmenting the production potential. Consumer preference for the antibiotic-free shrimp and fish products attracted the scientists to find out natural growth promoter, as an alternative to antibiotic growth promoters in aquafeed. Dietary supplementation of organic acids and their salts as growth promoter has been proven in animal feed and well documented. Aquafeed sector has equally benefitted with this novel additive though it was lately introduced. However, unlike animal feed the use of acidifier in aquafeed needs a different approach due to diversified feeding habit and wide variation in structure of the digestive system and physiological function. Dietary organic acids can stimulate secretion of pancreatic enzymes, lower gastric pH, inhibit pathogens, act as a source of energy, improve mineral utilization and enhance nutrient digestibility, which could lead to enhanced growth performance of shrimp. It is envisaged that intensive aquaculture will be the major focus in coming decades to supply the quality protein to the burgeoning population with the limited water, land, and feed resources.

Mechanism of Gut Acidifiers

Mechanisms of action in shrimp, the dietary acidifiers exhibit their effects in gastrointestinal tract (GIT) as antimicrobial agent against and provide acidic environment for the better action of enzymes. Similarly, it can support the energy production through directly entering in metabolic pathway. However, in feeds the addition of organic acid can act an antimicrobial agent and can extend the storage of feeds. Action in gastrointestinal tract Acidifiers can improve gut morphology along with stimulation, secretion, and activation of the digestive enzymes by lowering the pH of the digesta of stomach and foregut of many aquatic species. Short chain organic acids can provide acidic pH in the GIT which can stimulate the activation of enzymes like pepsin and other pancreatic enzymes and enhance digestion.

Action on metabolism Organic acids have considerable amount of energy stored in the form of chemical bonds and hence, they can act as a good energy source. The SCFAs absorbed through intestinal epithelia by passive diffusion can directly enter into the citric acid cycle and undergo for ATP generation.

How does it work?

1. **Palatability**

- Acidifiers enhances the feed palatability as well as intake.
- Mold inhibition due to presence of organic acids increases longevity.
- Controls Bacterial growth in feeds due to environmental conditions

2. **Nutrient Digestibility**

The effects of short chain organic acids go beyond modification of gut microflora, and other benefits such as improved digestive enzyme activity, increased pancreatic secretion, enhanced development of intestinal epithelium and intestinal barrier integrity and enhances the absorption of minerals including phosphorous, magnesium, sodium, and calcium. Enhances the bioavailability of minerals. Dietary supplementation of organic acids, their salts, or mixtures of those, could improve growth, feed utilization, disease resistance and survival.

3. **Effect in Gut**

The morphological feature of the gut is an important factor which determines the mode of action of the acidifier. Both gastric and gastric fishes are benefitted from the organic acid. Therefore, the diversity in the fish gut morphology complicates to generalize the effective dietary acidifiers and their optimum doses for all cultivable fish species rather it varies from species to species. Organic acids and their salts exert their growth inhibiting effects on stomach and gut microbes through pH reduction and anion and proton effects in the microbial cell. Moreover, small acids are lipophilic and can diffuse across the cell membrane of gram-negative bacteria. In the more alkaline cytoplasm, they dissociate, and the released protons will subsequently lower the internal pH. pH reduction alters cell metabolism and enzyme activity thus inhibiting growth of intraluminal microbes, especially pathogens.

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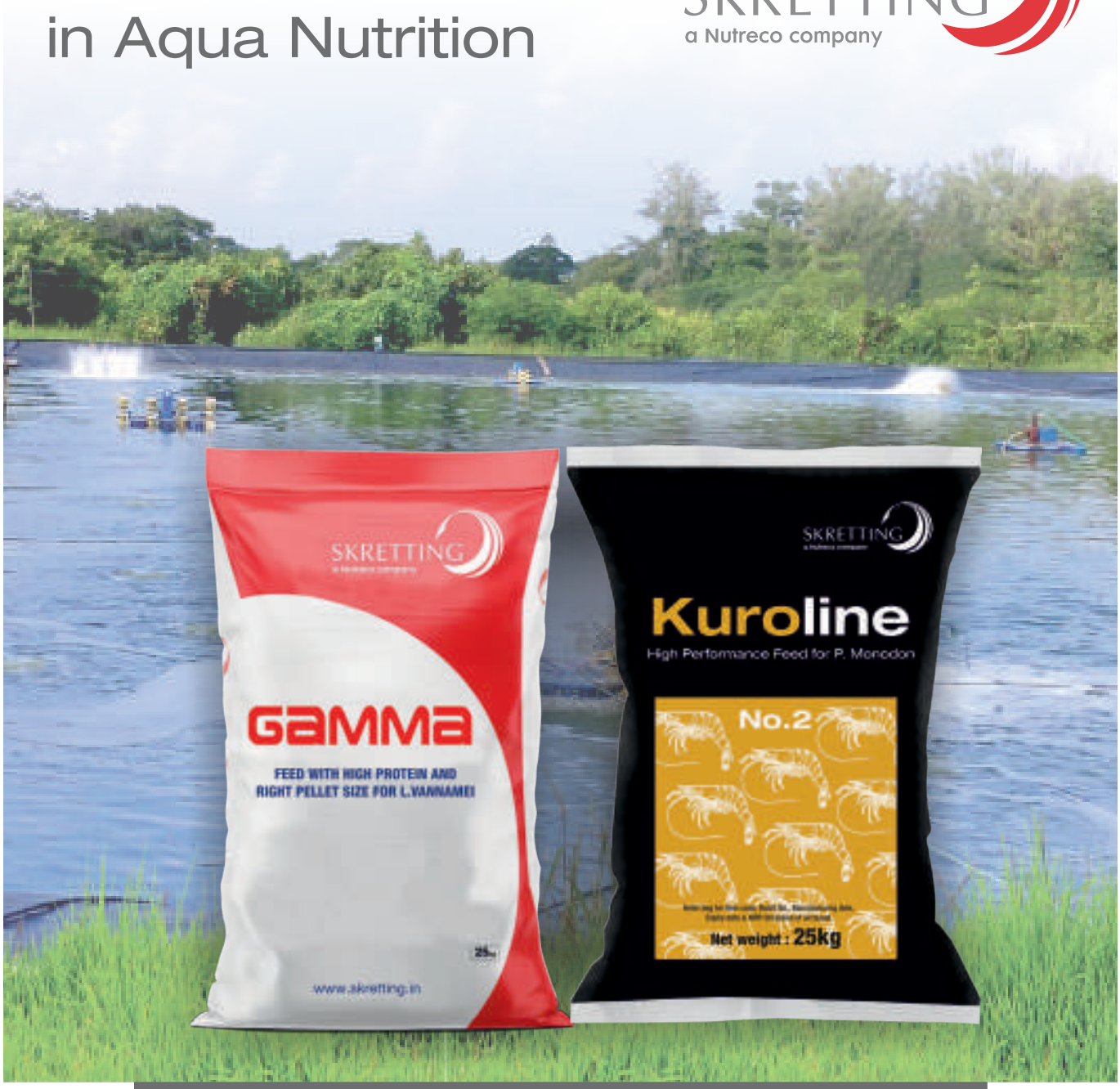

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4. Immunity

Acidifier can improve the general health status of cultured fish by its stronger antimicrobial effect towards acid-labile gram-negative bacteria, such as E. coli and Salmonella Sps, Vibrio Sps. than acid tolerant Lactobacilli Sps. Anti-inflammatory properties have been described and attributed to likely causes of enhanced performance when supplementing some of these organic acids particularly sodium or potassium salt of organic acids, especially potassium format or diformate low pH, the un-dissociated form of an organic acid is lipophilic and can passively diffuse through the cell wall of pathogenic bacteria and mould. In the more alkaline (higher pH) cytoplasm of bacteria, organic acid dissociates and causes the internal pH to decrease. This inhibits bacterial nutrient transport, cell metabolism and enzyme activity. Thus, inhibiting the growth and propagation of pathogens especially gram-negative bacteria in the fish gut but acid tolerant bacteria like Lactobacillus spp. etc. remained unchanged or may even be enhanced in numbers through propagation. The molecule of organic acid also attacks the DNA of gram-negative bacteria causing its death. Though medium chain fatty acids (MCFA) like capric, caprylic and lauric acid exhibit strong antimicrobial effect both on gram negative and gram-positive pathogens.

Commonly used Acidifiers in Aquaculture

1. Formic Acid or Calcium Formate and Potassium Formate as their most important salts.
2. Acetic Acid or its Sodium salt Sodium Acetate
3. Propionic Acid or Calcium Propionate; Butyric Acid or Sodium Butyrate
4. Lactic Acid and Citric Acid, Malic Acid, Fumaric Acid

Effect of Acidifiers in Feed

1. Higher growth rate
2. Increases protein digestibility.
3. Better feed conversion
4. Improved immune response.
5. Better Feed conversion ratio.

Effect of Acidifiers in Gastrointestinal Tract

1. Reduce the pH of the gut.
2. Improve the action of digestive enzymes.
3. Improves nutrient absorption.
4. Support the growth of beneficial bacteria so it promotes higher production of metabolites.

Summary

The concept of using dietary acidifiers in aquaculture has been successfully established since a decade ago. Acidifiers can be supplemented in the feed either as free organic acids or as their salts singly or in a blend (mixtures) of two or more than two organic acid salts with the combination of other functional additives. But dietary supplemented organic acids or their salts can hardly reach to the distal part of the gut to exhibit their mode of action.

Through stimulating secretion of pancreatic enzymes, lowering gastric pH, inhibiting pathogens, acting as an energy source, improving mineral utilization, and enhancing nutrient digestibility dietary organic acids can lead to enhanced growth performance for augmenting fish production. Though, the concept of using acidifier started since 1960 as addition of individual organic acid or their salts, but 2nd generation acidifier came with blending of different organic acids in different proportion to harness the maximum benefit.

About Skretting

Skretting is a global leader in providing innovative and sustainable nutritional solutions and services for the aquaculture industry working closely with shrimp and fish farmers. Our purpose is 'Feeding the Future'. Skretting has 30 production facilities in 18 countries on five continents and manufactures and delivers high-quality feeds from hatching to harvest for more than 60 species. The total annual production volume of feed is more than 3 million tonnes. It is headquartered in Stavanger; Norway and it employs 4,000 employees. Its team of more than 140 employees is dedicated to Innovation that works on the core competencies of nutrition, feed production and health for aquaculture. In India, we have head office in Hyderabad and our manufacturing footprint in Surat, Gujarat.

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Cultivation of Infusoria: *A step-by-step guide for fish farmers*

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Introduction

Aquaculture has been supported worldwide due to its contribution to an economy, human food, and a decent meal for people (Hussain et al., 2011). Aquaculture is an incredibly cheap and successful protein compared to other sources (Sahu et al., 2000). The major carps and other common cyprinids are the most cultivated in the culture of aquaculture, which have the highest production around the world. However, in the complex and multi-factorial world of aquaculture, such an important species for growing fish in the initial stages of development as infusoria should also be specifically mentioned as they serve as an ideal starter food for initial stages of fish larvae. Infusoria or tiny living beings are irreplaceable in the culture of aquaculture in the initial stages of development of fish larvae (Hirata et al., 1998). *Paramoecium*, *Fabrea*, *Euplotes* and *Stylonychia* are the main forms of freshwater infusoria. These microscopic organisms are food for many young fish and invertebrates and play an important role in their early growth and development. Therefore, understanding the technique of growing infusoria is essential for any successful aquarist. Infusoria are very small, but they have very soft bodies and are very nutritious. To grow the infusora, media containing lettuce, cabbage and banana peels are used, which stimulate the growth of the infusora in laboratory conditions (Zableckis, 2010). In this comprehensive guide, we will explore the process of growing infusoria step by step, its importance and use in aquaculture.

What are Infusoria?

Infusoria is a broad word that refers to minuscule aquatic creatures, including ciliates, euglenoids, protozoa, unicellular algae, and small crustaceans. These organisms include protozoa, rotifers, and other microorganisms that are not visible to the unaided eye. The species may be found in verdant lagoons, as well as in both fresh and brackish water, as documented by Hudinaga and Kittaka in 1975. Their primary diet consists of bacteria, algae, flagellates, decomposing debris, and

- Infusoria serve as a critical source of live food for a number of aquatic creatures, including fish fry, shrimp larvae, and even certain adult fish species
- The cultivation method of is crucial part of aquaculture, providing a sustained and nutritious supply of live food for aquatic species.
- Banana peels, hay, potato peels, lettuce, dried beans, cabbage, dried blood, egg yolks, tree leaves, spinach and dry aquarium plants are all acceptable ingredients for culturing infusoria.

plants. Conjugation is the method of sexual reproduction, whereas binary fission is the method of asexual reproduction. These microorganisms serve as the foundation of the aquatic food chain, supplying nourishment for many aquatic creatures, particularly during their early life stages.

Importance of Infusoria in Aquaculture

The success of aquaculture relies on the presence of robust and disease-free farmed organisms. To ensure the health of the cultured stock, it is important to provide them with a combination of live food and supplemented artificial feed. Artificial feed supplementation is insufficient to provide all the essential nutrients necessary for fish development (Chouhan and Choudhary, 2024). It plays a critical function in the early phases of aquatic life, notably for fish fry and larvae. Live food's size makes them a good initial diet for newly born fish, supplying important nutrients for growth and development. The most significant elements of live feeds, the diet may not be full / optimal for the species being farmed and long term or incorrect storage might result in feed quality degradation. We thus need to employ live feeds to complete the whole range of needs of an aquaculture diet by overcoming the inadequacies of artificial feeds. This is made feasible by the many unique benefits that live feeds provide, including domesticating wild fish for aquaculture, supplying minerals, vitamins, and medication, offering a balanced diet, and being an appropriate first feed for many species of larvae and nauplii. Artificial larval meals are no match to actual food organisms in terms of acceptance, nutritional and other characteristics. Feeding behavior of fishes in natural water bodies is diverse among the species but all the fishes need protein rich live food for their better development, effective breeding and survival (Mandal et al., 2009). Providing suitable live food at right time play a key part in attaining optimal development and survival of the young ones of finfish and shellfish. To achieve optimum output and profitability, the nutritious components of natural foods must be identified and measured. Furthermore, infusoria production gives aquaculturists a cost-effective and sustainable way of delivering live food for their fry, decreasing reliance on commercial feeds and assuring adequate nutrition.

Step-by-Step Guide to Cultivating Infusoria

1. **Set up the Culture Container**: Begin by selecting a clean, transparent container/jar/tank or a plastic tub. Ensure the container is thoroughly cleaned to prevent contamination. Fill it with dechlorinated water sourced from the same environment where the fry will be raised.
2. **Introduce Organic Matter**: Infusoria thrive on organic matter, so add a small amount of plant material such as lettuce leaves, spinach, banana peels, spent mushroom or rice grains to the container. These materials will decompose over time, releasing nutrients that support the growth of infusoria by acting as feed for them.
3. **Provide Aeration and Light**: Infusoria cultivation needs proper aeration and light. Install an air pump and airstone to provide proper oxygenation of the water. Additionally, position the culture container in a well-lit location, but avoid direct sunlight to prevent overheating.
4. **Wait for Infusoria Growth**: Patience is crucial in infusoria cultivation. Allow the organic debris to decay gradually, giving a nutrient-rich environment for infusoria to grow. Depending on climatic circumstances, infusoria populations may become evident between a few days to a week.
5. **Harvesting Infusoria**: Once the culture is established and bursting with infusoria, it's time to collect them for feeding. Use a fine mesh net or a pipette to collect the infusoria from the culture container. Rinse them carefully with fresh water before giving them to fish fry or larvae.
6. **Maintain the Culture**: To preserve a continual supply of infusoria, it's vital to maintain the culture routinely. Remove any surplus organic stuff to avoid polluting of the water. Additionally, refresh the culture with new water occasionally to ensure ideal circumstances for infusoria growth.

Culturing infusoria on farm

Culturing infusoria may be achieved by immersing items in previously cooked water for many weeks. Banana peels, hay, potato peels, lettuce, dried beans, cabbage, dried blood, egg yolks, tree leaves, spinach and dry aquarium plants are all acceptable ingredients. De-chlorinated water like distilled, boiling pond water, rain water and spring water works best for the culture.

a. Potato culture: Potato is available in cheap price in market and can be used to create the dense cultures of infusoria, by following the steps-

- ⇨ Cut a raw white potato into quarter-inch squares and wash well for use as a medium
- ⇨ Add around 300-400 gm of quarter-inch shaped potato to a gallon of spring water and allow them to stand overnight
- ⇨ Then inoculate the mixture with roughly one ounce of old culture material and let stand for about ten days
- ⇨ Growth of infusoria is visible easily after 3-4 days and can be used to fed fishes after it become dense
- ⇨ As the culture water is taken for usage it may be replenished with boiling pond or spring water

b. Banana peel culture: Peels of banana can act as a good source of starter feed for the infusoria and can be collected from juice shops. By following the below given steps infusoria can be cultured on farm-

- ⇨ Fill a gallon jar with clean, filtered pond water and add a dried banana peel

- ⇨ After two days the skin will have gone to the bottom and a strong bacterial scum should cover the water's surface. This scum is acting as feed of infusoria
- ⇨ Add little amount of old culture water or old aquarium water into the jar
- ⇨ After two weeks infusoria will generally be in apparent when the water clears up
- ⇨ The culture water is then utilized as a source of food for fish larvae

c. Lettuce culture: If plenty leaves of lettuce are available then it was used for the culture of infusoria on farm site by following these steps-

- ⇨ Rotten lettuce leaves are placed in a wide-mouth glass jar in enough amounts to atleast cover the bottom of the jar
- ⇨ Add water to fill the jar approximately 3/4 of the way full
- ⇨ Leave this jar standing and uncovered for 24 hours
- ⇨ Add 100 ml of old aquarium water (from the surface of the tank) and cover the jar
- ⇨ After one week, the water in the jar should contain a thick growth of infusoria
- ⇨ Once in every ten days a rotten lettuce should be introduced to keep the culture developing.

d. Dry peel culture: Dry peels of plants and trees can also be utilizes as a cost effective method of infusoria production by following these steps-

- ⇨ Add dry leaves in jar to cover the bottom
- ⇨ Add water to fill the jar approximately 3/4 of the way full
- ⇨ Leave this jar standing and uncovered for 24 hours
- ⇨ Add 50 ml of old aquarium water and cover the jar
- ⇨ After 10 days, the water in the jar should contain visible growth of infusoria

e. Mushroom spent culture: After the mushroom production the spent of mushroom is usually thrown and this should be used for producing infusoria by following given steps-

- ⇨ Add 2-3 kg mushroom spent in 50 liter tank/drum
- ⇨ Add water to fill the tank/drum
- ⇨ Leave this standing for 1-2 days
- ⇨ Add 1 liter of old aquarium water and cover the tank/drum
- ⇨ After 10 days the water is used as feed

Usage of Infusoria in Aquaculture

Infusoria serve as a critical source of live food for a number of aquatic creatures, including fish fry, shrimp larvae, and even certain adult fish species. Their minuscule size makes them a great initial diet for freshly born fish fry, supplying important nutrients for growth and development. Aquaculturists produce infusoria-rich cultures to offer a consistent supply of food for fragile fry, boosting their survival rates. This natural and cost-effective strategy underlines the necessity of harnessing the power of microscopic life in sustainable aquaculture methods. Aquaculturists typically include infusoria into the feeding regime of their fry, eventually moving them to bigger prey as they mature.

Conclusion

The infusoria as a live food became important due to its nutritional benefits and healthy operation of the hatchery or larval rearing. The cultivation method of is crucial part of aquaculture, providing a sustained and nutritious supply of live food for aquatic species. By following the step-by-step approach mentioned above, aquaculturists may build and maintain robust infusoria cultures, assuring the health and vitality of their fry and contributing to the overall success of their aquaculture activities.

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