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Aqua International

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Health • Nutrition • Management • Processing
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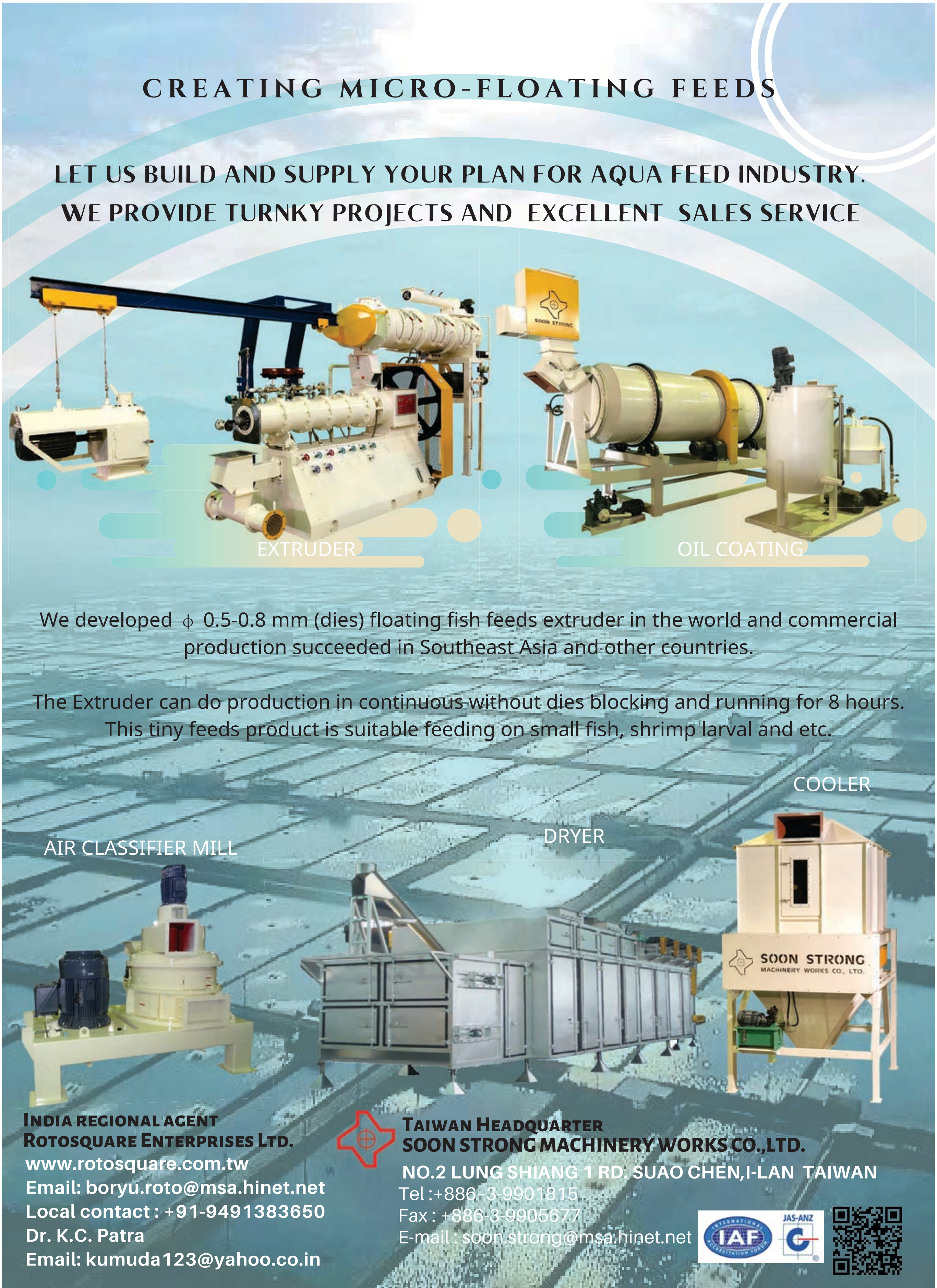
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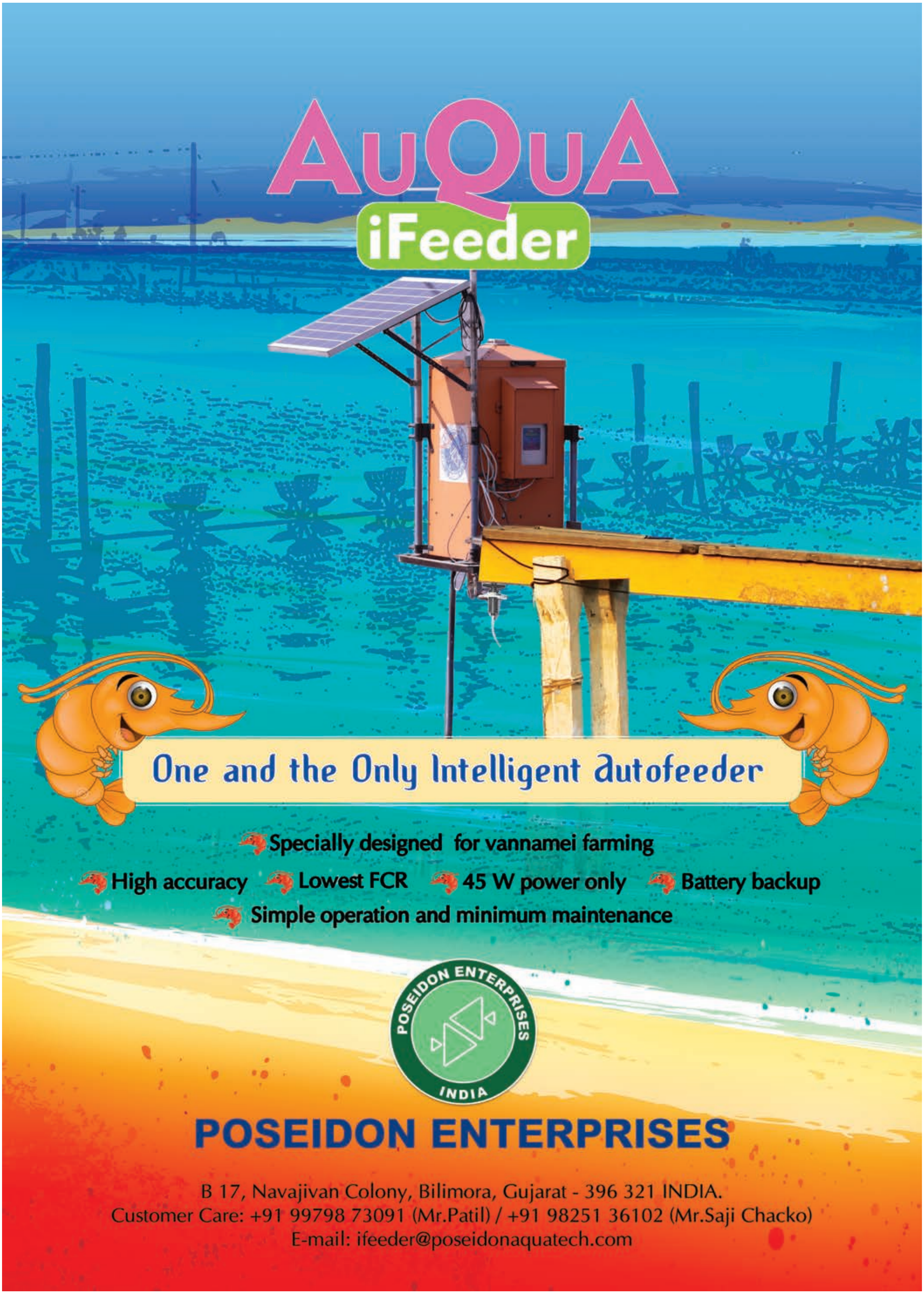
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Aqua International

English Monthly Magazine
(Established in May 1993)

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M. A. Nazeer

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Aquaculture Field Schools help a lot !

Scientific community says the white leg shrimp, Litopenaeus vannamei culture will bounce back soon in India

Dear Readers,

The December 2021 issue of Aqua International is in your hands.

In the News section, you may find news about –

Coastal Aquaculture Authority informed that CAA is implementing a voluntary certification programme for the issuance of Certificate of Compliance for Antibiotic Free Aqua Inputs. In this connection, CAA had issued a revised Guidelines on 01.11.2021 based on which the applications from the Input Manufacturers and Importers for Certificate of Compliance will be scrutinized. In this Guidelines, a Task Force has been envisaged for collecting samples of aquaculture inputs from the field / manufacturing facilities and testing them in the empanelled or designated laboratories for the presence of banned Antibiotics.

CAA has not directed or requested any Authorities or Agencies to check for the CAA certification status of the aqua inputs. Hence, the stakeholders are requested to ask for the identity of the individuals or officials and the Authority under a which they are undertaking such activity.

In the Articles section – Article titled **Robotic Revolution in Aquaculture Industry** written by T.Raahavishree, V.Ezhilarasi, Cherylantony and B. Ahilan, Dr. M.G.R Fisheries College and Research Institute, Ponneri highlighted that

Robotics is an interdisciplinary field that integrates computer science and engineering. It develops machines that can substitute for humans and replicate human actions. In the fast paced world, an aqua robot revolution is imminent with fish monitoring machines ready to dive into the oceans and start replacing humans.

Robotics integrated with aquaculture substantiated an impeccable output periodically. The evolution of aquaculture through robotics is on the horizon. The cutting edge science never fails to impress us through its labour-saving methodologies and trailblazing technologies; it would be unsurprising if they didn't find their way into many aspects of seafood production. By fully embracing and investing in AI and automation, we can significantly produce more seafood to feed the growing world population, while reducing the cost and environmental footprint of aquaculture operations.

Another article titled **Antimicrobial Resistance In Aquaculture** authored by Sudarshan S, Krishnaveni K .N, Alamelu V., Aanand S, Dr MGR Fisheries College and Research Institute, highlighted that Aquaculture is a rapidly growing food-producing sector that currently accounts for more than 50% of the fish for human consumption worldwide. Overcrowding and water quality deterioration in high-density fish-producing systems necessitates the need for antimicrobials.

Article titled **Importance of Photosynthesis Bacteria in Pond Management and Health Performances in Aquaculture** authored by Dr Prakash Chandra Behera, General Manager (Aqua), PVS Group discussed that aquaculture industry is rapidly growing and is now considered a major contributor in the global food production. To meet the global demand, aquaculture production practices have been intensified to a greater extent both in technological and practical measures. Aquaculture generates considerable amount of wastes, consisting of metabolic by-products, residual food, fecal matters and residues of prophylactic and therapeutic inputs, leading to the deterioration of water quality and disease outbreaks. Due to fast expansion of aquaculture and the use of more modern farming technologies that involve higher usage of inputs such as water, feed, fertilizers and chemicals.

Most probiotics proposed as biological control agents in aquaculture and suppressed the activity of Vibrio harveyi with increasing the survival rate. Photosynthetic bacteria also suppress the pathogenic vibrio like Vibrio harveyi, Vibrio parahaemolyticus and Vibrio splendens and reduce the opportunistic invasion of these pathogens in shrimps.

Contd on next page

NRS GROUP
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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The photosynthesis bacteria helps for use in aquaculture to clean up the pond bottom, maintain good water quality and improve shrimp health in aquaculture. The role of beneficial bacteria to control pathogens will become particularly important in aquaculture. The photosynthesis bacteria use as bioremediators will gradually increase and the success of aquaculture.

Article titled **Women Empowerment in Aquaculture** written by Gora Shiva. Prasad, Rajesh Debnath, Sutanu Karmakar Sangram Keshari Rout and P. Sruthi, Faculty of Fishery Sciences, West Bengal University of Animal and Fishery Sciences, Kolkata and College of Fishery Science, SVVU, Muthukur,

Andhra Pradesh said that gender quality and women empowerment are the keys to be successful in all areas but women are considered the most undervalued human resources and utilized inappropriately. Globally, they represent 47% of the fisheries workforce, and in small-scale fisheries catch, they contribute 25 to 50% in some regions (Harper et al., 2017). There is a great distinction in the activities of men and women in the fisheries sector including aquaculture and mostly they are complementary. These distinctions often depend on social, cultural and economic status. The contribution of women in fisheries is often overlooked due to some reasons. Several models have been used by the researchers to evaluate the women empowerment and also the factors that influence on women empowerment.

The government NGOs, including FAO and research institutes should take measures to introduce programs which help in the upliftment of women in self employment in aquaculture and processing sector by reducing time burden on them.

Another article titled **Role of Quality Control in Aqua feeds** authored by Sabiha Kadari, Technical Head, Nutreco India; Avinash Bhat, Laboratory Manager, Nutreco India; Shweta Tiwari, Laboratory Technician, Skretting India explained that in aquaculture, the level of productivity and economic efficiency of farming systems are influenced to greater extent by the quality of feed delivered to animals. The nutrients delivered through the feed are essential for promoting and maintaining the animal health, production and reproduction. The quality of aqua feed influences the animal performance and, consequently, the nutritional quality of fish and shrimp meat that has been supplied to the consumer market with a direct correlation of feed to food safety, considering that the managemental and farming practices are adequate.

The advantages of using NIR analysis is that it provides rapid analysis data, requires little sample preparation, is void of any chemicals usage and is a relatively safe technology, as against the traditional wet chemistry. It is non-destructive, operator friendly, fast (30-60 seconds), reliable, precise and a perfect tool for quality control. That said, the way the calibrations are developed, standardized and validated, play a critical role with respect to the authenticity of the results produced.

As the input data originates from wet chemistry, the wet chemistry methods need to be validated by ring tests, for the NIR outputs to be strong enough (What you input, comes out – so the input is critical). NIR technology is a boon to the modern-day feed production process, wherein efficiency in each and every step plays a critical role, in optimizing the entire production value chain.

Article titled Can Aquaculture Field School be an Alternative to Traditional Approach of Fisheries Extension written by the authors H K De,G S Saha and S K Swain, ICAR-Central Institute of Freshwater Aquaculture stated that Aquaculture Field School is a school without walls for improving decision making capacity of farming community in aquaculture. It is a participatory extension approach whereby fish farmers are given opportunity to make choice in the methods of aquaculture production through discovery based approach. AFS is composed of a group of farmers who regularly meet. Typical group strength is 20 to 25. The basic tenets of AFS are: fish farmers are experts; the fish farm is a learning place; fishery extension worker as facilitator not teacher; scientists/ SMS (subject matter specialist) work with rather than lecture them; learning materials are learner centered. The principle of AFS is similar to that of Farmers Field School implemented in agriculture.

AFS approach relied heavily on non-monetary inputs with technical advice and interaction as primary intervention. Sharing of experiences with the lead farmer at the AFS has brought in confidence among them in scientific fish farming. This approach of 'farmer to farmer' extension with no physical input would certainly be sustainable in the long run. It is suggested that AFS be established in each district enabling the lead farmer to meet the information requirements of fellow fish farmers effectively.

Article titled **Is Fishmeal free Aquafeed a Myth** written by Authers Ramya. R, Jemila Thangarani. A and Shanmugam S.A, Institute of Fisheries Post Graduate Studies, Tamilnadu Dr. J. Jayalalithaa Fisheries University, OMR Campus, Vaniyanchavadi, said that Fishmeal and Fish Oil are the two incredible ingredients of aquafeed. FM is an excellent protein source, mainly used in feed for aquaculture species and livestock. FO is mainly used to produce feed for farmed fish and refined FO for human consumption (FO capsules). This article highlights the need for Fish Meal, its unmatchable nutritional quality, FM replacers and sustainable feeding of the growing human population.

Another Article titled **The white leg shrimp, Litopenaeus vannamei culture will bounce back soon in India** written by authors Ashwinikumar and P.Soundarapandian CAS in Marine Biology Annamalai university

Aquaculture is an important socio-economic activity, particularly for rural sectors, contributing to livelihoods, food security and poverty assuagement through income production, pay, services, use of local resources, diversified farming practices, local and international business and other economic investments serving the sector. Shrimp aquaculture which is being trained along the coasts fulfill all the above-mentioned contributions. It is stagnant during the last few years mainly due to viral disease outbreaks and reduction in global shrimp price. However, China, Thailand, Indonesia and Vietnam have been shifted to a substitute species, Litopenaeusvannamei, commonly known as the Pacific white shrimp. Pacific white shrimp (L. vannamei) is a commercially significant species with high market price. Availability of Specific Pathogen Free and Specific Pathogen Resistant seeds and the suitability of the species for even high stocking density culture have led to the dramatic jump in the percentage contribution of the species in the world shrimp production.

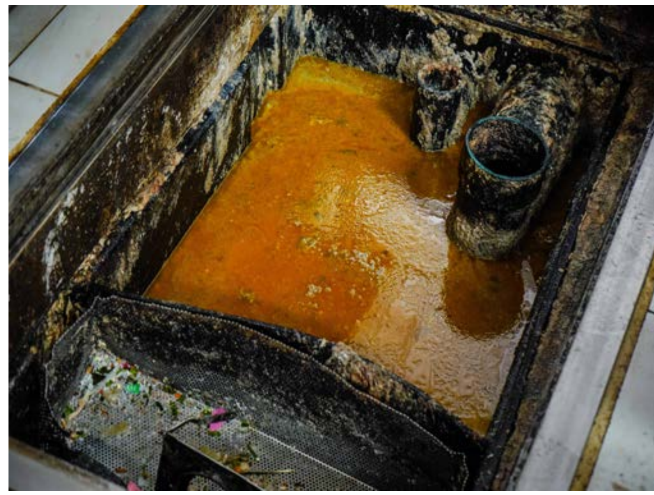
M.A.Nazeer
Editor & Publisher
Aqua International

CAA advisory to Coastal Aquafarmers and Aqua Shops/Dealers/ Distributors

Chennai: CAA informed that they are is implementing a voluntary Certification programme for the issuance of certificate of Compliance for Antibiotic Free Aqua Inputs. In this connection, CAA had issued a revised Guidelines on 01.11.2021 based on which the applications from the Input Manufacturers and Importers for Certificate of Compliance will be scrutinized. In this Guidelines, a Task Force has been envisaged for collecting samples of aquaculture inputs from the field / manufacturing facilities and testing them in the empanelled or designated laboratories for the presence of banned Antibiotics.

CAA has not directed or requested any Authorities or Agencies to check for the CAA certification status of the aqua inputs. Hence, the stakeholders are requested to ask for the identity of the individuals or officials and the Authority under which they are undertaking such activity. As on date, CAA is neither involved nor sought any Assistance of any Authority / Agency for the enforcement of this guidelines, said Ms V. Kripa Member Secretary, CAA.

Grease trap maintenance challenges in restaurants, cafeterias, other food processing facilities



Restaurants, cafeterias, and other food-processing facilities often face grease trap maintenance challenges. Too much fat buildup can lead to bad smells, clogged drains, and even fines for exceeding acceptable BOD or FOG (fat, oil, grease) discharge levels. Bionetix® International offers a biological solution for keeping the fat in check and grease traps under control with ECO-TRAP. ECO-TRAP is new, natural grease trap treatment containing speciality additives that loosen and liquefy heavy grease deposits, there by speeding up their degradation.

It reduces oil and fat accumulation, prevents emergency blockages, and reduces BOD and bad odors. ECO-TRAP contains biological nutrients and stimulants that boost the natural bacterial population to form a larger colony. The more beneficial bacteria are present, the more power is available to break down the fats, oils, and greases filling up the grease trap.

Goverment of Andhra Pradesh Fisheriesh Department

From
To
K.kanna babu, I.A.S
The representatives of the concerned
Commissioner of fisheries stakeholders (as per list enclosed)
Poranki-521137
Bandar Road
Vijaywada
Letter No.800/P1/2020
Date: 05-11-2021
Sir, Sub:- Fisheries-Endorsement of existing licenses / Applying for issue of new licenses / Registrations for Aquaculture farms and aquaculture business operations under APSADA Act, 2020 before 31-01-2022-regarding

Ref:-

1. The APSADA Act, 2020 (Act no.29 of 2020)., dated: 5-8-2020.
2. G.O.Ms.no.28, AHDD &F (fish) Department, dated 18-8-2020.
3. G.O.Rt. No.28, AHDD &F (fish) Department, dated 05-02-2021.
4. G.O.Rt. No.152, AHDD &F (fish) Department, dated 18-06-2021.
5. G.O.Rt. No.225, AHDD &F (fish) Department, dated 25-08-2021.

I invite kind attention of the stakeholders in the address entry to the references cited.

The references pertain to the enforcement of the APSADA Act 2020.

In The G.O. Fifth read above , the government have issued orders for publication of Notification in govt gazette, under sub-section (3) of section 1 of the APSADA Act,2020, TO APPOINT THE 1st day of October, 2021 as the date on which the provisions of the said Act, shall come into force by superseding the earlier orders issued in the references second to fourth read above and also by upholding the validity of Endorsements/ licenses Already issued, if any, and any action taken under the said act and its Rules from the previously notified appointed day i.e. 05-08-2020.

Therefore, it is to be noted that the endorsement of the existing licenses of the aquaculture farms and Aquaculture Business operation have to be done on or before 31-01-2022 as per the provisions of the APSADA Act 2020(section 22(1) & (2) and Section 23 (!), (2) &(8)).

The online process at village secretariats for applying for endorsement / new license for aquaculture business operations has put into functional mode since 30-10-2021.

In view of the above , the representatives of the aqua farms and aquaculture Business operations are requested to note the above and inform all the aqua culture note the above and inform all the Aqua Farmers and aquaculture business operators and apply for endorsement of their existing units on or before 31-1-2022 as per the provisions of the APSDA Act and rules in their respective village secretariat through online.

Encl: as above Yours faithfully Commissioner of fisheries

List of Representatives of aqua farms and aqua culture Business operations

1. The president, All india shrimp Hatcheries Association
2. The President, A.P.state fish farmers Association
3. The president, Delta fish farmers Association
4. The president, All India shrimp farmers Association
5. The president, Society for Aquaculture Professionals
6. The President, Aqua shops Association
7. Sri. Y . surya Rao Progressive shrimp farmer, East Godavari Dist
8. The Managing Director Avanti feeds , west Godavari dist.
9. The Managing Director C.P.Feeds, West Godavari Dist.
10. The Managing Director Growel Feeds, West Godavari Dist.
11. The Managing Director Galaxy Feeds, Krishna dist.
12. The Managing Director Godrej agro feeds, Krishna District
13. The Managing Director Nagahanuman feeds, west Godavari dist.
14. The Managing Director Anandha feeds, Bhimavaram.
15. The Managing Director Uno feeds, Bhimavaram, West Godavari dist.
16. The Managing Director Nexus Feeds, Bhimavaram, west Godavari dist.
17. The Managing Director Cargil Feeds, East Godavari Dist.
18. The Managing Director BMR Feeds, Nellor Dist.
19. The Managing Director Deepak NExgens Feeds, Krishna Dist.
20. The Managing Director Unibaite feeds, Krishna Dist.
21. The Managing Director Kwality feeds, Krishna dist.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FSSAI Releases Draft Regulations for GM Foods

Outlines Procedure for Prior Approval, Safety Assessment and Labeling MEENAKSHI VERMA AMBWANI

New Delhi, November 17
In a move that is expected to bring regulatory clarity on genetically modified on foods, the Food safety and Standards Authority of India (FSSAI) has released draft regulations stating that no one can manufacture or sell any food products or food ingredients derived from genetically modified organisms (GMOs) without prior approval.

The draft has been released for seeking stakeholder views, after an inter-ministerial consultation process.

The draft regulations outline the procedure for approval as well as safety assessment and labeling norms. It also specifies norms that labs will need to adhere for testing GM foods.

The regulations' ambit will include food products, that may have been made using food ingredient or processing aid derived from GMOs, even if GM content is not present in the end product.

The food safety authority has also said that Genetically Modified Organisms or Genetically Engineered Organisms "shall not be used as an ingredient" in infant food products.

"No person shell manufacture, store, distribute sell or import in the country any food or food ingredient, as the case may be, derived from Genetically Modified Organisms, except with the prior approval of the Food Authority. The provisions of this regulation are in addition to, and not in derogation, of any other rules or regulations made under the Act," the draft regulations stated.

Labelling norms

The draft also proposes labelling norms for food products that contain one per cent or more that one per cent of GMO content. "All food products having individual Genetically Engineered (GE) ingredient one per cent or more shall be labelled- contains GMO/ Ingredients derived from GMO." the draft regulations stated.

Industry observers said the regulations once finalised will bring in clarity of regulatory status especially when it comes to imported food products.

In a bid to ensure only non-GM crops are imported into the country, the food safety regulatory had last year said that imports of 24 crops will need to be accompanied with "Non-GM,GM-Free" certificate from January 1. However, after receiving some representations from stakeholders it was postponed and these norms march 1. The norms were laid down since FSSAI was in the process of finalising the regulations.


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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
NITROBACTOR
STABILIZERS

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

PRESENTATION: 500 gms &1 kg

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Robotic Revolution in Aquaculture Industry

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Introduction

Robotics is an interdisciplinary field that integrates computer science and engineering. It develops machines that can substitute for humans and replicate human actions. In the fast paced world, an aqua robot revolution is imminent, with fish monitoring machines ready to dive into the oceans and start replacing humans. In the digital era Robotics coupled with Internet of Things (IoT) and Artificial Intelligence (AI) is the new quantum leap for escalating the production, modernization of culture techniques and sustainability. In aquaculture, wastage of inputs can be managed through AI and cost can be reduced up to 30%. Thus, AI provides complete control over the fish producing systems with less maintenance and reduced input cost. AI aquaculture farms can be maintained and managed in a much easier way with nearly 95% accuracy in operations.

Game changing innovation and its applications

Internet and its applications is boon for the fisheries sector. The sector was first greeted by the Internet of Things (IoT), but in this day and age aqua culturists are veering towards robotics and its futuristic inventions for domesticating aquatic species. At present, incorporation of robotics is done within aquaculture for its extensive application. A few mentions includes screening unviable seeds and removing it meticulously, smart automated feeding, keeping track of water quality using sensors, monitoring fish's growth performance and health status until final harvest. The rise of this avant-garde technology could prevent many problems faced by divers, e.g., fatal attacks like bends.

Game changing innovations that marked the rise of robotics in aquaculture (Shapawi, et al., 2021) It includes.,

1. Self-propelled, roving fish cages
2. Smart automated feed dispenser
3. Undercover parameter assessing sensors
4. Underwater monitoring & maintenance service

I. Self-propelled, roving fish cages

a. Aquapod: It is a free-floating, self- propelled, tethered offshore fish cage that can accommodate several hundred thousand fish. It is designed using thermoplastic polyurethane (TPU). It's jaw-dropping feature and the ability to manoeuvre with the oceans currents and stabilize it beneath the waves are some of the advantages of aqua pod. This pod was designed to resist rough seas while fully or partially submerged. The cages do not wreck the seabed due to their drifting nature therefore we could avoid the risk of losing the fish to bad weather or predators (birds and big fishes).

Highlight Points

- Refinement of new technologies such as robotics and automation has allowed many businesses to boost productivity, efficiency and safety
- Development of new robot technologies for daily and periodic inspection, maintenance and repair operations by controlling them remotely from a land-based control centre without onsite personnel
- Underwater drones, automated feeders and other high-tech tools give a glimpse into the future of fish farming
- Autonomy and remote control options in auxiliary tools – like ROVs, vessel control and cage-integrated intervention tools – will expand the time window for operations in exposed locations.
- Realtime aquaculture has developed an ingenious monitoring technology that delivers real-time data about open-water fish farm conditions (including water temperatures and oxygen levels) directly to a smartphone or web browser

II. Smart Automated Feed Dispenser

a. Umitron cell: A smart, real time ocean based fish appetite detection feeding system uses AI and IoT technology. This system automatically measures the size of the fish, by using a portable camera paired with the Umitron mobile app. The first unit was installed in Japan and are known to accelerate the growth rate of red sea bream. This device can be managed through a smartphone or desktop computer besides the fish data regarding its growth and numbers collected and stored in the cloud. The benefit of the device includes improved work environment (flexibility through remote control operations, reduction in boat trips etc) increased environment stability (reduction of waste feed), increased food supply stability and traceability.

b. AKVA group IR pellet sensor feeder: IR Pellet Sensor is suitable for automatic feeding of fish to satiation. Both the feed rate and feed amount is adapted to fish appetite. This ensures that the fish gets the correct amount of feed, at the right rate at the right time. The sensor is installed in the bottom of the funnel, below the fish main eating area and it uses Infra-Red single beam optics to spot the uneaten pellets.

c. eFishery Vibration-based sensor fish feeder: e Fishery's automatic smart feeder was developed for commercial aquaculture in Indonesia. It was designed for large and small-scale farmers. This system picks up on hungry fish behaviour through an in-water, vibration-based sensor that can read the movement of a hungry versus a full fish. The app lets farmers to see when this is happening on their phone and further it controls the system whenever it is needed. On an average, the system reduces the amount of feed waste by 21% with its "sophisticated algorithm-based feeding program." This device is employed currently for the culture of carp, catfish, tilapia, snapper and white leg shrimp

III. Undercover parameter assessing sensors

a. Akvasmart Multi Sensor: It houses six water quality sensors and measures 12 different parameters. The sensor is placed inside the cage and collects information about the temperature, salinity, oxygen, conductivity, water pressure, water depth, water level, and current.

b. Wireless sensor: AKVASMART digital CAP network sends signals to the software in case fish wants to eat based on the water temperature and the movement of the fish. Temperature sensor combined with the optical oxygen sensor and current sensor will provide excellent environmental reference points. The device is equipped with a 360 degree adjustable surface camera and directional antennas to ensure video are transmitted wirelessly from each pen to the base.

c. Biomass monitor: This system is automated and senses the fish on the whole column that it is floating on top of it. It sends daily reports to the software which contains information about the size of the fish, density, speed, and arrangement of the fish. It can even send a warning when fish is about to escape.

IV. Underwater monitoring & maintenance service

a. Underwater Drones: Underwater drones are known as unmanned underwater vehicles (UUV). The vehicles are capable of functioning under water without a human occupant. It is equipped with a sensor which can collect and analyse water quality data such as turbidity, temperature, dissolved oxygen, etc. and even heart rates of fishes. These data can easily be accessed through a Smart phone connected to the drone.

These vehicles are generally divided into:

- Remotely Operated Underwater Vehicles (ROVs) that are used to control the operations by a distant human operator.

Cage Reporter - Maintenance Bot: An autonomous, underwater robot ROV (Remotely Operated Vehicle) is known as cage reporter. It is controlled manually using images from the camera on the ROV. This robot will deliver laser-sharp photos of the cage in real time, as well as precise positioning data which allows it to navigate in surroundings that are constantly changing. With this technology, cage reporter can discover and report any deformations in the net and also it carry out systematic inspection and anticipate the future damage. Upon discovery of any hole, the ROV could repair it using a superior manipulator tool. Cage reporter is armed with robust technology such as sensors and artificial intelligence. Its communications system is based on acoustic signals. Huge emphasis was put on the development of a bio-interactive control function in order that ROV can better coexist with the fish without disturbing them. Blue Robotics has been a pioneer in developing a low cost ROV. One of the world's most affordable high-performance underwater ROV is Deep Trekker, it offers compact ROVs that can be carried by one person, designed for ease of use and portability. This system has much potential in aquaculture; mooring and net inspections, feed assessment and the company even offer specific attachments for net repair and mort retrieval

- **Autonomous Underwater Vehicles (AUVs),:** It is capable of functioning autonomously without any real-time human inputs. It has traditionally been tethered to boats or powered by bulky and expensive propellers. Watbotsan emerging autonomous robot company is an Norway based company aims to solve two of the biggest environmental problems in the fish farming industry such as algal growth and autonomous net inspection to prevent fish escaping. This company utilises machine learning, 3D vision analysis, and artificial intelligence. This company is still in 'secret mode', and will not disclose too many details about the core technology.

b. Saildrone: A saildrone is a wind and solar-powered unmanned surface vehicle (USV) capable of up to 12-month data collection missions on the open ocean. "Saildrone USVs have a minimal carbon footprint and are equipped with advanced sensors and AI technology to deliver critical data and intelligence from any ocean, at any time of year." Saildrone's system can autonomously collect crucial ocean

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data such as temperature, water chemistry and wave height but what is the most interesting is their ability to conduct fisheries stock assessments using a technique known as acoustic trawling. The drone can passively observe schools of fish and provide an estimate of their numbers. The primary goal of the Saildrone technology is to lower the cost of in situ ocean data collection. Saildrone works with science partners like NOAA to gather valuable data about fisheries, oil seeps and spills, meteorology, and underwater bathymetry.

c. ROV net cleaners: A flying net cleaner (FNC), remotely controlled to reduce marine fouling organisms. It has an inbuilt sensors and HD camera for productive cleaning.

d. Robotic Fish:

Scientists developed 'shoal'- a robotic fish that helps to detect pollution around the farm site. These robots independently swim and collect data about water quality. They can even communicate with each other using low frequency sound waves

e. SeaVax – Robotic Vacuum Ship

A solar-powered robotic vacuum cleaner that could pick up around 150 tons of plastic from the ocean built by Bluebird Marine Systems. Deck-mounted solar panels and two wind turbines will feed power to electric pumps and filters that will suck up plastic solids and micro plastics. The SeaVax would also be equipped with sensors to shut down operation if marine life is detected in its path. Strong suit about SeaVax is its accompaniment: drones that uses satellite technology to steer the ship to its destination.

Conclusion

Robotics integrated with aquaculture substantiated an impeccable output periodically. The evolution of aquaculture through robotics is on the horizon. The cutting edge science never fails to impress us through its labour-saving methodologies and trailblazing technologies; it would be unsurprising if they didn't find their way into many aspects of seafood production. By fully embracing and investing in AI and automation, we can significantly produce more seafood to feed the growing world population, while reducing the cost and environmental footprint of aquaculture operations.

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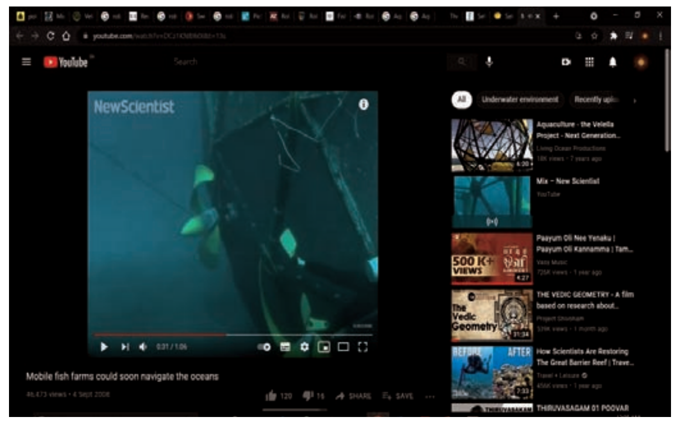
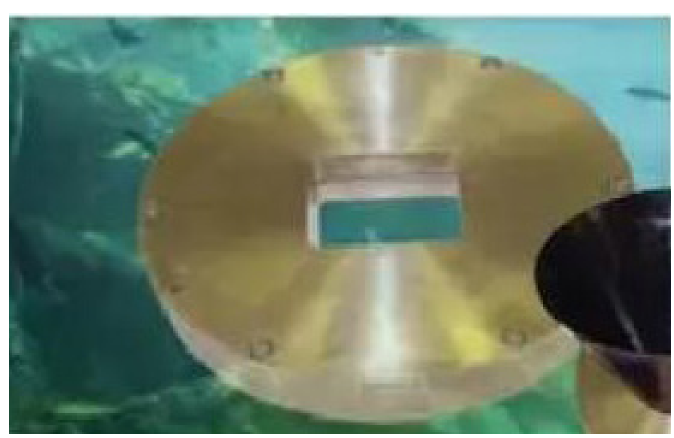
Aquapod



Electrical powered thrusters

Umitron Cell



The pellets are funnelled through the opening of the IR pellet sensor and detected, counted by the Infra-Red beam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eFishery's automatic smart feeder uses sensors to detect hungry fish behavior and dispense the right amount of feed.

Akvasmart Multi Sensor

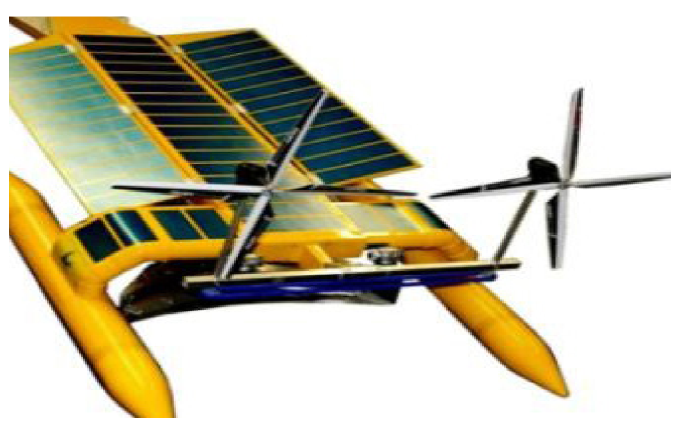
Akvasmart Digital Cap

Biomass monitor

Saildrone

Net Cleaning Rigs

Shoal – Robotic fish



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THE WHITE LEG SHRIMP, LITOPENAEUS VANNAMEI CULTURE WILL BOUNCE BACK SOON IN INDIA

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Annamalai university
Parangipettai-608 502

Aquaculture is animportant socio-economic activity, particularly for rural sectors, contributing to livelihoods, food security and poverty assuagement through income production, pay, services, use of local resources, diversified farming practices, local and international business and other economic investments serving the sector. Shrimp aquaculture which is being trained along the coasts fulfills all the above-mentioned contributions. It is stagnant during the last few years mainly due viral disease outbreaks and reduction in global shrimp price. However, China, Thailand, Indonesia and Vietnam have been shifted to a substitute species,Litopenaeusvannamei, commonly known as the Pacific white shrimp. Pacific white shrimp (L. vannamei) is a commercially significant species with high market price. Availability of Specific Pathogen Free (SPF) and Specific Pathogen Resistant (SPR) seeds and the suitability of the species for even high stockingdensity culture have led to the dramaticjump in the percentage contribution of the species in the world shrimp production.

India's seafood industry has become one of the leading suppliers of quality seafood to all the major markets of the world. India is the second largest fish and exporter of shrimps to EU, the 4th largest exporter of shrimps to Japan and the 5th largest exporter of shrimp to US. Sustainable fishing methods, increased shrimp aqua production particularly of L. vannamei offers best opportunity to participate in this growth.

The switch to Pacific white shrimp (L.vannamei) from giant tiger shrimp (P. monodon) has had a huge impact on India's shrimp production. Exports of farmed L. vannamei from the states of Andhra Pradesh and Odisha,the heart of India's shrimp farming industry, jumped from $385 million in 2011-12 to $730 million in 2012-13. India exported a record 91,000 MT of L. vannamei in 2012-13, compared to 40,787 tons in 2011-12, boosting total seafood exports by five percent in quantity and 12 % in value. India's Marine Products Exports Development Authority (MPEDA) reports that 22,715 ha of ponds are dedicated to L. vannamei farming, but seafood exporters, some of whom are themselves involved in shrimp farming, estimate that there may at least be 50,000 ha of L.vannamei ponds. L. vannamei farmers are even encroaching on forest and government lands, but these ponds are not registered, and their production is not counted in the official statistics. L.vannamei farms produce approximately ten MT a ha every year. But the aquaculture industry like other industry is suffering last two years due to covid 19 virus.

During the financial year 2011-12, for the first time in the history of Marine product exports, the export earnings have crossed US$ 3.5 billion. Exports aggregated to 0.86 million tones valued at Rs. 16597.23 crores and US$ 3508.45 million. Compared to the previous year, seafood exports recorded a growth of 6.02% in quantity, 28.65% in rupee and 22.81% growth in US$ earning. Frozen Shrimp is the major export value item accounting for 49.63% of the total US dollar earnings. The above was achieved during a period of collapse in the international market. One of the major reasons for the increase in production and higher export turnover was due to the introduction of SPF L. vannamei shrimp for Aquaculture production.

Considering the established infrastructure for farming shrimps in India, it is reasonably easy for L.vannamei farming and can substantially contribute to marine product export from the country. However, one of the major obstacles for increasing the L.vannameiproduction is the non-availability of quality SPF broodstock in India in required quantities. Currently shrimp hatcheries import L.vannamei broodstock from broodstock multiplication centers in USA, Thailand and Singapore with high shipping cost and transit loss due to mortality. Average cost of broodstock when it reaches the hatchery is estimated at Rs.5000/- and the higher cost of broodstock and transportation ultimately get transferred to the shrimp farmers who purchase seeds at a higher price (Rs. 0.6 per seed). High cost of broodstock is also prompting some hatcheries to source broodstock from shrimp ponds which ultimately results in the production of poor-quality seeds and subsequent crop loss to farmers. About 80% of the shrimp farmers are marginal and small-scale farmers with 0.5 to 5 ha water spread area and the success of the crop largely depends on the quality of seeds supplied to the farmers. Hence for sustaining the productivity and profitability of shrimp farmers, it is essential that quality seeds are provided to farmers at reasonable rate.

L. vannamei is considered to be more disease resistant, tolerant to high stocking densities, low salinity and temperature and with high growth rate. The decision to

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import L. vannamei in India was spurred further by the continuous demand of the shrimp growers and traders for the introduction of this shrimp as there is good export market potential for this species. The introduction of the exotic shrimp species L. vannamei is called for the set up of a quarantine facility which was essential to reduce the risks of adverse effects arising from the introduction of non native species. Subsequently, a dedicated quarantine centre for L. vannamei called the "Aquatic Quarantine facility for L. vannamei" (AQF), was established under the Department of Animal Husbandry Dairying and Fisheries, MoA in Chennai, Tamil Nadu and is being operated by the Rajiv Gandhi Centre for Aquaculture (RGCA), the Research & Development arm of Marine Products Export Development Authority (MPEDA), Ministry of Commerce & Industries, Government of India. The facility started its operation in July 2009 and is probably the only one of its kind to be in Southeast Asia, set up for the quarantine purpose of imported SPF (Specific Pathogen Free) L. vannamei.

The AQF serves as an approved quarantine premise for the imported SPF stocks. The centre functions on the basis of strict pre-quarantine and quarantine protocol which was notified under the Act regulated by the Animal Quarantine & Certification Services (AQ & CS) of the Ministry of Agriculture. The quarantine protocol followed for L. vannamei falls under the category of "high risk species" which means quarantine of aquatic animals moved either internationally or domestically between regions of different health status that are destined for use in aquaculture.

The key role of the facility is to ensure the SPF status of the imported broodstock, thus preventing the entry of any infected broodstock into the country. The centre funded by the National Fisheries Development Board (NFDB), Ministry of Agriculture, operates on Standard Operating Procedures (SOP) framed by a team of technical experts. The member institutions involved include the Coastal Aquaculture Authority (CAA), the Animal Quarantine and Certification Services (AQ&CS, Ministry of Agriculture, Department of Animal Husbandry, Dairying & Fisheries), the National Fisheries Development Board (NFDB), the Central Institute of Brackish water Aquaculture (CIBA, Indian Council of Agriculture and Research), the Marine Products Export Development Authority (MPEDA) and the Rajiv Gandhi Centre for Aquaculture (RGCA). All activities of the AQF are under the legal provision of Livestock importation Act, 1898.

The SOP of AQF aims to confirm the SPF status of the imported shrimp before permitting its transfer to the importing hatcheries. The hatcheries and farms eligible to import and farm L. vannameiwere identified by the CAA after inspection of the facilities. Only the CAA approved broodstock suppliers are permitted to provide SPF L.vannameibroodstock to the hatcheries or importers in India. The broodstock imported by the hatcheries were quarantined at the facility for a period of 5 days to ensure that the stock is SPF and of high health. The specific OIE (Office International des Epizooties) listed pathogens diagnosed for SPF L. vannameiat the facility are White Spot Syndrome virus (WSSV), Yellow Head / Gill Associated virus (YHV/GAV), Infectious Hypodermal and Hematopoietic Necrosis Virus (IHHNV), Infectious Myonecrosis Virus (IMNV), Taura Syndrome Virus (TSV), and NecrotisingHepatopancreatitis α – Proteobacterium (NHPB).

The introduction and farming of L. vannameiin India through this approved quarantine premises had benefitted in augmenting the marine shrimp production through aquaculture of the county from a level of about 88,800 MT valued at Rs. 1915 crores in the year 2008-09 to about 145600 MT valued Rs. 3585 crores in 2010-11 and further to about 224500 MT valued at Rs. 6600 crore in 2011-12. Since its full fledged introduction, the aquaculture production of L. vannameirose exponentially from a level of about 1730 MT in 2009-10 to about 80,717 MT in 2011-12 recording an annual growth rate of about 583%, thereby increasing its share in the total cultured shrimp production from a mere 1.6 % to about 35.9 % within a span of two years. Shrimp being an export-oriented commodity, it would be interesting to analyze the impact of this growth on exports. The total shrimp export which was about 1,30,000 MT worth about Rs. 3900 crore prior to introduction of L.vannamei rose to about 1,89,246 MT worth Rs. 8,167 crore in the year 2011- 12. The annual growth rate achieved over the last three year period was about 20% in terms of quantity and about 40% in terms of value. The export of aquacultured shrimp during the same period showed growth rates of 34 % and 47 % in terms of quantity and value. The provisional estimates of cultured shrimp production during the current year showthat the total shrimp production which includes L. vannamei also is set toquarantined cross new heights. Even though all business were affected by Covid 19 virus, We hope, aquaculture will bounce back very soon.

ANTIMICROBIAL RESISTANCE IN AQUACULTURE

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ABSTRACT

Aquaculture is a rapidly growing food-producing sector that currently accounts for more than 50% of the fish for human consumption worldwide. Overcrowding and water quality deterioration in high-density fish-producing systems necessitates the need for antimicrobials. The selective pressure exerted by these drugs results in the emergence of resistant bacterial strains. It is now widely recognized that the passage of antimicrobial resistance genes and resistant bacteria from aquatic to humans and vice versa can have detrimental effects on human, animal health and ecosystems. A global effort is required to stop the overuse or misuse of antimicrobial agents in aquaculture and encourage farmers to adopt alternate disease prevention measures such as probiotics and phage therapy, etc.,

Highlight Points:

- Antimicrobial Resistance, Aquaculture, Antibiotics, AMR Genes.

INTRODUCTION

Global fish stocks have been substantially exploited to feed the growing human population, with estimates of up to an 80% reduction. To reduce this depletion and fulfill the animal protein requirement, our reliance on aquaculture has intensified due to its potential to provide sustainable, safe, and reliable alternative food production. Aquaculture is considered one of the most sustainable sectors for animal protein. It is the fastest-growing food sector, yet to meet global demand, production must further expand by 50 % by 2050. Currently, aquaculture accounts for around 10% of all animal protein consumed globally, with this figure expected to increase by 50% by 2030. In aquaculture, several bacterial diseases are routinely encountered, which affect production. The primary pathogens identified are Gram-negative bacteria, Aeromonas hydrophila, A. salmonicida, Vibrio anguillarum, V. harveyi, Flavobacterium psychrophilum, Edwardsiella tarda, Citrobacter freundii, Pseudomonas fluorescens, and Yersinia ruckeri; rarely by Gram-positive ones such as Streptococcus and Staphylococcus; and also by acid-fast Mycobacterium sp. The consumption of such infected cultured fishes poses public health concerns, including humans. This incidence enforces the farmers to use antibiotics frequently in the aquaculture system. Antibiotics are the first-line treatment for bacterial infections, and therefore play an essential role in modern medicine. Associated with the rise in antibiotic administration in aquaculture as a part of therapy and prevention, antimicrobial resistance (AMR) has emerged among bacterial fish pathogens.

ANTIMICROBIAL RESISTANCE

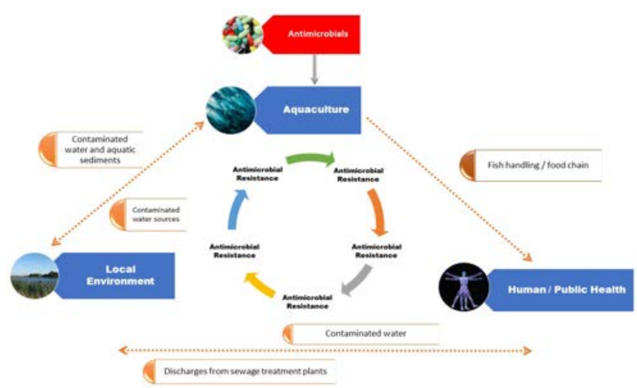

Figure 1. Drivers of antimicrobial resistance in aquaculture

Figure 1. Drivers of antimicrobial resistance in aquaculture (Source – Santos et al., 2017)

Many cultured fishes such as carp, salmon, tilapia, catfish, and crustaceans like shrimps worldwide have been reported to possess antimicrobial-resistant pathogens. Several of them are zoonotic that may infect the fish handlers. Continuous use of antibiotics for treating bacterial diseases in aquaculture has led to "pseudo durability" and their vast presence in the environment, which has caused the development of selective pressure on the microbial community. Antimicrobial-resistant (AMR) bacteria formed under selective pressure can develop into an environmental reservoir of antimicrobial-resistant (AMR) genes. Aquaculture systems and fish farms have been observed as the "genetic reactors" or 'hotspots for AMR genes' where significant genetic exchange and recombination can occur. Antimicrobial resistance is an ancient process and pre-

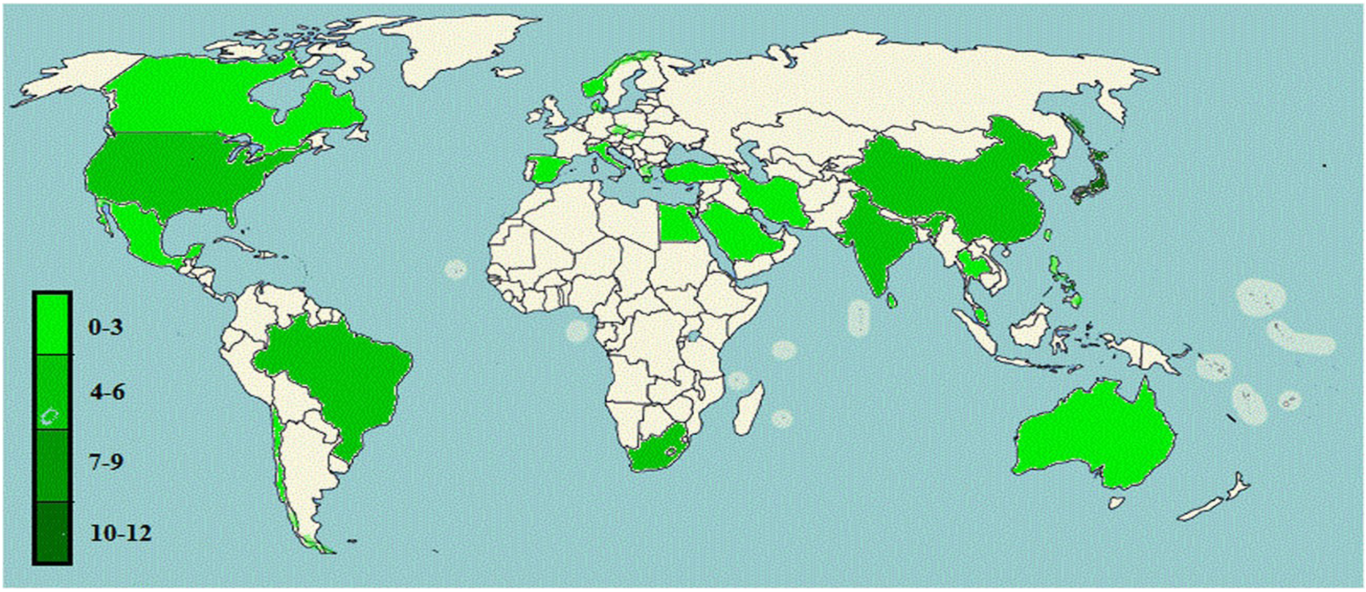

Figure 2. Reported percentage (%) of occurrence of antimicrobial resistance in various countries

dates any clinical antibiotic usage; however, the increase of extensive drug-resistant (XDR) and multidrug drug-resistant (MDR) strains is a cause of immense concern. Bacteria are becoming resistant to a wide array of antibiotics due to natural processes and widespread anthropogenic activity. Bacteria can acquire antimicrobial resistance (AMR) either through mutation, or more likely horizontal gene transfer (HGT) in the environment, via natural transformation, transduction, or conjugation. The genetic plasticity of the microbial community enables resistance genes to move quickly throughout different environmental bacterial populations and communities.

EFFECT OF ANTIMICROBIAL-RESISTANT PATHOGENS

The transfer of antimicrobial-resistant pathogens from aquaculture to natural aquatic environments could lead to the emergence of antimicrobial resistance in wild fishes and related food products. This has been considered severe, impacting human health due to their direct consumption and near impossible management measures. Aquaculture and hospital environments could act as the single interactive environment because of the transfer of resistance genes carrying plasmids between fish and human pathogens.

Since most of the antimicrobials used in aquaculture are those used in human medicines, the application of antimicrobials in aquaculture severely impacts the development of AMR in other ecological niches, mainly the human environment. Regardless of the pathway, the transfer of AMR genes from environmental microbes to fish, human, and animal pathogens would have a detrimental effect on animals and human health. This potential link between the aquatic and terrestrial resistomes is of particular concern, as many of the antimicrobials authorized for use in farmed fish (e.g., oxytetracycline, florfenicol, and amoxicillin) are all medically crucial for human use. Even when antimicrobials not associated with antimicrobial therapy in humans are selected for use in aquaculture, once the acquisition of AMR to one antimicrobial within a class occurs, cross-resistance is often conferred. Around 51 antibiotics recommended in aquaculture are essential to human medicine, and about six classes of those antibiotics are recorded as critically essential antimicrobials in World Health Organisation's (WHO) list. Increased frequency of severe infections and treatment failures had been reported in humans due to the consequences of the transfer of antimicrobial resistance from aquaculture to humans through the consumption of aquaculture products.

ANTIMICROBIAL RESISTANCE IN AQUACULTURE SYSTEM

(I) AMR IN OPEN AQUACULTURE SYSTEM

Antimicrobial agents are usually administered to fish mixed with food, and doses can be proportionally higher than livestock. The residues of antimicrobials remain in fish products. Depending on their concentrations and biodegradability, antimicrobials in undigested food and fish feces remain in surrounding water and sediment for an extensive period. Indeed, some studies suggest that 70–80% of antibiotics given to fish are excreted into the water and can further alter the microbial communities present. Such material can persist and select for AMR bacteria, even at low concentrations, leading to significant alterations in the biodiversity of the sediment and water in the proximity of open aquaculture systems by replacing susceptible communities of bacteria (and other microorganisms) with resistant ones.

(II) AMR IN CLOSED AQUACULTURE SYSTEMS

Closed aquaculture systems refer to systems that isolate the farming process from the natural environment and control parameters such as oxygenation, temperature, and photoperiods—these range from flow-through water systems to comprehensive near zero-discharge recirculating aquaculture systems (RASs). RAS is designed to produce species at high density and minimize environmental impact by effectively managing and treating wastes that accumulate during fish culture systems. Water is recycled, and, under optimal conditions, very little (if any) water is exchanged with the environment. It is conceivable that antibiotics added in the feed may accumulate throughout the system, promoting the growth of AMR bacteria associated with the host, the sediment (waste solids), and the RAS biofilter community.

ANTIMICROBIAL RESISTANCE GENES IN AQUACULTURE ENVIRONMENTS

(1) PLASMID-MEDIATED RESISTANCE

Plasmids, the extrachromosomal genetic element, constitute various genes that confer resistance to multiple antibiotics and toxic heavy metals. Early reports are available on the plasmid-mediated antibiotic resistance among various fish pathogens. Vibrio anguillarum, Pseudomonas fluorescens, Aeromonas hydrophila, A. salmonicida, Pasteurella piscicida, Yersinia ruckeri, Edwardsiella tarda are the well-known bacterial fish pathogens carrying transferrable R plasmids and thereby exhibiting plasmid-mediated antimicrobial resistance

(2) QUINOLONE RESISTANCE

The protein targets of quinolones are the bacterial enzymes, DNA gyrase and topoisomerase IV. DNA gyrase is a tetrameric enzyme encoded by the gyrA and gyrB genes, and its main activity is to catalyze the negative supercoiling of bacterial DNA. The primary mechanism behind the quinolone resistance is the incidence of mutations in DNA gyrase and DNA topoisomerase along with the plasmid-mediated resistance and that of fluoroquinolone resistance. The acquisition of quinolone resistance is primarily due to chromosomal mutations in topoisomerases genes (i.e., gyrA, gyrB, parC, and parE) and mutations that reduce drug accumulation by decreasing uptake or increasing efflux. Additionally, at least three mechanisms of quinolone resistance are known to be plasmid-encoded: (1) Qnr proteins (topoisomerase protection); (2) AAC(6)-Ib-cr aminoglycoside acetyltransferases; and (3) QepA and OqxAB mediated efflux pumps.

(3) TETRACYCLINE RESISTANCE

Oxytetracycline is a broad-spectrum bacteriostatic antimicrobial, active against a wide variety of Gram-positive and Gram-negative bacteria, extensively used in fish farming. Tetracyclines bind reversibly to the 70S ribosome of prokaryotes and block protein synthesis. Mechanisms of tetracycline resistance include active efflux, ribosomal protection, ribosomal RNA mutations, and tetracycline inactivation. Tetracycline resistance in fish farm-associated bacteria is mainly mediated by one or more of the Tet family of proton-dependent efflux pumps or via ribosomal protection by cytoplasmic proteins found widely in Gram-negative bacteria. Tetracycline resistance genes tetA-G have been detected in fish pathogens belonging to fish species of different geographical locations.

(4) BETA LACTAM RESISTANCE

It is reported that beta-lactam antibiotic resistance is mainly associated with the production of beta-lactamases. Vibrio cholerae, V. vulnificus and V. aestuarianus are the major aquaculture pathogens that possess β-lactam resistant genes. The increased expression of chromosomal amp C beta-lactamase gene results in strong resistance to β-lactam antibiotics such as amoxicillin, cefoxitin, ampicillin and low-level resistance to cephalosporin.

(5) MACROLIDE RESISTANCE

Macrolide resistance is also a severe problem in aquatic fish farms, where target ribosome-site modification, macrolide inhibiting enzymes and synthesis of drug efflux proteins are the primary mechanisms behind the phenomenon. Erythromycin, a macrolide class, resistance was detected in both Gram-positive and Gram-negative pathogens associated with farmed fish and crustacean crabs.

(6) PHENICOL RESISTANCE

The use of phenicols such as chloramphenicol was limited in aquaculture in the mid-1990s due to its toxicity; however, a fluorinated derivative, florfenicol, became popular in aquaculture due to its effectiveness against broad fish pathogens. Florfenicol is a synthetic fluorinated analogue of chloramphenicol whose bacteriostatic activity is based on a reversible binding to the 50S subunit of 70S bacterial ribosomes that prevents peptide elongation. The replacement of a hydroxyl group with a fluorine atom protects florfenicol from inactivation by chloramphenicol acetyltransferases (CATs), a common mechanism of bacterial resistance to chloramphenicol. The effectiveness of florfenicol against several relevant fish pathogens makes it a precious drug for the fish farming industry. Mechanisms of resistance to florfenicol include specific and non-specific drug transporters, RNA methyl transferases, and specific hydrolases. Genes floR and fexA belong to the major facilitator superfamily and code for efflux proteins that export florfenicol out of the cell.

CONCLUSION

The persistence and proliferation of AMR in the environment represents a global health crisis, with a current estimate of 7x105 AMR deaths attributed annually and estimated to rise to 10 million deaths per year in 2050. Effective alternative strategies have to be put forward in the aquaculture industry, thereby regulating antibiotic dependence to prevent the emergence of antibiotic resistance. Preventive measures such as vaccinations are being used in aquaculture for controlling the disease onset. In addition to vaccines, probiotics are also increasingly used to control aquatic diseases by conferring health benefits. Bacteriocins like antimicrobial peptides are found to be another promising natural alternative to antibiotics. Immunostimulants like β-1,3 glucans are the other components effective against various aquatic diseases. Different alternative strategies have been used to alleviate pathogen activity, including phage therapy; and quorum sensing disruption (affecting virulence). In addition, the disinfection of system water may be managed with UV application or via ozone treatment.

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More references can be Provided on Request

Importances of Photosynthesis Bacteria in Pond Management and Health Performances in Aquaculture

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General Manager
(Aqua), PVS Group

Introduction:

The aquaculture industry is rapidly growing and is now considered a major contributor in the global food production. To meet the global demand, aquaculture production practices have been intensified to a greater extent both in technological and practical measures. Aquaculture generates considerable amount of wastes, consisting of metabolic by-products, residual food, fecal matters and residues of prophylactic and therapeutic inputs, leading to the deterioration of water quality and disease outbreaks. Due to fast expansion of aqua culture and the use of more modern farming technologies that involve higher usage of inputs such as water, feeds, fertilizers and chemicals. As a result, aquaculture is now considered as a potential polluter of the aquatic environment and a cause of degradation of wetland areas.

Waste Production in Aquaculture

The physical, chemical and biological conditions of the culture environment have an influence on the health and productivity of shrimp. Exposure of shrimps to toxins like hydrogen sulphide, ammonia and carbon dioxide lead to stress and ultimately disease .There are differences in quality and quantity of components depending on the species cultured and the culture practices adopted. The wastes in hatcheries or aquaculture farms can be categorized as: (1) residual food and fecal matter (2) metabolic by-products (3) residues of biocides and biostats (4) fertilizer derived wastes (5) wastes produced during molting (6) collapsing algal blooms.

Bioremediation in Aquaculture

The current approach to improving water quality in aquaculture is the application of microbes/enzymes to the ponds, known as 'bioremediation'. When macro and microorganisms and/or their products are used as additives to improve water quality, they are referred to as bioremediators or bioremediating agents.

A successful bioremediation involves:

- Optimizing nitrification rates to keep low ammonia concentration.
- Optimising denitrification rates to eliminate excess nitrogen from ponds as nitrogen gas.
- Maximizing sulphide oxidation to reduce accumulation of hydrogen sulphide.
- Maximizing carbon mineralization to carbon dioxide to minimize sludge accumulation.
- Maximizing primary productivity that stimulates shrimp production and also secondary crops.
- Maintaining a diverse and stable pond community where undesirable species do not become dominant.

Photosynthetic Bacteria (PSB)

PSB (Photosynthetic bacteria) are a special and unique class of microorganisms that has the ability to convert light energy into chemical energy using their light-absorbing pigments and reaction centers. These bacteria contain a compound known as bacteriochlorophyll which works similarly as chlorophyll in plants and enables them to perform the process of photosynthesis. There are mainly three types of photosynthetic bacteria: Chlorobiacae, Chromatiacae, and Rhodospirillacae.

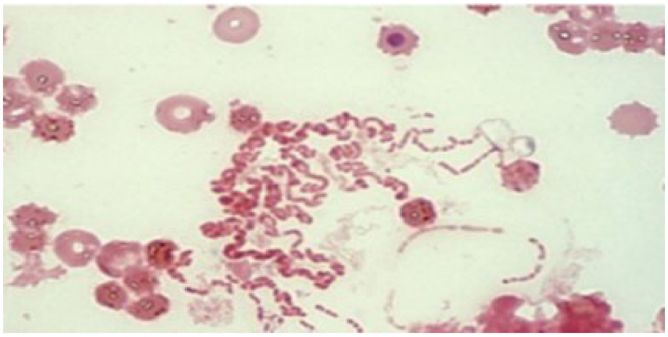
Classification of Photosynthetic Bacteria

Cyanobacteria perform photosynthesis using water as an electron donor in a similar manner to plants. This results in the production of oxygen and is known as **Oxygenic photosynthesis.** They contain light-harvesting pigments, absorb carbon dioxide, and release oxygen. Cyanobacteria or Cyanophyta are the only form of oxygenic photosynthetic bacteria known to date.

Bacteria that contain bacteriochlorophyll do not use water as an electron donor .This is known as Anoxygenic photosynthesis. **Anoxygenic photosynthetic** bacteria consume carbon dioxide but do not release oxygen. These include Green and Purple bacteria as well as Filamentous Anoxygenic Phototrophs (FAPs), Phototrophic Acidobacteria and Phototrophic Heliobacteria.

Chlorobiacae bacteria are **green bacteria** and also **sulphur bacteria** that perform anoxygenic photosynthesis. It works as an obligate photoautotroph and uses reduced sulphur species as electron donors. Rhodospirillacae is purple bacteria in rod-shape, whose length can vary. Hydrogen gas is used as an electron donor by these purple bacteria and can also use malate or succinate. There is another purple microorganism known as Chromatiacae which are short gram-negative rods. These bacteria use sulphide and sulphur as their electron donor.

The species currently used in aquaculture are Rhodopseudomonas pastries, Rubrivivax gelatinosa,



Rhodobacter capsulata, R. spaheroides, Phaeospirillum fulvum, etc.

Role of Photosynthetic Bacteria (PSB) in Pond Management

Disease Controlling Agents

Most probiotics proposed as biological control agents in aquaculture and suppressed the activity of Vibrio harveyi with increasing the survival rate. Photosynthetic bacteria also suppress the pathogenic vibrio like Vibrio harveyi, Vibrio parahaemolyticus and Vibrio splendens and reduce the opportunistic invasion of these pathogens in shrimps.

Decomposes Organic Detritus/ Waste

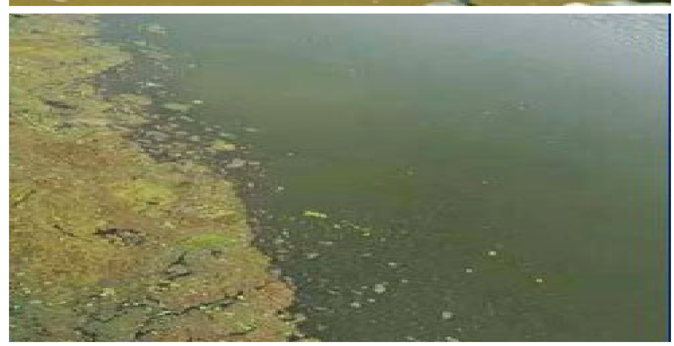
The dissolved and suspended organic matter contains mainly carbon chains and is highly available to microbes and algae. A good bioremediator (Photosynthetic bacteria) are capable of effectively clearing carbonaceous wastes from water and suitable for bioremediation of organic detritus. Photosynthetic bacteria produce a variety of enzymes that break down proteins and starch to small molecules, which are then taken up as energy sources by other organisms. The removal of **Reduction of Nitrogenous Compounds**

Bacteriological nitrification is the most practical method for the removal of ammonia from closed aquaculture systems. There are also some heterotrophic nitrifies that produce only low levels of nitrite and nitrate and often use organic sources of nitrogen rather than ammonia or nitrite.

Reduction of Hydrogen Sulphide level

In aerobic conditions, organic sulphur decomposes to sulphide, which in turn get oxidized to sulphate. Sulphate is highly soluble in water and so gradually disperses from sediments. Sulphide oxidation is mediated by microorganisms in the sediment by purely chemical processes .Under anaerobic conditions, sulphate may be used in place of oxygen in microbial metabolism. This process leads to the production of hydrogen sulphide gas.

The photosynthetic benthic bacteria that break H_2S at pond bottom have been widely used in aquaculture to maintain a favorable environment. These bacteria contain bacteriochlorophyll that absorb light (blue to infrared spectrum, depending on type of bacterio-chlorophyll) and perform photosynthesis under anaerobic conditions.



Functions and Benefits of Photosynthetic Bacteria in Aquaculture

Photosynthesis Bacteria (PSB) helps in the health management of the aquaculture and benefits the aquatic life like shrimps or fish. It also helps degrade organic waste and keeps the pond bottom clean. The bacterial cell wall of these bacteria is more digestible. Also, vitamins, proteins, biological cofactors and carotenoids are found in abundance in these bacteria. Photosynthesis Bacteria (PSB) have multiple effects such as improve water quality, prevent diseases and increases growth rate, all the same time. Photosynthesis Bacteria (PSB) can help to maintain pond in better condition and can increase level of production.

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Photosynthetic bacteria are currently being used in various applications which include water purification, bio-fertilizers, animal feed and bioremediation etc. They are used in the treatment of polluted water for reduction of toxic substances in aquaculture ponds such as H_2S.

- The beneficial organisms (Photosynthetic bacteria) create several environmental factors during application and discourage the growth of many harmful or undesirable species of microorganisms.
- Photosynthetic bacteria utilizes visible light from the sun thereby increasing in population.
- Photosynthetic bacteria help the production of metabolic by-products, increased biomass population of plankton and algae, production of anti-pathogenic substances and control of the population of pathogenic organisms.
- Photosynthetic bacteria breakdown organic matter thereby releasing complex compounds such amino acids for utilization by plants.
- Photosynthetic bacteria generally improve the water quality of aquaculture systems and inhibit the pathogens in water there by increasing production of the target culture
- Restrains the overgrowth of algae to keep the water clear and clean
- Degrades organic substance (Sludge) in form of black mud in the pond bottom.
- Reduces level of toxic gasses such as ammonia nitrogen, nitrite and hydrogen sulfide to eliminate all kinds of odor in the sludge, while reducing the sludge amount.
- Photosynthetic bacteria reduces the chemical and antibiotic usage as it prevents aquatic life from disease.
- Photosynthetic bacteria decrease COD, SS (suspended

Benefits as Feed Additives Photosynthetic Bacteria (PSB) for Shrimp/ Fishes

- Photosynthetic bacteria is rich in nutrition as it contains vitamin B, vitamin A, vitamin D, protein and others.
- Photosynthetic bacteria improve the appetite of fish / shrimps and their digestion.
- Photosynthetic bacteria stimulates fast growth rate & enhances the survival rate
- Photosynthetic bacteria enhances immunity & prevents diseases
- Photosynthetic bacteria improves on production level.
- Photosynthetic bacteria increases the population growth rate of live food like plankton

Sources.

Conclusion

The photosynthesis bacteria helps for use in aquaculture to clean up the pond bottom, maintain good water quality and improve shrimp health in aquaculture. The role of beneficial bacteria to control pathogens will become particularly important in aquaculture. The photosynthesis bacteria use as bioremediators will gradually increase and the success of aquaculture.

Use of probiotics is an effective alternative sustainable source of beneficial microbes with bactericidal or bacteriostatic effect on pathogenic bacteria. The photosynthesis bacteria acts as immunomodulatory capabilities of promoting health status with improving the growth performance & augment the immune system in fishes / shrimps.


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WOMEN EMPOWERMENT IN AQUACULTURE

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Introduction:

Gender quality and women empowerment are the keys to be successful in all areas but women are considered the most undervalued human resources and utilized inappropriately. Globally, they represent 47% of the fisheries workforce, and in small-scale fisheries catch, they contribute 25-50% in some regions (Harper et al., 2017). There is a great distinction in the activities of men and women in the fisheries sector including aquaculture and mostly they are complementary. These distinctions often depend on social, cultural and economic status. The contribution of women in fisheries is often overlooked due to some reasons. Several models have been used by the researchers to evaluate the women empowerment and also the factors that influence on women empowerment. The nature of women empowerment affecting the performance, psychology and satisfaction of women that may influence the balance between personal and professional lives of women.Several types of research have been taken place on women empowerment but the exact meaning of women empowerment is still unknown because of both external and internal factors (Raudeliunieneet al. 2014). The observation of experts, social media, the formal and informal discussion has played an important role in understanding the true meaning and its definition.

Theupliftment of a society depends upon women empowerment. Narayan (2005) highlighted the four main elements of empowerment and link betweeninstitutions and the public. These are information access, responsibility, attachment and participation, and role of the local organization. These elements may have limited scope due to individual choice, social and cultural norms. Considering all the aspects, Raudeliunieneet al. (2014) defined empowerment as access to increase option, managing the life by own decision and acquired authority over an individual’s life.

Why gender matters in fisheries and aquaculture:

Integrating women empowerment into conservation and addressing gender issues in fisheries improved ecological results. When the roles of women will understand then the effectiveness of the programmatic approach will improve. For example, implementation and enforcement of regulations in the coastal area especially nearshore ecosystems will improve by engaging women as stewards.

Highlight Points:

- As aquaculture is emerging sector, the contribution of women in it plays a vital role with various successful aspects.
- Women’s engaged in seaweed farming, backyard shrimp hatchery production and homestead catfish farming
- Women are being employed like fishing gear making, fish processing industries, selling the fish and fishery products in markets etc.
- They can implement of new modern technologies which help in the progress of aquaculture.
- The government NGOs, including FAO and research institutes should take measures to introduce programs which help in the upliftment of women in self employment in aquaculture and processing sector by reducing time burden on them.

Additionally, women in fish processing industries reduce product loss or by-product and also increase product value. According to FAO, 90% of the jobs in processing industries have been occupied by women and only 15% of women are engaged in harvesting.

Despite having a great chance of advancing gender equality, the sector still faces gender inequality challenges. Harmful social norms and structural inequality put women in a vulnerable situation and rise gender-based violence. US government has taken an initiative by launching Women's Global Development and Prosperity (W-GDP) to promote the economic empowerment of women globally as a national security strategy priority (Siles. et. al., 2019).

Status of women in India:

In this study, women empowerment in India is seen from various perspectives. A comparison has been carried out in the graph between 2005-06 and 2015-16 considering six parameters which reflect the status of women in India. From the graph, it can be easily noticed that the women's educated rate has been increased to 13.1% but the women


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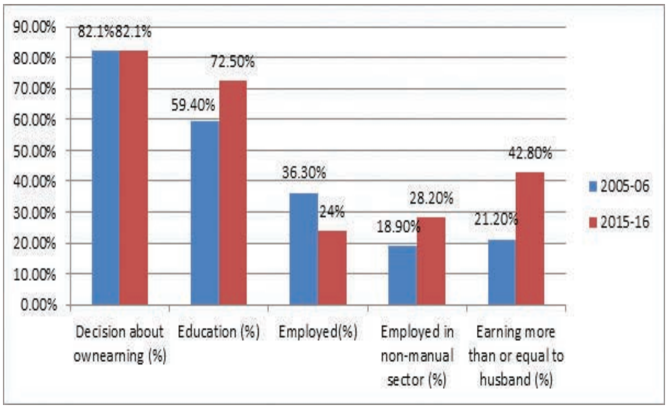
employed rate has been decreased to 12.3% though the decision about their own earning remains the same for a decade. So, there must be some factors that negatively influence the empowerment of Indian women.



Graphical comparison of the status of women in India between 2005-06 and 2015-16.

(Source: ANON, Economy survey (2017-18), Govt. of India)

Several researchers have identified various factors that affect women empowerment. According to Johnson (2005), seven factors responsible for women empowerment are perceptions of power and competence; self-Nurturance and Resource Access, Interpersonal Assertiveness, Awareness of Cultural Discrimination, Expression of Anger and Confrontation, Autonomy, Personal Strength and Social Activism. Later Mahmud et al. (2012) gave somemore factors like demographic status (age), social status (education), media exposure (TV and/or radio), economic status (household wealth) etc.

Table: Factors affecting women empowerment

Factors	Reference
Participation in public life, mobility in public domain, paid work, education level	Mahmud, Tasneem 2013
Age, education, gender inequality (psychological, economy, social), decision making, experience	Subramaniamet al. 2013
Activism, Autonomy, self-esteem, anger	Roger et al. 1997
Interactional, intrapersonal, behavioural Interactional, intrapersonal, behavioural	Raudeliunieneet al. 2014
Socio-cultural	Bespinar, 2010
Community influence, psychological sense	Henry et al. 2011

Need for women empowerment in fisheries and aquaculture:

Aquaculture is considered as the culture of aquatic organisms such as fish, crustaceans, molluscs, aquatic plants etc. in controlled conditions. Culture of fish includes several scientific management practices and some steps involved are breeding (seed production); rearing to spawn, fry, fingerlings, fertilizing the pond, feeding, harvesting, marketing etc. Nowadays, women are engaged in fisheries and aquaculture including fishing, gear making etc. and contribute an important part to the total revenue. Women who are engaged with fishing gear making or net making can reduce the cost of production in aquaculture. Women are mostly allowed for feeding in aquaculture and the processing of fish and shellfishes. But in technical and physical activities in fisheries and aquaculture such as fish feed preparation, pond maintenance, harvesting, etc., women tend to be less demanding human resources. Educationally, financially and mentally well-prepared women can manage almost all the tasks in aquaculture such as record keeping and finance, decision making, social participation, laboratory works (water quality estimation, disease diagnosis, feed quality estimation, research etc.), preservation of the ecosystem, policy making etc. Women are mentally stronger than men and can make a better decision and also can make a great market due to their great communication skill and public behaviour. So, there is a need forgiving opportunities to the aquaculture industry irrespective of gender that can improve the overall fisheries sector including enterprises and entrepreneurship.

At present, women of some states are facing different kinds of challenges to engage themselves in the aquaculture sector. To achieve Sustainable Development Goals (SDGs) of poverty reduction and nutritional security, gender equity plays a key role in all sectors including fisheries and aquaculture. Gender equity may help to improve productivity and revenue generation as well as household income and nutritional outcomes. According to the State of Fisheries and Aquaculture published by FAO (2014), gender improvement has been noticed and more than 19% of women engaged directly in the fisheries and aquaculture. In terms of numbers, women contribute 50% of the workforce when both primary and secondary fisheries sectors are combined (Jennifer, 2016).

STRATEGIC INTERVENTIONS FOR ADDRESSING WOMEN IN FISHERIES:

Based on their interest, both men and women have an equal right to participate in the development process. The women's involvement in aquaculture greatly varies from place to place, religion, caste, family hierarchy etc. Several strategies can be implemented to promote women empowerment in fisheries and address gender issues.

1. Supporting women leadership and entrepreneurship:

Due to the rapidly growing population in India, job opportunities for peoples have been decreasing. Entrepreneurship is the only possible way to feed

ourselves besides creating ample job opportunities for livelihood. Entrepreneurship is the propensity of the mind to take calculated risks with confidence to achieve a pre-determined business objective with correct decision-making. Women are seen to have a low rate of entrepreneurship than men which indicates lower income returns of women from entrepreneurship. There is an abundant scope for women to improve their economic condition and contribute to the national income through entrepreneurship. Ornamental fish-based enterprise in India getting high value and popularity in the present day. Ornamental fishes provide aesthetic beauty and upkeep of the environment because of the attractive colour pattern they have. This is one of the simple and easiest ways of starting entrepreneurship from backyard facilities available in the home with very less investment. Here two modules are available – Firstly, aquarium construction, set up and marketing of ornamental fishes; and secondly, ornamental fish breeding and marketing. Ornamental fish breeding and culture is considered a profitable business and has high market demand.

There is some evidence found on women's leadership in aquaculture in Tamilnadu. Renuka was the manager of green crab or mud crab hatchery, Kancheepuram district, Tamil Nadu. She had very strong leadership qualities and also expertise in induced maturation, larval rearing, post-larval rearing, live-feed culture, broodstock maintenance, and other related activities. The name of several other women of Tamil Nadu has been documented for having good leadership and entrepreneurship quality in aquaculture such as crab farming in the pond (Mrs. Annai), crab fattening in the cage (Mrs. Kayal), shrimp farming (Mrs. Akila, Nagapattinam district), ornamental fish farming (Mrs. Latha, Kancheepuram district), etc. (Shanthiet al. 2012).

2. Strengthening women's voice:

Women's organizations and NGO's have the potential to provide benefit to the women in fisheries by supporting them to work and overcome all the social and cultural barriers of the society by promoting education, finance, skills, resources, technology. The organizations can raise voice on behalf of the women community for gender biases and stereotypes and can help women to engage for sustainable fisheries production and management. The organizations can also financially and psychologically support women for their enterprise

3. Promoting the processing industry to add value to fisheries products:

A group of professionally trained women can organize post-harvest processing technologies and can add value to the fisheries products and improve community health. The contribution of women workers in fish processing industries is very crucial. They are engaged with all kinds of activities such as sorting, weighing, peeling, washing, gutting, drying, processing, preserving, packaging, marketing, etc. The contribution of females in the industrial sector is higher than the men workers and the majority of the women may be from the economically weak background. Men are mainly involved in office work, supervision, manager, and in some heavy works such as loading and unloading of containers.

4. Improving marketing and sales skills:

The livelihoods of women can be improved by better marketing and trading of fisheries products. In different states of India, the role of women in marketing also different. In Gujarat, women are usually engaged in unloading the fish catch, sorting of fish species wise, and their auctioning. The boat owner used to give monthly salary. Some women workers also borrow some amount of money in advance in offseason for their livelihood and later the boat owner deducted the money from their salary in the fishing season. The main problem related to the hiring of women workers is that they get fewer wages compared to men but the effort that they give is the same as men.
The market channel involved women at various levels of marketing activities like wholesaling, retailing, collaboration with other companies (in case of fish feed), distributors, advertisements, etc. Local fish markets of some coastal states of India such as Gujarat is completely dominated by the women and the majority of them used to engaged in wholesaling and retailing the fish. To convert the fish into money, fishermen depend on the women.

5. Gear manufacturing:

Fishing gear industries are the vital components of fisheries on which the catch or the quantity of fish harvest is dependent. The net making, repairing and rope making are the profitable enterprise that can be the source of employment for numbers of skilful women. ICAR-CIFT and CIFNET are key institutes developing technologies for this industry and also provide the skill to the willing persons. The activities are mainly carried out in offseason which provides a supplementary income. These activities can be done in the home and by everyone irrespective of gender.

Conclusion:

Fisheries play a major role in the live hood to eradicate poverty and malnutrition.Women are involved in aquaculture time immemorial. However, their contributions were not recorded. Women have the potential to engage in aquaculture enterprises like fish hatchery and rearing, grown out culture,integrated aquaculture,sampling, record-keeping and feed making etc. Other hand government should encourage women to participate in aquaculture by providing financial support to the rural population. Extension workers should demonstrate technical skills to overcome the problem faced in aquaculture. Seaweeds are upcoming high demand in pharmaceuticls and food etc. Training modern seaweeds cultivation,transplantation, breeding methods and harvesting methods can improve lifestyle.

Reference:

ANON, Economy survey (2017-18), Govt. of India.

More references can be Provided on Request

Role of Quality Control in Aqua feeds

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Introduction

In aquaculture, the level of productivity and economic efficiency of farming systems are influenced to greater extent by the quality of feed delivered to animals. The nutrients delivered through the feed are essential for promoting and maintaining the animal health, production and reproduction. The quality of aqua feed influences the animal performance and, consequently, the nutritional quality of fish and shrimp meat that is been supplied to the consumer market; with a direct correlation of feed to food safety, considering that the managemental and farming practices are adequate.

Aquaculture feeds

The quality of aqua feed is determined by diet formulation according to nutritional requirement of the various species. The pelleting characteristic of raw materials are just as important as the nutritional content and need to be considered whilst formulating feeds. Production diet (Fig. 1) so produced along with its superior quality and effectiveness, must be the one that is economical to manufacture, ship, store and broadcast to the species. Also, the physical and chemical properties of the pellets must remain intact in water (water stability) until the specie consumes it.

Fig. 1: Aqua pellets:

Nutritional Requirement

Aquaculture specie nutrition and feeding has been directed towards the formulation of feeds with high nutritional value, high digestibility with optimal balance of nutrients to achieve maximum productivity of different species. The nutritional quality of aquaculture feeds depends on the nature and quality of the raw materials which are used in its composition, the nutritional approach adopted in the formulation of the products, as well as the equipment and manufacturing technology. The feed must necessarily contain adequate amounts of protein with essential amino acids, fat and lipids as a source of fatty acids, carbohydrates as a source of energy, vitamins and minerals and other feed supplements and additives (Fig. 2)

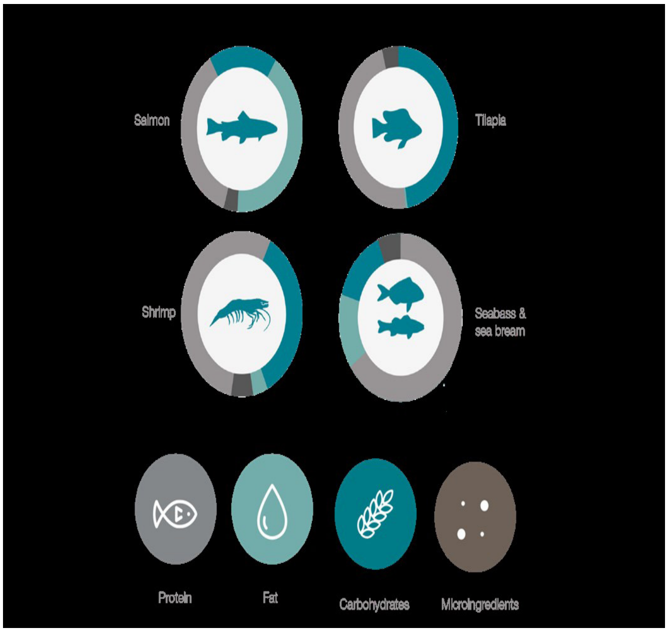

Fig. 2: Schematic diagram of various nutrient requirements of aqua

Quality Control (QC) measures in Aqua feed Manufacturing

Assessing and monitoring the nutritional quality is the first most essential quality parameter in feed manufacturing. A robust and stringent nutritional quality check from raw material to final product will ensure a consistent quality in nutritional parameters. Proximate analysis (analysis of moisture, protein, fat, starch, fibre and ash) is the primary quality check for raw materials. Conventional method for proximate analysis employs labor intensive and time consuming wet chemical analysis. The analysis employs several chemicals which are not environmental friendly. Advances in spectroscopy in biochemical analysis has led to the development of near infrared reflectance spectroscopy (NIRS) application in feed industry. Robust, reliable and authentic calibrations need to be developed for the analysis of proximate principles using wet chemistry analysis as primary calibration sources.

Near Infrared Reflectance spectroscopy (NIRS)

NIRS is an accurate and rapid analysis method that is well suited for quantitative determination of nutrients in feed ingredients and finished feed (Fig. 3). NIR technology has rapidly gained momentum over the past few years and nowadays, NIR is most reliable QC technique which is used by many aqua feed mills for determining the quality of fish meal, fish oil, soya bean meal, meat meal and various other raw materials which are used for production of aqua feeds.

NIR instruments are highly versatile and can measure all the samples and the nutritional parameters that are organic in nature, provided the calibrations that are been developed are strong and variable enough, to account for any type of raw material variant to be analyzed. It should therefore be possible to measure protein, moisture, fat, ash, fiber and many more parameters in less than a minute. The quick determination of nutrient content of the raw material enables faster decision-making process with respect to supplier mapping and monitoring. The real benefit of NIR is realized when real-time nutrients are incorporated in day-to-day formulation adjustments, which makes the diet precise with respect to nutrients and ensures product quality is optimal.

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Fig.3: NIR instrument

process of building these comprehensive calibrations can take many years of development time to acquire the necessary reference data sets as per the nutritional requirements of the aquaculture species.

Skretting NIR Calibrations

NIR Instruments are installed at every Skretting plant worldwide and provide rapid, accurate analyses of feed ingredients, intermediate products and finished products. This brings in a diversity with respect to calibration of various materials, making the calibrations more robust and reliable. Skretting NIR calibrations are accredited by ISO standards, which further adds into the reliability of the data generated from NIR. Every year, Skretting analyses

600,000 samples, generating more than 3 million analytical results. Skretting Aquaculture Research Centre (ARC) is responsible for innovations, calibration development, performance monitoring and acts as a support to various Skretting plants throughout the globe.

The Skretting NIR calibrations enables the formulators to ensure apt selection of raw materials according to the nutritional requirements of species thereby delivering superior quality of finished feeds match the specifications precisely (Fig. 4). This allows our esteemed customers to receive feeds with all the features and benefits the research and product development team intended. Availability of NIR in a production facility also ensures that a consistent product (feed) has been produced from batch to batch, without any major variations.

The NIR advantage

The advantages of using NIR analysis is that it provides rapid analysis data, requires little sample preparation, is void of any chemicals usage and is a relatively safe technology, as against the traditional wet chemistry. It is non-destructive, operator friendly, fast (30-60 seconds), reliable, precise and a perfect tool for quality control. That said, the way the calibrations are developed, standardized and validated, play a critical role with respect to the authenticity of the results produced. As the input data originates from wet chemistry, the wet chemistry methods need to be validated by ring tests, for the NIR outputs to be strong enough (What you input, comes out – so the input is critical). NIR technology is a boon to the modern-day feed production process, wherein efficiency in each and every step plays a critical role, in optimizing the entire production value chain.

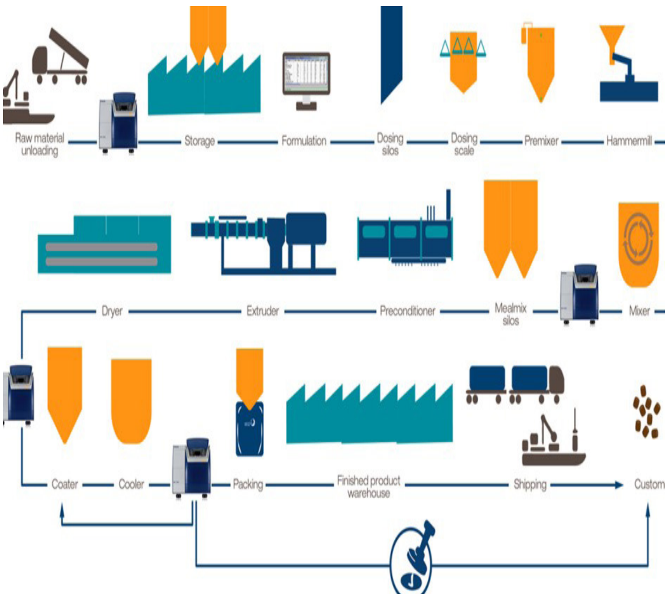

Fig. 4: NIR in production process


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