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India International Aquaculture Expo 2021™

IIAE

Exhibition & Conference on Aquaculture

Dear Exhibitors & Stakeholders of Aquaculture sector,

Greetings from IIAE !

We are waiting for Indian government orders permitting organising of Events / Conferences / Exhibitions / Conventions in India and in Hyderabad city. We are expecting the orders for Unlock 7.0 in the first week of December 2020. We will update you on this once government announces permission for organising exhibitions.

Hence, IIAE will not happen on 18-19-20 November 2020 in Hyderabad as announced earlier.

In case government gives permission for organising events, India International Aquaculture Expo (IIAE), which contains Exhibition, Conference and Awards presentation, **is expected to be held in the first quarter of 2021.**

Meanwhile, we request you to book your stalls in IIAE 2021 Exhibition and also register your participation as a Delegate in the Conference "UPDATE Knowledge on Aquaculture".

Work is in progress from our side for the Expo.

We also request you to send us your feedback in this matter.

Regards,
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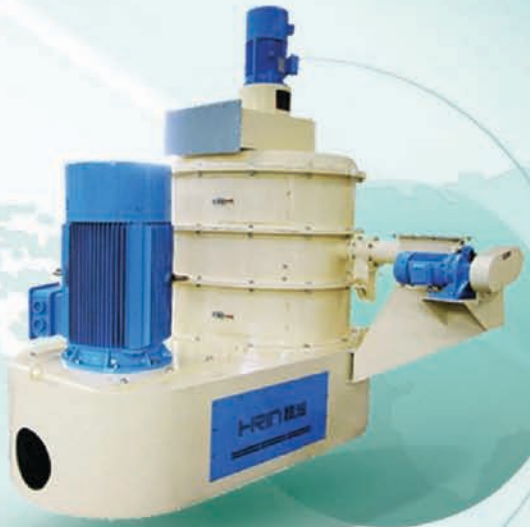

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M. A. Nazeer

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India looking at increasing national fish production from 14 mn ton to 22 mn tons in next 5 years

Dear Readers,

The November 2020 issue of ***Aqua International*** is in your hands.

In the News section, you may find news about – The Webinar on Biofloc-based Aquaculture was organized by ICAR-Central Institute of Brackishwater Aquaculture, Chennai on 6 November 2020. In his presidential address, Dr J. K. Jena, DDG (Fisheries Science Division), ICAR extended respect to the most important speaker and Biofloc fish farming expert Dr Y. Avnimelech and others and mentioned that fisheries and aquaculture sectors in India not only provide protein and food (nutritional) security but have received much attention of professional people, farming community and others over the years. Technology has provided much opportunity for all participants registered in the Webinar. We are looking at increasing national fish production from 14 million tonnes to 22 million tonnes in the next 5 years under PMMSY.

Even as the job markets are recovering amid pandemic, the College of Fisheries, affiliated to Karnataka Veterinary, Animal and Fisheries Sciences University has come forward to help unemployed graduates. They are organising a four-week free-residential training on 'Aquaclinics and Aquapreneurship Development Programme' from November 3 to 30. The training programme is supported by National Institute of Agricultural Extension Management and National Fisheries Development Board. Dr A Senthil Vel, Dean, College of Fisheries is the nodal officer for the training programme.

Fish farming proposals worth over Rs 5 crore were approved for this season by the district-level committees in Ghaziabad and Gautam Budh Nagar to promote fisheries-related activities on a large-scale. Ghaziabad has got the lion's share of the budgetary allocation at Rs 4.5 crore while GB Nagar will get Rs 64.2 lakh. Officials informed that availability of more private and community ponds in Ghaziabad is the major reason behind the larger fund allocation. Of 27 individuals from Ghaziabad who submitted their proposals, 20 were shortlisted by the district level committee while in Noida only 17 of 33 proposals were approved after scrutiny.

Goa has received Rs 2 crore under the central government's grant for focused and sustainable development of fisheries – the Pradhan Mantri Matsya Sampada Yojana (PMMSY). "The department had moved a proposal for this grant. According to fisheries official the central government has approved approximately Rs 14 crore for Goa. Of this, they have released Rs 2 crore to the state.

Himachal Pradesh will start land-based fish farming using Recirculation Aquaculture Systems (RAS) technology under Pradhan Mantri Matsya Sampada Yojana (PMMSY) to raise different varieties of fish throughout the year. The RAS technology is a new way to farm fish under which fish is reared in indoor tanks with limited use of water in a controlled environment instead of traditional method of fish rearing in water reservoirs, open tanks, ponds and rivers. The regular supply of limited quantity of clean water is ensured at a controlled temperature and dissolved oxygen content that is optimum for growth in a closed and containment system. The method is ideal for fish farmers of the state during shortage of water in summer as farmers can supplement their income with little use of water through inland fisheries.

In the articles section – article titled "Traditional Fishing Boats, Types and Operations along West Coast of India" written by Dr Jaya Naik highlighted that Traditional fishing boats or Artisanal fishing is small-scale commercial or subsistence fishing particularly practices involving coastal or island ethnic groups using traditional fishing techniques and traditional boats. This may also include heritage groups involved in customary fishing practices. Artisan fishers usually use small traditional fishing boats that are open boats (undecked) and have sails; these boats use little or no mechanized or electronic gear. Large numbers of artisan fishing boats are still in use, particularly in developing countries with long productive marine coastlines needs to be utilized it effectively.

M.A.Nazeer
Editor & Publisher
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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Newly designed KVK Sales Counter Starts functioning at CMFRI

KVK Sales Counter

Kochi: Newly designed sales counter of the Ernakulam Krishi Vigyan Kendra has started functioning at the Central Marine Fisheries Research Institute (CMFRI). Re-located to the road side to the convenience of the public, the sales counter now enables an easy access directly from the Goshree road.

The sales counter has a Farm Shoppe which offers fresh, hygienic and packed food products, including vegetables and fish, and a Farm Store where various seeds, plants, feeds and organic manures among many other varieties exclusively for farmers are available. Farm Shoppe offers quality-ensured branded food products directly procured from farmers, farmer collectives and self-help groups. Food and health products that are being used at home on daily basis such as cleaned fish, cut vegetables, fruits, pokkali rice, country eggs, milk, cooking oil, pulses, spices, ghee, etc are available at the Farm Shoppe. Frozen ripe jackfruit, raw jackfruit and jackfruit seeds are available on all seasons at the Shoppe which is aimed at ensuring reasonable price to the farmers without the interference of middlemen and, at the same, ensuring quality and toxic-free food products to the consumers.

Farm Store at the sales counter offers all kinds of feeds, seeds, plants and organic manures for farmers on a daily basis along with fish fingerlings, chicks, poultry shelters, fish cage, azolla units and hydroponic units subject to booking. In addition, various farm machinery and tools are available for rent from the Farm Store.

More facilities will be made available in future by utilising the network of ICAR and KVKs functioning across the country, said Dr Shinoj Subramanian, Head of KVK. The sales counter will remain open from 9.30 am to 7 pm on all working days. Phone. 8281757450.

Free-residential training for unemployed fisheries graduates

Mangaluru: Even as the job markets are recovering amid pandemic, the College of Fisheries, affiliated to Karnataka Veterinary, Animal and Fisheries Sciences University has come forward to help unemployed graduates. They will organise a four-week free-residential training on "Aquaclinics and Aquapreneurship Development Programme" (AC&ADP) from November 3 to 30.

The training programme is supported by National Institute of Agricultural Extension Management and National Fisheries Development Board, Hyderabad, said Dr A Senthil Vel, Dean, College of Fisheries, who is also the nodal officer for the training programme.

Aqua Clinics or Aqua One centre will help farmers in sustainable aquaculture practices such as the culture of fishes and shrimps, pond design, pond preparation, soil analysis, water quality analysis, selection of species, seed and feed supply, disease management (laboratories), Better Management Practices (BMPs), technical consultancies, skill development, networking and marketing linkages as well as well connected with state and central government institutions, said training coordinator Dr A.T. Ramachandra Naik.

"Aquapreneurs will know how to prepare Detailed Project Reports (DPRs) to get financial assistance from the funding agencies and subsidiary schemes. The major objective of this programme is to promote entrepreneurship development in fisheries and aquaculture and self-sustained employment opportunities. Finally, the farmers will cost-effectively get the service and practice sustainable aquaculture production," he said.

Maharashtra cabinet clears schemes to boost fisheries

Mumbai: The state cabinet recently cleared a series of schemes to boost the fisheries sector. The state decided to implement the Centre's Fisheries and Aquaculture Infrastructure Development Fund. This aims for the development of jetties and landing areas for fishermen. The Centre is to provide Rs 7,522 crore to states over 5 years between 2018 and 2023.

The cabinet also agreed to implement the PM's Fisheries scheme in the state. It is to be implemented between 2020-21 and 2024-25. The Centre's contribution will be Rs 9,407 crore and the state's share will be Rs 4,880 crore. It aims to improve acquaculture facilities especially for prawns, crabs and shellfish.

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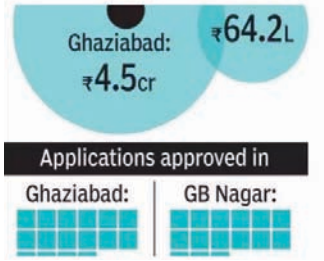
Ghaziabad gets lion's share in fish farming allocation

Ghaziabad/Noida: Fish farming proposals worth over Rs 5 crore were approved for this season by the district-level committees in Ghaziabad and Gautam Budh Nagar to promote fisheries-related activities on a large-scale. Ghaziabad has got the lion's share of the budgetary allocation at Rs 4.5 crore while GB Nagar will get Rs 64.2 lakh only. Availability of more private and community ponds in Ghaziabad is the major reason behind the larger fund allocation, officials said.



Of 27 individuals from Ghaziabad who submitted their proposals, 20 were shortlisted by the district level committee while in Noida only 17 of 33 proposals were approved after scrutiny.

Ajay Kumar Bana, assistant director of the fisheries department at the two districts, said, "Among other formalities for undertaking fisheries related activity in Noida or Greater Noida, a no-objection certificate from the industrial development authority is required. As a result, the majority of the applications in GB Nagar have been put on hold for now."

Bana added that the recommendation to release funds for the 37 applicants have been forwarded to the state government for further action and response to the same is expected in a fortnight.

Sources said that majority of the funds allocated for Ghaziabad will be utilised in development of aquaculture. Community and private ponds under the ownership of individuals or gram sabhas will be developed for farming Indian carp.

"Since most of the land here has been notified under Noida Authority, Greater Noida Authority and Yamuna Expressway Authority, only a limited number of gram sabhas remain active in Noida and Greater Noida. Permission is required from the concerned authority for excavating land to create a pond," said Kailash Bhati, a resident of Kasna in GB Nagar district.

On the other hand, many farmers in Ghaziabad have agreed to excavate agricultural fields which are not being used to create ponds. "Fish farming can lead to much higher revenues compared to agriculture. However, it requires a lot of efforts and extra care," Bhati added.

In a related development, two individuals from both the districts had submitted proposals to operate live fish vending vans and all the four proposals were approved.

Goa gets Rs 2 cr aid to propel fisheries sector

PANAJI: Goa has received Rs 2 crore under the central government'sgrant for focused and sustainable development of fisheries – the PradhanMantri Matsya Sampada Yojana (PMMSY). "The department had moved a proposal for this grant. The central government has approved of approximately Rs 14 crore for Goa. Of this,they have released Rs 2 crore to the state," a fisheries official said.

This is for various schemes such as deep sea fishing, aquaculture, buildingof bio-toilets in fishing vessels, among others to boost the fishing sector in the state under the Aatmanirbhar Bharat Abhiyaan.

The state action plan includes 24 beneficiary-oriented schemes, of which nine are towards development of inland fisheries and aquaculture including technology infusion such as construction of brackish water ponds and biofloc ponds, recirculatory aquaculture system (RAS), open sea cages and reservoir cages. In addition to this, there are three non-beneficiary schemes like the upgradation of departmental jetties, and construction of astate of the art wholesale fish market. However, the department has not received funds for the non-beneficiary schemes. The state fisheries department has already started receiving applications for its various schemes under this grant. "We are planning to disburse the amount very soon, after we complete scrutinising the applications," the official said.

The PMMSY scheme is being launched in 21 states of the country for focused development of fisheries sector in the country with an estimated investment of ₹20,050 crore during a period of five years as part of the Atmanirbhar Bharat package.

India International Aquaculture Expo 2021

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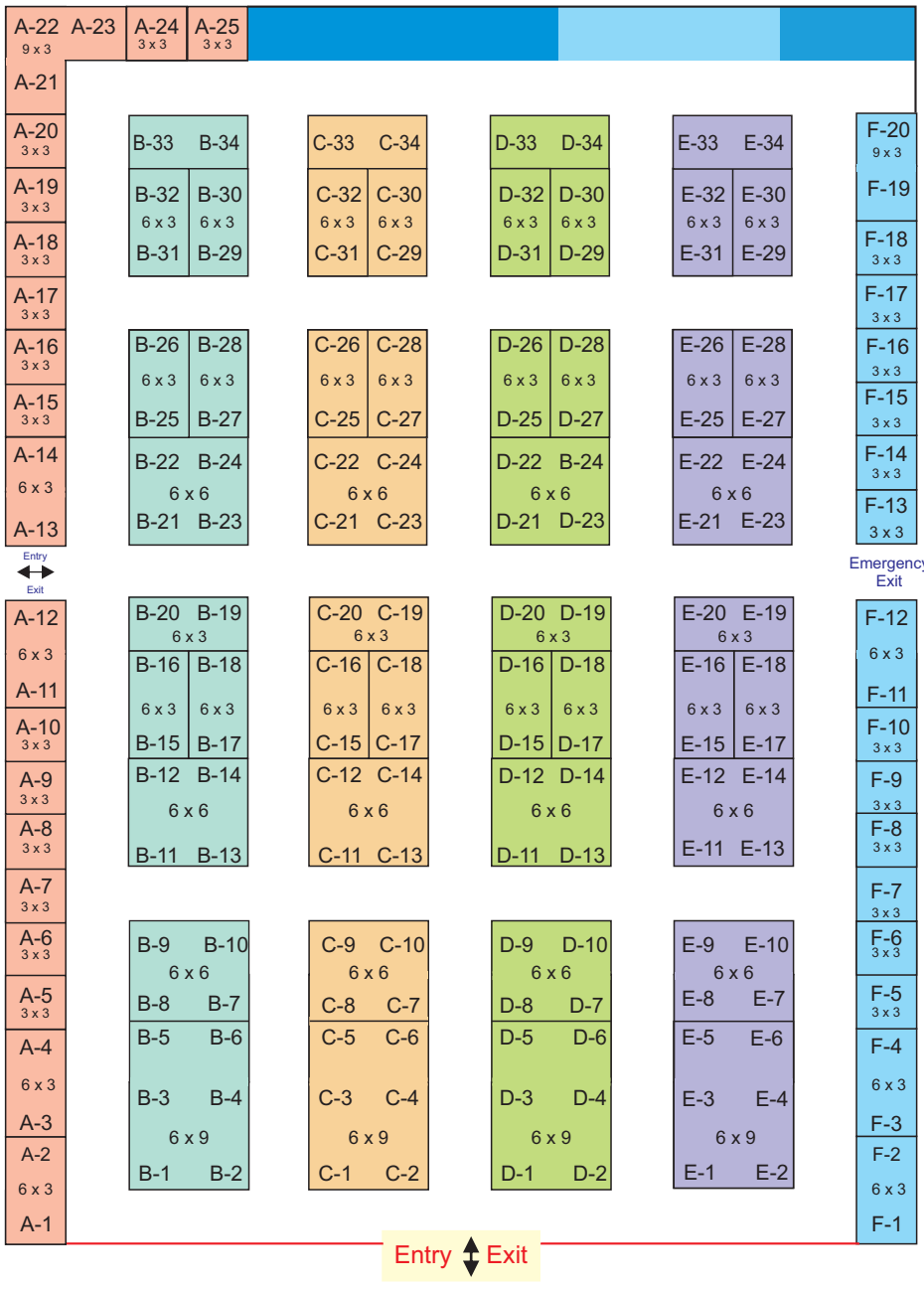

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Himachal to start land based fish farming using RAS technology

Shimla: Himachal Pradesh will start land-based fish farming using Recirculation aquaculture systems (RAS) technology under Pradhan Mantri Matsya Sampada Yojana (PMMSY) to raise different varieties of fish throughout the year.

The RAS technology is a new way to farm fish under which fish is reared in indoor tanks with limited use of water in a controlled environment instead of traditional method of fish rearing in water reservoirs, open tanks, ponds and rivers. The regular supply of limited quantity of clean water is ensured at a controlled temperature and dissolved oxygen content that is optimum for growth in a closed and containment system. The method is ideal for fish farmers of the state during shortage of water in summer as farmer can supplement their income with little use of water through inland fisheries

Under this scheme state will set up 15 fish ponds using RAS technology during next five years beginning from 2020-21 to 2024-25.

Out of total 15 fish farms, five fish farms will be set up in normal waters in Una, Mandi, Kangra (Palampur and Pong dam) and Sirmaur districts and 10 in cold water fisheries under the RAS technology in Kinnaur, Sirmaur, Shimla, Mandi, Chamba and Kullu districts during next five years aiming at enhancing fish production and productivity in the state in an integrated and holistic manner .

The first batch of fish farmers will be sent to National Fisheries Development Board, Hyderabad for training in latest aquaculture techniques under cold water fisheries using RAS Technology.

It is estimated that total 40 ton per unit annual fish production will be achieved in normal RAS unit while in cold water RAS there are 4 ton and 10 ton production capacities units, which will meet the growing demand of trout fish in metropolitan cities and will generate additional employment and economic activities in the respective regions.

Fishery Minister Virender Kanwar said that when all 15 fish farms under RAS technology will be operationalised approximately 270 ton fish is expected to be produced annually in the state. He said that rainbow trout will be reared in coldwater RAS while in normal water RAS Pangasius, Tilapia, Common carp will be reared.

He said that initially, the land based fish farms will be set up in cold water areas in Kullu, Mandi, Chamba, Sirmaur, Shimla, and Kinnaur districts and in the beginning two new fish farms in district Kullu and Kinnaur will be set up under RAS technology during the year 2020-21 under PMMSY in the state.

He said that new fish farms in the state under RAS technology will be set up in private sector and it is estimated that around Rs 5 crore private investment will be received for infrastructural development for setting up new land based fish farms under RAS technology in the state in next five years under PMMSY.

The state government will provide incentives to the private sector for setting up fish farms under RAS technology under which financial assistance at the rate of 40 percent to general category and 60 percent to SC/ST/women of the total unit cost will be provided to the entrepreneurs under the scheme.

RAS technology fish farms of Rs 50 lakh and Rs 20 lakh unit costs are proposed to be established in the state under PMMSY keeping in view of the topography and geography different regions of this hill state.

At present, fish is reared all the year around, although summers are most favourable for growth of fish. RAS technology is expected to boost fish growth all the year around irrespective of weather conditions.

Sree Hatchery's Mustafa Hussain passes away

Mr Mohammed Mustafa Hussain, General Manager of Sree Hatchery, producers of shrimp seed, passed away on 1 October 2020. Mustafa Hussain had an experience of 30 years in aqua field at Sree Hatchery.

While Sree Hatchery is situated at Nellore, Andhra Pradesh, its sales office is located at Olpad, Surat in Gujarat. Mustafa Hussain's son Mr Mohammed Nawaz has taken up his father role as the General Manager of Sree Hatchery based at Olpad.

Mohd Mustafa Hussain, General Manager, Sree Hatchery

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Aker BioMarine's sustainable harvesting operations recertified by MSC

Aker BioMarine receives its third consecutive certification from the Marine Stewardship Council (MSC) for its sustainable Antarctic krill fishery following an independent assessment. The company was initially certified in 2010, being the first krill company ever to carry the MSC label.

The independent assessment report notes that Aker BioMarine's key sustainability strengths include the minimum amount of bycatch, its 100 percent observer coverage on its vessels, and the active partnerships with NGOs and scientific institutes that contribute to increased knowledge and raised standards in the fishery.

To receive the MSC blue label on a product, companies must clearly demonstrate that they are achieving high sustainability standards in their operations. Through an independent, third-party audit and assessment, the fishery has demonstrated that the marine resources are sustainably managed and harvested and that all products are traceable.

"Aker BioMarine's Antarctic krill fishery remains committed to the highest sustainability standards. With their precautionary approach to catch levels, as well as a sound and well-functioning management of the operation, the company is ensuring it has no significant impact to the food chain and future of krill in the Antarctic," said Linnea Engström, MSC Program Director for Scandinavia and the Baltic Sea Region.

"MSC is the gold standard for fisheries certifications globally. Through our 10-year partnership they have always pushed us towards new sustainability targets. We are extremely proud of the entire Aker BioMarine team, our partners and our customers, for supporting and reinforcing our sustainability approach. MSC has now validated our efforts with their stamp of approval for the next five years and we will make sure our sustainability work keeps moving forward," said Pål Einar Skogrand, Director Antarctic Affairs, Aker BioMarine.

Highlights from the certification report:

- Unconditional re-certification and a higher score achieved in the Ecosystem and Management System categories than in the previous assessment 5 years ago
- Catch levels well below what would generally be regarded as a precautionary upper level relative to the best estimates available of stock size
- Active engagement and support to NGOs and scientific institutes, contributing to knowledge production
- Negligible bycatch and virtually no interaction with species other than the target krill or minimal retained species
- Well-established and well-functioning management regime and enforcement system for the fishery, including 100% observer coverage and catch reports after each haul Precautionary and ecosystem approach to managing the fishery

Kerala Inland Fisheries and Aquaculture Act 2010 to be amended

Step to achieve self-sufficiency in fish production, make aquaculture more scientific

The Kerala Inland Fisheries and Aquaculture Act, 2010, will be amended so as to enable conservation of species, scientific breeding, and a sustainable livelihood for the fishing community. The proposed amendments also seek to introduce better control over ornamental fisheries, and fish species introduced into the State.

The Cabinet recently decided to recommend to Governor Arif Mohammed Khan to promulgate an Ordinance to facilitate the amendment.

The amendment seeks to regulate the fishing of species with low populations during their breeding seasons. A minimum legal size will be determined for the fish that can be caught, as was done in the case of 58 marine varieties to protect juvenile fish.

Aquaculture will be made more scientific so as to enable the State to achieve self-sufficiency in fish production. The amendments seek to scientifically organise aquaculture methods followed in the State.

An important aim is to check the introduction of foreign species and their marketing and breeding in the State. Breeding of species potentially harmful to local varieties will be checked.

Ornamental varieties

Further, the amendments seek to introduce better controls over the marketing and exhibition of ornamental fishes. No person without a valid licence will be allowed to sell ornamental varieties on an industrial scale or exhibit them for more than 30 days by selling tickets. However, this does not apply to the sale of fish from a production unit or displaying them at homes. Further, the display and sale of banned species will not be allowed.

Regional fisheries management councils and Aquaculture Development Agencies will be formed with fisher representatives as members. Constructions will not be allowed in any notified rivers, backwater stretches, or lakes that obstruct natural flow and fish breeding.

Uni-President

AQUACULTURE PROBIOTICS EXPERT

Nu Ri
NET 200 g **BSL**

Probiotics for water treatment

1. WATER QUALITY CONDITIONING

Best choice of *Bacillus* spp. that rapidly decompose uneaten feed, feces and other organic substances in pond water, keeps water quality optimal

2. HIGH ACTIVITY OF SPORES

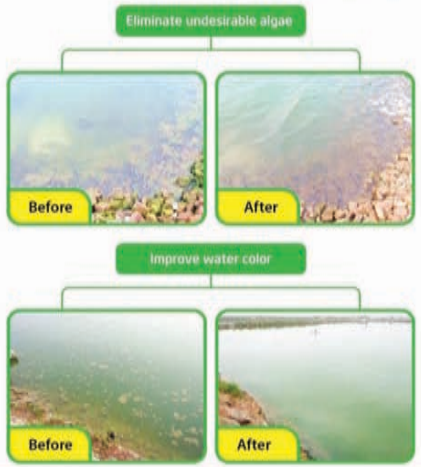
No cultivation is needed. Easily adapt to the changes of surroundings and grow fast in freshwater or seawater culture farming, even under low oxygen environment

3. DECREASE AMMONIA CONTENT

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

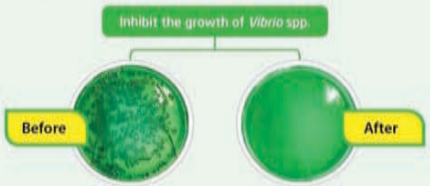
4. IMPROVE WATER COLOR

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



5. ESTABLISH BALANCED POND BACTERIA SYSTEM

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



6. INCREASE AQUACULTURE PRODUCTION

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

* COMPOSITION:

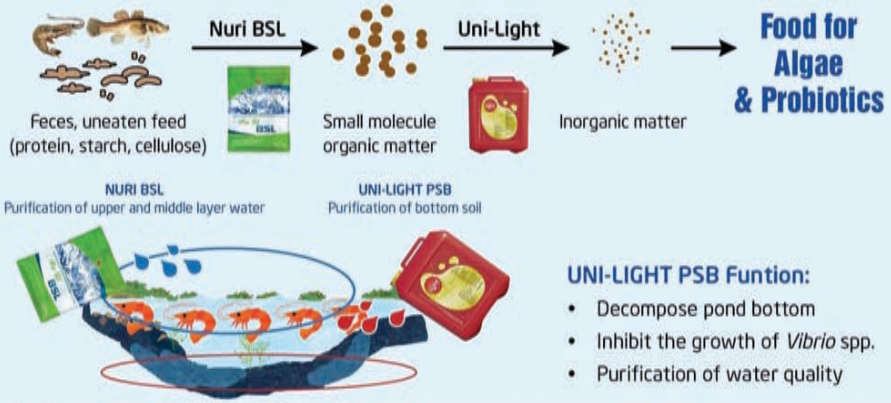
Bacillus spp. > 1x 10^{11} cfu/kg	15%
(Bacillus subtilis, Bacillus amyloliquefaciens, Bacillus licheniformis)	
Carrier (rice bran, corn gluten)	75%
Moisture	10%

* STORAGE:

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

* DIRECTION OF USE:

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



UNI-LIGHT PSB Funtion:

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

BSL Dosage:

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

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

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CIBA partners with Kerala government to set up multi-species fish hatchery

Hatchery to produce seeds of pearl spot, seabass and milkfish

Kochi: Setting a stage for increasing the brackishwater fish production in Kerala, the Chennai-headquartered Central Institute of Brackishwater Aquculture (CIBA) has partnered with the state Fisheries Department to set up a multi-species fish hatchery under the aegis of the government.

An MoU was signed between the CIBA and Agency for Development of Aquaculture (ADAK) of the Government of Kerala for the establishment of the hatchery at Odayam in Thiruvananthapuram district, following the initiatives taken by Fisheries Minister J Mercykutty Amma. According to the MoU, the CIBA will provide scientific and technical support to the government for developing captive breeding and seed production technology of commercially important brackishwater fishes—Asian seabass, milkfish and Kerala's state fish pearl spot. The hatchery will target seed production of these species throughout the season enabling continuous seed production. In addition to being a seed production centre, the partnership between CIBA and the state government also aims to support critical human resources development in the niche area through regular and continuous hands-on training programmes.

Game-changer

Dr K.K. Vijayan, Director of CIBA described CIBA's linkage as knowledge partner with the Kerala government a 'game-changer' in state's brackishwater aquaculture sector as it, according to him, would become an ideal model for transfer of technologies in a farmer-focussed manner. The establishment of the much needed brackishwater multi-species hatchery is timely and would provide stimulus for augmenting brackishwater finfish production in the state along with enhancing the livelihood generation during every step of the fish production process, he said.

"Kerala is endowed with rich brackishwater resources to the tune of 1.26 lakh ha. Since timely availability of fish seeds in sufficient quantity is still a major constraint, the brackishwater aquaculture is yet to explore its potential resources. Timely availability of seeds in a farmer-friendly way will help develop the sector", he said.

"Partnership between research institutions and the government agencies is crucial to develop and popularise sustainable aquaculture practice", Dr Vijayan added.

"The proposed hatchery will help boosting the sustainable brackishwater fish production in the state as it addresses the critical issue being faced by the fish farmers—inadequate seed availability of brackishwater fishes",said Tinku Biswal, IAS, Secretary to the Department of Fisheries and Chairperosn of the Executive Committee of the ADAK.

According to Dr M. Kailasam, Principal Scientist & Head-in-Charge of Fish Culture Division of CIBA, fish species such as seabass, milkfish and pearl spot are ideal for Kerala, considering resilient nature of the species to changing salinities and their market demand in the state. Dr Dinesan Cheruvat, Executive Director of the ADAK hoped that the agency could build up more technology partnerships in the areas such as hatchery, indigenous feeds, aquatic animal health and stock improvement.

CIBA organises Mahila Kisan Divas -2020 at Keelarkollai coastal village in Chengalpattu of TN

Mahila Kisan Divas which coincides with the International Day of Rural Women to recognise the role of Women in Agriculture and Rural Development was celebrated with coastal fisher families and Tribal families by the ICAR-Central Institute of Brackishwater Aquaculture (ICAR-CIBA) at Keelarkollai coastal village, Chengalpattu district of Tamil Nadu on 15 October 2020. About 50 participants from coastal fisher families, mostly fisher women (85%) from Keelarkollai and Karathittu villages, in Chengalpattu district of Tamil Nadu

and scientists from CIBA, Chennai participated in the programme. Mrs Senthamarai, the Irula tribal woman and her SHG members from Karathittu village shared their experiences on adoption of pearl spot fish larval rearing technology as a profitable livelihood option for them and how it helped them during the COVID-19 lock down period. Further, tuned CIBA's technologies like nursery rearing of fishes, ornamental fish farming, mud crab fattening exclusively for the women farmers. During the occasion an interactive session was held on CIBA technologies for empowering coastal women and enhancing the livelihood security of coastal fisher families. Success stories of CIBA's livelihood

women aqua farmers from Keelarkollai village shared their experiences of CIBA facilitated farming of Asian Seabass and Milkfish farming in coastal brackishwaters which fulfilled their dream of self-reliance. Dr K.K.Vijayan, Director ICAR-CIBA conveyed his Mahila Kisan Divas message to the participating women and emphasized that CIBA has been working with the coastal womenfolk and fine-technology interventions undertaken as part of the "Mera Gaon Mera Gaurav" programme and Tribal Sub Plan on nursery rearing of Asian Seabass (Lates calcarifer), Pearl spot (Etroplus suratensis) farming, ornamental fish culture and crab farming were shared during the session. Dr D.Deboral Vimala and Dr P.Mahalakhsmi, Principal Scientists, Social Sciences Division of CIBA coordinated the event.

Blue Aqua launches Doctor Shrimp - A Centre of Excellence for Shrimp Farming

Doctor Shrimp.com – Where Science Meets Art

Singapore: Blue Aqua International is launched Doctor ShrimpTM – a Centre of Excellence for shrimp farming on the 2nd of November, 2020.

Doctor ShrimpTM will leverage on the group's expertise and knowledge in shrimp farming to be consolidated on its online platform – doctorshrimp.com, where the latest research findings and practical solutions on shrimp farming are published.

Focusing on 5 species of cultured shrimp – Litopenaeus vannamei, Penaeus monodon, Marsupenaeus japonicus, Penaeus indicus, and Litopenaeus stylirostris, Doctor ShrimpTM aims to be a Centre of excellence for shrimp farming with research and practical trials conducted in Blue Aqua's R&D farms and facilities.

Doctor Shrimp will provide up-to-date findings and technical results on current issues in the shrimp industry. Technical knowledge on the management of disease, culture environment, and nutrition and health will be shared online through its digital platform.

Doctor Shrimp will also offer targeted solutions and consultancy services for shrimp farmers globally. An extension of the website will also allow users to purchase products, feed, equipment and even shrimp post-larvae online across Blue Aqua's business operations.

Blue Aqua International has been at the forefront of super-intensive shrimp farming, with over 4000 customers worldwide. The group provides cutting-edge solutions for the management of the culture environment and the optimization of animal nutrition. Specialised in shrimp and fish farming – the group transfers its expert solutions to customers worldwide and operates farms in Singapore and Indonesia.

Blue Aqua Group CEO/ President and Founder Dr Farshad Shishehchian commented, "We are incredibly proud to launch Doctor ShrimpTM. Being in the shrimp industry for over 25 years and with Blue Aqua's experience in shrimp farming – we believe that Doctor ShrimpTM will be a trusted centralized knowledge platform for the sharing of practical knowledge and innovation in the industry. We hope that with the launch of Doctor ShrimpTM we can help make a difference to bring about a sustainable growth for shrimp farmers around the world."

Rare two headed juvenile shark found by Palghar fisherman

A fisherman from Satpati village in Palghar discovered a baby shark, about six inches in length, with two heads in his by-catch recently.

Confused by the genetic anomaly, Nitin Patil took a few pictures and videos of the shark before throwing it back into the sea. When he shared the images with other fishermen, he was told that it was a rare anomaly. "We do not eat such small fish, especially sharks, so I thought it was strange but decided to throw it anyway," said Patil.

Another fisherman, Umesh Palekar said, "We have never seen anything like this before. We believe one of the larger sharks may have given birth to this double-headed shark baby. We shared the images with researchers from the Indian Council for Agricultural Research - Central Marine Fisheries Research Institute (ICAR-CMFRI), Mumbai."

CMFRI scientists and other marine biologists confirmed it was a very rare documentation and could be the first along the Maharashtra coastline for a double-headed shark species. "Our records show that double-headed sharks are very rarely reported along the Indian coast. This species appears to be the embryo of the spadenose shark (Scoliodon laticaudus) from the Carcharhinidae family or a sharpnose shark (Rhizoprionodon species). Both are viviparous [birthing live young which have developed inside the body

The fisherman threw the rare double-headed shark back into the water after finding it off the Palghar coast.(Nitin Patil/ Umesh Palekar)its current production cycles

of the parent], and are common in Maharashtra waters," said Dr Akhilesh KV, scientist, ICAR-CMFRI, Mumbai

Dr Akhilesh said the heads were joined behind the gills and such two-headed sharks were quite rare in the wild. "These are also called dicephaly. This phenomenon is reported in several animal species including sharks, possibly due to mutation or any other embryonic malformation, disorders, and these are very rare reports. Similar cases are reported elsewhere outside the northern Indian Ocean. These materials should be preserved out of scientific interest," he said.

According to CMFRI records, a similar two-headed milk shark (Rhizoprionodon acutus) was reported from Gujarat in 1964, while a two-headed spadenose shark was reported from Karwar in 1991, and a double-headed cownose ray was reported from Andhra Pradesh in 1984.

In 2008, a fisherman discovered a two-headed blue shark embryo in the Indian Ocean, as reported by National Geographic.

Marine biologist Swapnil Tandel said the recently documented species seemed to be a spadenose shark and could be the first record of this species in a dicephalic condition (double-headed) from along Maharashtra waters. "These finds are so rare that it is difficult to find a cause for the anomaly. Genetic or metabolic disorders, viruses, pollution or overfishing could be the possible reasons. If two-headed fetuses are more prevalent in nature, then overfishing is a strong culprit as it may cause the gene pool to shrink," he said.

E Vivekanandan, emeritus scientist, ICAR-CMFRI said these species have a very low survival rate. "There are hardly any documentations of this species as adults. This finding is purely an aberration. We cannot attribute it to any exact reason. It is regularly seen for snake species or conjoined or Siamese twins in humans. In maximum cases, they do not survive beyond the juvenile stage, but it definitely opens up an avenue for much needed research."

India looking at increasing national fish production from 14 mn ton to 22 mn tons in next 5 years

The Webinar on Biofloc-based Aquaculture was organized by ICAR-Central Institute of Brackishwater Aquaculture, Chennai on 6 November 2020. In Presidential address, respected Dr J. K. Jena, DDG (Fisheries Science Division), ICAR extended respect to most important speaker and Biofloc fish farming expert Dr Y. Avnimelech and others and mentioned that fisheries and aquaculture sectors in India not only provide protein and food (nutritional) security but have received much attention of professional people, farming community and others over the years. Technology has provided much opportunity for all participants registered in this Webinar (all of them may not have much fisheries background) to be involved. We are looking at increasing national fish production from 14 million tonnes to 22 million tonnes in next 5 years under PMMSY, we will not be able to achieve this only from horizontal growth in fish production from existing pond resources.

With limited resource and small backyard of one's own of 200 - 400sqmt land area, and even in certain regions with not much available water resource, Biofloc fish farming technology can be adopted and we can think about it; an opportunity provided by Dr Avnimelech. It can be adopted in freshwater, brackishwater or mariculture; the species to be cultured and target to achieve must be thought about. Some issues arose in earthen pond aquaculture where stocking has to be done during full water level in June-July and fishes harvested before water table recedes. When going for intensive fish production in ponds, we need to know how much water exchange is needed, where should one get the water from and where should it be discharged after harvest, which is a difficulty. In Biofloc system, waste is retained and converted into Biofloc, a natural feed, with addition of heterotrophic and other bacteria, microalgae, protozoa; it is a process of preparing a floc utilizing those for fish to feed, going for quite high stocking density, high production target and minimizing water exchange.

In Recirculatory Aquaculture System in indoors, we have control over water quality, temperature, maintaining particular dissolved oxygen level. In Biofloc, we give source of carbon and other ingredients and floc develops. Maintaining the same thing is difficult; if one has 10 different Biofloc tanks, we cannot have the same kind of water and developed floc at the same place at particular time. But still Biofloc fish farming has merits. It should not be set up in places where electrical energy is not there. In some places in India, there is power cut during summer days for continuous 5-6 hours or more, so alternative system must be there to generate power. We need to be ready with alternative energy sources in Biofloc fish farming system with high stocking density. Dr Jena spoke about his experiences in working in shrimp farming sector in Nellore in late 1990s when country's shrimp production was only 30000 tonnes. After 2nd month of stocking, when power went off in night, with no generator, whole lot of growing shrimps died in about 10 hectare of ponds.

If we want to look at for more profit in a system, we need to have investment. Also no system can give more profit without any risk. We have different advantages in Biofloc system. We can minimize or even exclude the pathogenic microbial load. Tilapia and Pangas catfish have been cultured in Biofloc system; it can be done with any species having potential. Growth rate in shrimp farming is important in nursery phase; future of shrimp farming in India will definitely depend on nursery-based farming system, which is Biofloc-based nursery that will take production and survivability at the crest. We have to do everything with scientific basis in this information age.

Electronic platform in present COVID-19 situation have enabled us to get connected to 2000 registered farmers (as in this Webinar), which is a benefit; it would not have been possible in normal physical platforms. Biofloc fish farming technology has created ripple everywhere, even outside India, which holds potential. In pond-based intensive fish farming, we need to know about how much is farmer's water area, what is production target, water sources and water table before giving any prescription for intensive fish or shellfish farming. In Biofloc fish farming, one can start with 100 tonne capacity tanks if he has more resource, and those with less resource can start with 10 tonne capacity tanks. It can be started with 20 tanks or with one tank depending on one's available resource. Farmers and entrepreneurs joined as participants in this Webinar have thought about or trying to adopt Biofloc fish farming system where one can get good production and is remunerative.

This system can provide source of protein food on daily basis to fish farmer/ entrepreneur. If one has Biofloc fish farming in 10 tanks, some fish can be harvested for own consumption; fresh, live and quality fish. It will not be needed to purchase from somewhere, which may be 3-4 days old, ice-preserved fish from Kolleru Lake. Biofloc fish farming is a green system, here we do not manipulate with fertilizers or no kind of toxicants. In coming days, with Government intervention and PMMSY scheme, more attention will be given to this technology. This Webinar will arouse interest in people. In the end, Dr Jena felt that more deliberations and intense training programmes are necessary in this regard. In Biofoc, we work with a consortium of microbes and a proper understanding is very much necessary about beneficial aspects of microbes in Biofloc fish culture. News communicator Subrato Ghosh participated in this Webinar.

How has India's shrimp sector weathered the Covid-19 crisis?

After the India's lockdown in March put the summer shrimp season in jeopardy, researchers estimate that the shrimp industry could face a $1.5 billion loss for 2020-2021. But government safeguards and improved labour retention could keep firms afloat for the winter season.

The coronavirus pandemic has adversely impacted aquaculture production across the globe. The economic fallout from nationwide stay-at-home orders and slowed export flows affected all segments of the aquaculture value chain. For farmed shrimp, lockdowns and closed food services have been catastrophic, especially in India. According to a paper published in *Aquaculture*, researchers with India's Central Institute of Brackishwater Aquaculture (CIBA) estimate that the sector will face a $1.5 billion loss for 2020-2021 due to the pandemic.

India's shrimp sector has had difficulty contending with the Covid-19 crisis

After conducting multiple surveys and interviews with key stakeholders, the research team at CIBA mapped the pandemic's economic shocks to the farmed shrimp sector. The study found that Covid-19 outbreaks and restrictions negatively impacted each link of the industry's supply chain. Shrimp hatcheries, farms, processors, retailers and exporters lost an estimated 30 to 40 percent of their business in the wake of India's lockdown.

Though the initial assessment is dire, the researchers note that targeted policy protections for the sector could keep businesses afloat through the first wave of the pandemic. Officially classing aquaculture as an "essential activity", enforcing economic protection measures like price controls and allowing producers to keep workers on the payroll during future lockdowns could keep firms solvent through the winter season.

India's coronavirus outbreak and the shrimp sector

At the end of September 2020, India has confirmed more than 6.22 million positive cases of Covid-19 and recorded more than 97,000 deaths. Its lockdown, which began on 25 March, included movement restrictions and mothballed multiple sectors of the economy. Most of India's workforce had to stay at home for the duration of lockdown. Though it is currently undergoing a phased reopening, the economic impacts of the stay-at-home orders caused a multi-faceted shock to India's food value chain that is still ongoing.

India is the world's third largest shrimp producer and the industry brings in an estimated $5 billion of foreign exchange earnings every year. The country exports 90 percent of its shrimp, with the United States, European Union, China and Japan receiving most of the shipments. Economists estimate that the sector employs 1.2 million people across the value chain – from farming, processing, retailing and exporting.

For India's shrimp farmers, the lockdown was announced at the beginning of its summer farming season (between March and July). This period usually yields 60 percent of India's annual shrimp production, with the winter crop (between August and December) making up the remainder.

Inter-state and intra-state movement are key to India's shrimp sector. Farming, processing, feed production and research activities are concentrated in different regions. The industry's structure meant that lockdown restrictions

A huge portion of India's workforce had to stay home during lockdown, leading to labour shortages

left it vulnerable to labour shortages and market shocks. To say the sector was unprepared for Covid-19 is an understatement.

Value chain analysis: from seed to sale

Seed production and supply

The biggest impact on shrimp hatcheries came from manpower shortages – especially for skilled technicians. Though many sectors across India complained of reduced labour availability between March and June of this year, agriculture and aquaculture are particularly vulnerable to labour squeezes. Shrimp production cycles are inflexible and time-dependent. A sudden dearth of skilled labour meant that hatcheries struggled to fulfil their contracts.

A second-order impact of the lockdown was seen in the precipitous drop of consumer and export demand for shrimp. Since hatchery owners couldn't be sure there would be future buyers for shrimp larvae, holding on to unsold post-larval shrimp meant taking a steep loss. The researchers reported that most shrimp hatcheries discarded their available seed stock due to economic uncertainty.

An additional constraint for shrimp hatcheries is their dependence on specific pathogen-free (SPF) broodstock. Like most international cargo, imports of SPF broodstock were temporarily suspended during lockdown. Hatchery operators told the researchers that India's existing broodstock supply couldn't meet their needs – they typically make up the shortfall with imports.

India's shrimp sector depends of SPF broodstock to maintain its current production cycles

This caused a stoppage at the first link in the shrimp aquaculture value chain. The subsequent weakness caused a ripple effect through the rest of the sector.

Lockdown's impact on shrimp farmers and shrimp farming

India's lockdown came into force at the end of the first month of the summer season. Researchers found that 27 percent of farmers who had prepared shrimp ponds for stocking didn't finish the three-phase production cycle. When speaking to farmers, the researchers noted that producers had difficulty obtaining production inputs like feed and seed and demand for finished shrimp was unpredictable.

25 percent of farms were in phase one (less than 30 days into the culture period) when lockdown began. 34 percent were in phase two (their shrimp had had between 30 and 80 days of growth) and 14 percent were in phase three (in which their shrimp had spent more than 80 days in the pond environment). Farms in phase three told researchers that they were able to make a small profit or break even, but others weren't as lucky. Some producers reported "panic harvesting" small shrimp to sell at a discount to avoid bigger losses in the future.

However, these "distress sales" weren't always effective: producers couldn't access insulated trucks or labour to harvest and transport the shrimp. Even when a contract was agreed, movement restrictions meant that producers couldn't access processors or market their goods. Many farmers were forced to take a loss for the summer crop.

Farmers listed closed diagnostic labs as an additional challenge during lockdown. Farmers often rely on these labs to monitor water quality and shrimp health during the production cycle. Losing access to that data and monitoring capacity meant that farmers couldn't easily manage their water quality or identify disease outbreaks during the culture period.

Like hatchery operators, farmers had difficulty recruiting and retaining labourers during lockdown. Official movement restrictions and farmers' inability to guarantee wages or job security caused a severe labour shortage. Production slowed as a result.

India closed many of its diagnostic labs during lockdown, leaving many producers without a way to monitor water quality.

Processing and marketing

Seafood processors told researchers that manpower shortages were their primary constraint. Migrant workers – who make up the bulk of India's skilled labourers at processing plants – returned home during lockdown. This not only slowed processing times, but also decreased shrimp quality after they were processed. Requirements for social distancing and securing personal protective equipment (PPE) for labourers were further challenges for seafood processors.

Many of the other constraints facing processors were knock-on effects from the first two links in the shrimp value chain. Some processors told the research team that many shrimp orders weren't large enough to justify running the processing equipment.

The fact that many farmers "panic harvested" shrimp that were too small to be mechanically processed compounded the issue.

Processors also said that the sudden nosedive in export orders put a strain on India's cold storage facilities. Unsold inventory began accumulating in key ports as buyers for Indian shrimp closed their food service sectors. Further procurement couldn't take place.

Though researchers noted that the state government of Andhra Pradesh enacted

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India's farmed shrimp industry is expected to lose $1.5 billion this year

a minimum procurement price for difference sizes of harvested shrimps to stabilise the market, study participants said the policy wasn't strictly enforced. Processors often refused to pay the fixed prices, telling farmers that the shrimp was poor quality.

The estimated impact of Covid-19

The researchers estimate that pandemic-related disruptions caused a 30 to 40 percent drop in each component of the shrimp aquaculture value chain. In economic terms, this could amount to $1.5 billion loss for 2020. The biggest decline was attributed to shrimp exports – projected export volumes for 2020 are almost 40 percent lower than they were in 2019. The decline in exports is putting pressure on shrimp prices – researchers expect a 35 percent reduction before 2021.

The research team also expects a 30 to 40 percent reduction in labour resources in the sector due to supressed farming and processing activities. Their analysis also warns that these effects could be compounded if India experiences a second wave of Covid-19 and must contend with another lockdown during the winter shrimp season.

Rebuilding after the shock

The researchers note that Indian government attempted to mitigate the worst effects of the pandemic. Shortly after locking down, fish farming and processing were categorised as "essential activities", allowing some businesses to keep operating, even if it was at reduced capacity. Officially designating key points of the aquaculture value chain as "essential" will insulate the industry from the economic shock of lockdowns. However, governments should consider other protections for shrimp aquaculture.

Though initial efforts to set minimum prices for farmed shrimp saw limited success, additional enforcement efforts could turn this into a key protection for shrimp farmers and improve forecasting for processors.

The research team highlighted the Fisheries Development Scheme as a potential way to make the sector more resilient. The programme is part of a five-year blue development initiative that wants to ramp up investment in India's aquaculture value chain and provide incentives for sustainable fish farming.

If this policy intervention focuses on employment generation as well as economic security for producers, many of the losses stemming from labour shortages could be mitigated. Increasing protections for labourers in the sector would also go a long way to prevent the manpower shortages seen in the first lockdown. If hatchery, farming and processing labour becomes more formal and stable, the businesses will be able to keep workers and potentially stay afloat if a different crisis emerges.

Mangaluru: CMFRI releases jelly safe kits

Mangaluru: Mangalore Regional Centre of Central Marine Fisheries Research Institute in collaboration with Coastal Security Police, on the occasion of world jellyfish day, released 'Jelly safe' kit on 28 October 2020. Jelly safe is a first aid kit put forward by the institute for treating jellyfish stings.

Dr Prathibha Rohit, head, Mangalore Regional Centre, ICAR-CMFRI, said that jellyfish stings are common among people working in marine environments and recreational swimmers. To tackle the problems arisingdue to jelly stings, the Institute has developed a first aid kit. This has already been launched in Tamil Nadu and is now being released in Karnataka. Dr Prathibha handed over 18 first aid kits to Gangi Reddy, inspector, Coastal Security Police, Mangaluru in the presence of lifeguards posted along Dakshina Kannada beaches.

The Marine Biodiversity Division (MBD) of ICAR-CMFRI that has been working on jellyfish for last four years and has found that;Karwar, Gokarna, Malpe, Panambur and Ullal are the major areas where regular swarms of jellyfishes are seen in Karnataka. Jellyfishes commonly found in coastal waters of Karnataka with severe stinging potential are Chrysaora sp. and Cyanea sp. Jelly safe kit contains all the necessary first aid items required to treat the jellyfish sting. The kit would be helpful for fishermen, beach tourists and marine researchers who are likely to encounter jellyfish stings that are generally reported after monsoon from September to March.

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

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

COMPOSITION:
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BACILLUS SUBTILIS
BACILLUS POLYMIXA
BACILLUS LICHENIFORMIS
NITRASOMONAS
NITROBACTOR
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Bioactive Peptides in Fish

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Highlight Points

▶Bioactive peptides are food derived constituents comprising 2–20 amino acids linked with amide or peptide bonds. ▶Currently, >1500 different bioactive peptides have been reported in a database named 'Biopep'. ▶Marine organisms are exposed to more extreme environmental conditions than that on land, which make the marine bioactive peptides to have significant different amino acid compositions and sequences and thereby possess better bioactivity from land bioactive peptides. ▶Bioactive peptides derived from marine organisms muscle proteins have shown potent antihypertensive, antibacterial, anticoagulant, anti-inflammatory, and antioxidant activities. ▶Bioactive peptides obtained from fishes are Urotensin 1-2-3, adrenomedullin, melanin-concentrating hormone (MCH), piscidin, etc. and referred as the potential material for biomedical, nutraceutical and food industries.

Introduction

Bioactive peptides are food derived constituents exerting physiological effect in the body which comprises 2–20 amino acids linked with amide or peptide bonds. The vast majority are encrypted in the structure of the parent proteins and are released mainly by enzymatic processes, whereas, some exist freely in the natural source. Bioactive peptides may be absorbed through the intestine where they subsequently enter the circulatory system intact to exert various physiological effects. Aquatic organisms total the highest number of species in the world, therefore discovering bio-active peptides from fish source is more conceivable. Several marine organisms are exposed to extreme conditions than that on land, making the marine bioactive peptides significantly different in the amino acid compositions and sequences compared to land bioactive peptides. Abundance of native and obtained peptides with proper enzymatic methods may open new horizons for future medical research.

Biopeptides from fish

Peptides are inactivated in main protein blocks until being separated by enzymatic process and act as hormones. These are specific protein fragments acting as amino acids and nitrogen sources, having numerous potential physiological functions within the body and can be referred as naturally occurring biomolecules, produced by microbial fermentation or generated with a variety of commercially available enzymes and have potential for disease prevention and complex metabolic effects. Currently, >1500 different bioactive peptides have been reported in a database named 'Biopep'. Bioactive peptides obtained from fishes are Urotensin 1-2-3, adrenomedullin, melanin-concentrating hormone (MCH), piscidin, etc. and referred as the potential material for biomedical, nutraceutical and food industries.

Bioactive peptides derived from marine organisms muscle proteins have shown antihypertensive, antibacterial, anticoagulant, anti-inflammatory, and antioxidant activities(Lepp¨al¨a 2000), and can be produced by proteolytic hydrolysis using commercially available enzymes including trypsin, chymotrypsin, alcalase, or proteolytic microorganisms and fermentation methods. After digestion, bioactive peptides can be absorbed in the intestine and enter the blood stream directly, which ensures their bioavailability in vivo and a physiological effect at the target site. They can be extracted and purified with technologies varying from simple to complex, and such compounds may include preparation and isolation of bioactive peptides for biotechnological and pharmaceutical applications.

Bioactive peptides naturally found in fish mucus, functions as an outer defence against bacteria. However, they are potentially pre-sent in any protein as part of the protein sequence and are released into their functional forms upon protein degradation, these hidden peptides or "cryptides" are multifunctional in nature. Majorly, peptides can be isolated from muscle, skin, bone, intestine, mucous layer in fish.

Health facts and their Bioactivities:

Biologically active peptides are released, either during digestion or during food processing, and have decisive impact on human metabolism i.e. regulation and modulation, hence, can be referred as probable nutraceuticals. In general marine organisms are exposed to more extreme environmental conditions than that on land, which make the marine bioactive peptides to have significant different amino acid compositions and sequences and thereby possess better bioactivity from land bioactive peptides. The bioactivities possessed by seafood derived peptides is discussed below:

Antioxidative

Oxidation plays an important role in signal transduction and antioxidants are the compounds which inhibits lipid oxidation, usually by scavenging and countering free radicals (Bernardini et al., 2011). Spare free radicals may lead to heart disease, strokes, arteriosclerosis, diabetes and cancer. The synthetic antioxidants such as butylatedhydroxyanisole and butylatedhydroxytoluene have long-term safety problems leading, the demand for natural antioxidants. Compared to terrestrial environment, marine organisms live in complex habitat thus, have high antioxidant activities. Many fishes are reported to show significant free radical scavenging activities like Mackerel *(Pneumatophorusjaponicus)*, Mussel *(Pernacanaliculus)* muscle, Croaker *(Otolithesruber)*, Tuna backbone, Hoki frame *(Johniusbelengerii)* and Prawn *(Penaeusjaponicus)*, apart various studies conducted reflects the antioxidative property of various seafood byproducts like, Sardinelle *(Sardinellaaurita)* by-products, Abalone *(Haliotis discushannailno)* viscera, Nile Tilapia skin, Jumbo Squid *(Dosidicusgigas)* skin, thereby, increasing the utilization value.

Anti-Cancer

Cancer mostly treated by surgery (oftenly combined with chemotherapy and radiotherapy), though appears detrimental by drug-induced damage to healthy cells and tissues. Hence, discovery of novelas well as safe cancer drugs turn out to be an important goal in biomedical science research, focusing new marine based anticancer compound. Marine anticancer peptides (MACPs) induce cancer cell death through apoptosis (programmed cell death) and angiogenesis (formation of new blood vessels). Apoptosis the most preferable way of cancer cell death during treatment. Mostly seafood based anticancer peptides have been isolated from molluscs, tunicates, sponges and ascidians, while regarding the fish by-products the peptides derived from snow crab by-products found effective against colon, breast, prostate and lung cancer cell lines, in addition, anticancer peptide obtained from shrimp shells showed significant inhibition of colon and liver cancerous cells.

Antimicrobial

AMPs evolved through positive selection are reported to be significant immune effectors. Owing to the special living environment, much attention has been paid towards marine-derived bioactive peptides and being in close contact with microbes, they provide a huge source of AMPs and found to be safe, natural, economical with high bioactivity properties. Till date these have been isolated from various finfishes,crabs, oysters, sponge *(Trichoderma sp.)*, marine snail *(Cenchritismuricatus)*, etc (Suarez-Jimenez et al., 2012). A number of methods for testing the antimicrobial activity have been used but agar diffusion assay is most common method, it quantifies the ability of antibiotics to inhibit bacterial growth. Other assays are disc diffusion assay, broth dilution, high throughput fluorescence screening assay, etc. Kumanesan et al. (2015) reported a novel antimicrobial peptide from goose type lysozyme (LyzG) identified from the cDNA library of freshwater fish *Channastriatus*(Cs) containing 585 nucleotides encoding a protein of 194 amino acids. Sila et al. (2014), assessed the mode of action of new peptides (Gly-Val-His, Trp-His-Arg, Trp-His-Phe, Pro-Pro-Ser-Ser, Ala-Ala-Ala-Leu, Ala-Ala-Gly-Gly-Val, Ala-Ala-Val-Lys-Met, Ala-Ser-Ser-Ser), formerly characterized from barbel (*Barbuscallensis*) protein hydrolysates against *Listeria monocytogenes*through membrane damage mechanism.

Angiotensin-I-Converting Enzyme (ACE) Inhibitory

Hypertension is one of the most common cardiovascular diseases worldwide and approximately 54% of strokes (Wilson et al. 2011), 47% of ischaemic heart disease, 75% of hypertensive disease and 25% of other cardiovascular diseases worldwide were attributable to high blood pressure. Angiotensin-I-Converting Enzyme (ACE) plays asignificant role in the regulation of blood pressure, can catalyse the transformation of angiotensin I to angiotensin II, besides angiotensin II is a potent vasoconstrictor that increases peripheral vascular resistance and consequently elevates arterial pressure. Therefore, ACE inhibitors and angiotensin receptor blockers are now used clinically for the treatment of various cardiovascular diseases. Naturally occurring peptides with ACE inhibitory activity were obtained from various marine sourceslike green algae, sea cucumber, tuna, sole, blue mussels, jumbo squid, oysters, shrimp, etc. (Chen et al. 2013 and Wu et al. 2014) Techniquesutilized for evaluating the ACE inhibitory activity *in vitro*, includes spectrophotometric, fluorometric, radiochemical, highperformance liquid chromatography (HPLC) and capillary electrophoresis (CE).

Source of peptides production

1. Muscle protein peptides

Discarded fish (bone and cutoffs) comprises substantial amount of muscle proteins which are nutritionally valuable and easily digestible with well-balanced amino acid composition. Hence, fish proteins derived from seafood processing by-products can be hydrolyzed enzymatically to recover protein. Protein hydrolysates from numerous marine species are well known for their nutritional and functional properties, and various studies have been carried out mainly to explore the possibility of obtaining organically active peptides.

2. Peptides from fish skin

Fish skin waste can be considered as a potential source to isolate collagen and gelatin. Gelatin is derived from the fibrous protein collagen, a prime component of animal skin, bone and connective tissue.

3. Fish bone

Representing 30% of organic collagen component, while 60-70% calcium phosphate and hydroxylapatite. Fish-bone peptides (FBP) with a high affinity to Ca can be isolated using hydroxyapatite affinity chromatography. Tuna backbone hydrolyzed using proteases like alcalase, a-chymotrypsin, neutrase, papain, pepsin and trypsin possess excellent antioxidative properties.

4. Other body parts

Antimicrobial peptides are amply present in the Intestine as well as mucous layer, mainly present in the mucous layer and eliminate the pathogenic bacteria

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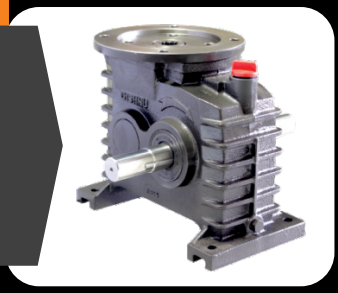

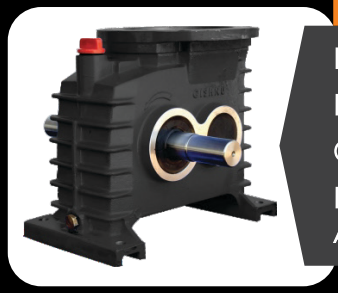

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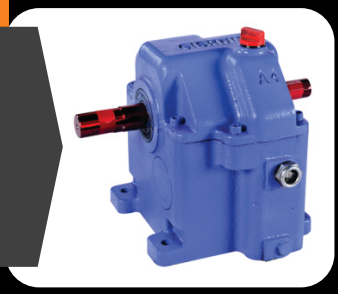

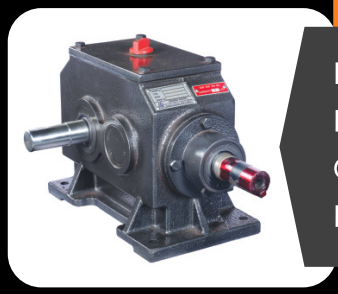

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before crossing the skin barrier. Antimicrobial peptide, Pleurocidins reported from various marine fishes like, Winter flounder (*Pleuronectesamericanus*), American plaice (*Hippoglossoidesplatessoides*) and Atlantic halibut (*Hippoglossushippoglossus*). The red sea bream gills are potent source of chrysophsins whereas, gills and skin of striped bass for piscidin or moronecidin.

Preparation of Bioactive Peptides

The bioactive peptides are diverse, depending on the species, amino acid composition, and sequence, moreover, preparation method too affects the biological activities of peptides (Agyei et al. 2016). Preparation employs organic synthesis, chemical hydrolysis, enzyme hydrolysis, etc. but most common and efficient one is the enzyme hydrolysis. The production of peptides using enzymes hydrolysis follows following process:

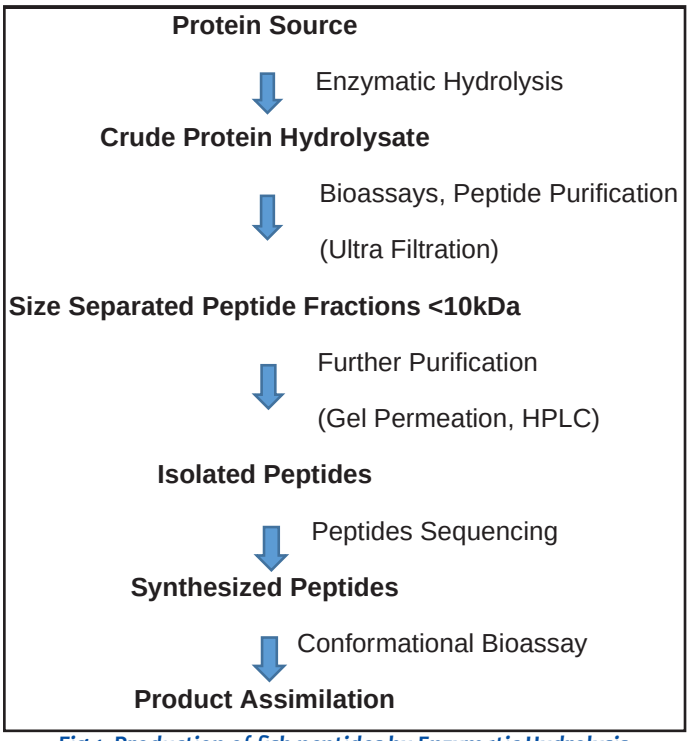

Fig.1. Production of fish peptides by Enzymatic Hydrolysis

Fish Derived Bio-Active Peptides

A) Melanine-Concentrating Hormone (MCH)

MCH, a regulating hormone for skin colour, also found in mammalians central nervous system as a cyclic neuropeptide (Takahashi et al., 2004), functions as regulator on food intake thereby influences the feeding behavior, spontaneous locomotor activity and anorexigenic action in the goldfish brain, in contrastof orexigenic action in mammals (Kawauchi, 2006, Matsuda et al. 2006)

B) Epinecidin

Epinecidin-1 have an antitumor effect in human fibrosarcoma cells. Fish can regulate their defense system while cytokine expressions, bacterial infection consequences and protect from death by injecting epinecidin-1 peptide just before inoculation of *V.vulnificus*(Pan et al. 2007). Similar infection were prevented in grouper (*Epinepheluscoioides*) and zebrafish (*Daniorerio*) by the injection of epinecidin.

C) Adrenomedullin (AM)

Adrenomedullin, member of Calcitonin Gene Related Peptide (CGRP) family, its five paralogues are identified in teleost fishes. Among these, AM2, may be considered more advantageous than AM for quick response to changes in blood flow and oxygen content in the coronary artery beside AM2 can be used as a diagnostic marker for the initial stage of ischemic heart failure. Comparative genomic analyses concluded that mammalian AM2 is an ortholog of puffer fish AM2 (Takei et al. 2004b).

D) Ghrelin

Ghrelin, documented as a multifunctional peptide, it's isolation from goldfish is well documented and is naturally secreted by stomach and hypothalamic neurons and functions as regulator of food ingestion, growth hormone production, reproduction and other physiological metabolisms (Miura et al. 2009). However, the differences in metabolism of ghrelin on same or different teleost fishes like locomotor mechanisms, energy intake and fat deposition have also been reported.

E) Urotensin (1 & 2)

Homologues to humanurocortins (UCNs) produces a hypotensive response, (Inada et al., 2009) performingas stress mediator on food intake and plays a protective role against cardiovascular stress. Apart, Urotensin 2 is a cyclic peptide expressed in some tumour cells, stimulates proliferation of those cells. Urocortins also functions in energy, hearing, gastrointestinal, immune and reproductive systems. Firstly, from urophyes of the white sucker (*Catostomuscommersoni*) 'Urotensin 1' was first isolated.

F) Hepcidin

A well-known peptide having role in iron metabolism and defense mechanism against bacterial infections. Chen et al. (2009) Tilapia hepcidin (TH2-3) may be promising for treatment of cancer with its cytotoxic effects on destructive impact on membranes of cancer cells and down regulation of apoptosis gene expression, blocking invasion to prevent metastasis, especially on human fibrocarcinoma cell. Sea bass genome reported with 8 copies of hepcidin gene functioning towards iron regulation and infection response.

G) Piscidin

Piscidins acts as an antibiotics and have potent, broad-spectrum *in vitro* activity against many pathogens, including multidrug-resistant bacteria. Peptide antibiotics, have been isolated from almost all types of organisms, from plants to mammals, possess a number of characteristics making them an attractive drug candidates. A potential new and novel family of peptide antibiotics named "piscidins," have been isolated from fish recently. Piscidin 1 (P1) has more effective in fungicidal and hemolytic activities than piscidin 3 (P3), Sung et al. (2008) in addition, P1 have higher ability to permeabilize phospholipids membranes.

H) Calcitonin (CT)

Calcitonin is 32 amino acid peptide, a member of CGRP (Calcitonin Gene-Related Peptides) superfamily like amylin, adrenomedullins and CRSPs (Calcitonin receptor-stimulating

peptides). Initially calcitonin was isolated from fish and reported to have higher affinity to mammalian CT receptor (Kloosterman et al., 2006) hence used as a drug for treatment of human bone diseases.

Conclusion

Fish derived bio-active peptides are gaining importance among all scientific community that linked human health like pharmacy, biochemistry and medicine. Their high nutraceutical, pharmaceutical and disease prevention potentials may make possible to produce products in food industry like nourishment support and in medicine like vaccines. New modelling concepts on the way with developing techniques to solve their structures and creating artificial active forms of polypeptide subunits as mimicked oligopeptides and peptides. It's clear that humankind could find solutions for pathologies in nature by completing billion pieces puzzle where bio-active peptides takes leading roles as big part by future visions with sophisticated methods and devices.

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More references can be provided on request.

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Traditional Fishing Boats, types and operations along West Coast off India

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Highlight Points

Traditional fishing boats or Artisanal fishing is small-scale commercial or subsistence fishing, particularly practices involving coastal or island ethnic groups using traditional fishing techniques and traditional boats. This may also include heritage groups involved in customary fishing practices. Artisan fishers usually use small traditional fishing boats that are open boats (undecked) and have sails; these boats use little or no mechanized or electronic gear. Large numbers of artisan fishing boats are still in use, particularly in developing countries with long productive marine coastlines needs to be utilize it effectively.

Traditionally, many different kinds of boats have been used as fishing boats to catch fish in the sea, or on a lake or river. Even today, many traditional fishing boats are still in use. According to the United Nations Food and Agriculture Organization (FAO), at the end of 2004, the world fishing fleet consisted of about 4 million vessels, of which 2.7 million were undecked (open) boats. While nearly all decked vessels were mechanised, only one-third of the undecked fishing boats were powered, usually with outboard engines. The remaining 1.8 million boats were traditional craft of various types, operated by sail and oars.

Early fishing vessels included rafts, dugout canoes, reed boats, and boats constructed from a frame covered with hide or tree bark, such as coracles. The oldest boats found by archaeological excavation are dugout canoes dating back to the Neolithic Period around 7,000-9,000 years ago. These canoes were often cut from coniferous tree logs, using simple stone tools. A 7000-year-old sea going boat made from reeds and tar has been found in Kuwait. These early vessels had limited capability; they could float and move on water, but were not suitable for use any great distance from the shoreline. They were used mainly for fishing and hunting.

Dugout canoe

Raft

The development of fishing boats took place in parallel with the development of boats built for trade and war. Early navigators began to use animal skins or woven fabrics for sails. Affixed to a pole set upright in the boat, these sails gave early boats more range, allowing voyages of exploration

According to the FAO, at the end of 2004, the world fishing fleet included 1.8 million traditional craft of various types which were operated by sail and oars. These figures for small fishing vessels are probably under reported. The FAO compiles these figures largely from national registers. These records often omit smaller boats where registration is not required or where fishing licenses are granted by provincial or municipal authorities. Indonesia reportedly has about 700,000 current fishing boats, 25 percent of which are dugout canoes, and half of which are without motors. The Philippines have reported a similar number of small fishing boats.

Traditional fishing boats are usually characteristic of the stretch of coast along which they operate. They evolve over

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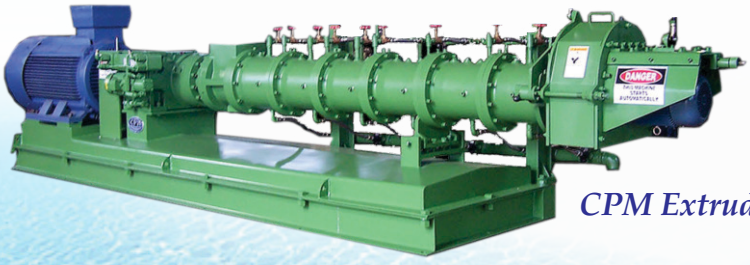

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time to meet the local conditions, such as the materials available locally for boat building, the type of sea conditions the boats will encounter, and the demands of the local fisheries.

Artisan fishing is small-scale commercial or subsistence fishing, particularly practices involving coastal or island ethnic groups using traditional fishing techniques and traditional boats. This may also include heritage groups involved in customary fishing practices. Artisan fishers usually use small traditional fishing boats that are open (undecked) and have sails; these boats use little to no mechanised or electronic gear. Large numbers of artisan fishing boats are still in use, particularly in developing countries with long productive marine coastlines.

A raft is a structure with a flat top that floats. It is the most basic boat design, characterized by the absence of a hull. The classic raft is constructed by lashing several logs, placed side by side, to two or more additional logs placed transverse to the others. In many Asian countries, the rafts are similarly constructed using bamboo.

In shallow waters, rafts can be punted with a push pole. They can be used as stealthy platforms for fishing shallow waters around lakes. In sheltered coastal waters, anchored or drifting rafts can become effective fish aggregating devices. Payaos were traditional bamboo rafts used in Southeast Asia as aggregating device. Fishermen on the top of the raft used handlines to catch tuna. Pontoon boats, and to some degree the punt, can be viewed as modern derivatives of rafts.

Boats, rafts and even small floating islands have been made from reeds. Reed rafts can be distinguished from reed boats, since the rafts are not made watertight. The earliest known boat made with reeds (and tar) is a 7000-year-old sea going boat found in Kuwait.

The Uros are an indigenous people pre-dating the Incas. They live, still today, on man-made floating islands scattered across Lake Titicaca. These islands are constructed from totora reeds.[9] Each floating island supports between three and ten houses, also built of reeds. The Uros also build their boats from bundled dried reeds. These days some Uros boats, used for fishing and hunting seabirds, have motors.

Reed boats were constructed in Easter Island with a markedly similar design to those used in Peru. Apart from Peru and Bolivia, reed boats are still used in Ethiopia and were used until recently in Corfu.

Coracles are light boats shaped like a bowl, typically with a frame of woven grass or reeds, or strong saplings covered with animal hides.[14] The keel-less, flat bottom evenly spreads the weight across the structure reducing the required depth of water often to only a few inches. Coracles have been used, and to a degree are still used, in India, Vietnam, Iraq, Tibet, North America and Britain.

Coracles in Iraq are called "quffa." Their history goes back to antiquity where they appear on Assyrian-era reliefs sculpted between 600 and 900 BC. These reliefs are now in the British Museum. Herodotus visited Babylon in the 5th century BC, and wrote a long description of the coracles he encountered there. Traditionally, quffa were framed with willow or juniper and covered with hides or reeds. The outside was then coated with hotbitumen for waterproofing, although the inside could also be coated for larger vessels. These coracles have been in continuous use on the Tigris and Euphrates rivers, particularly around Baghdad, through the 1970s. Some of the Iraqi coracles are very large, with the largest reaching up to 5.5 metres (18 ft) in diameter and being able to carry up to 5 tons.

Coracles are known to have been in use in Britain in 49 BC when Julius Caesar encountered them. They are still used in Wales, where they were traditionally framed with split and interwoven willow rods, tied with willow bark. The outer layer was an animal skin, such as horse or bullock hide, with a thin layer of tar for waterproofing. Today tarred calico or canvas, or simply fiberglass can be used. Different Welsh rivers have their own designs, tailored to the flow of the river. The Teifi coracle, for instance, is flat-bottomed, as it is designed to negotiate shallow rapids, common on the river in the summer, while the Carmarthen coracle is rounder and deeper, because it is used in tidal waters on the Tywi, where there are no rapids.

Coracles and Reed boats

Coracles can be effective fishing vessels. When operated skillfully, they hardly disturb the water or the fish. Welsh coracle fishing is performed by two men, each seated in his coracle and with one hand holding the net while with the other he plies his paddle. When a fish is caught, each hauls up his end of the net until the two coracles touch and the fish are secured. Many coracles are so light and portable that they can easily be carried on the fisherman's shoulders.

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Tuna Masi: A fish by-product from Lakshadweep: Preparation and Processing - A Glance

S. Akash and T. T. Ajith Kumar
ICAR- National Bureau of Fish Genetic Resources, Lucknow

Highlight Points

▶Tuna is considered as maximum profitable fish species and its dwindling catch in the recent days has been a great concern in Lakshadweep. Nowadays, the fishes that were caught from the Lakshadweep Sea were taken directly to the mainland, because of its demand. The fishes, which were brought to the Lakshadweep shore, were sold for the daily consumption of the islanders and the excess fish is then used for making masmeen, a dry tuna.
▶'Masmeen', a traditional cooked, smoked and dried tuna fish product, originated from Maldives and also referred as 'Masmeen' or 'Masi' in India and 'Umbalakada' in Sri Lanka. It is a heavily smoked and hard-dried material obtained from tuna meat. This is a pure dried fish product, which retains the antioxidant and omega-3 of fresh fish. The fabrication and marketing of masmeen will contribute significantly to raise the income of small-scale to the large scale business in Lakshadweep. The process involved in the preparation of masmeen includes. Boiling, smoking and drying etc. are discussed in details, besides the nutritional profile of the product is elaborated.

Introduction

The union territory of Lakshadweep is chain of 36 islands covering an area of 32 sq.km., out of which 11 are inhabited and 25 are uninhabited (Pillai et al., 2006). The continental shelf area around these islands is 4336 sq.km and the lagoons altogether have an area of 4200 sq. km. offering immense biodiversity. Lakshadweep has a long history of being a traditional maritime community of sailors, traders and fishers. The socio-economic mainstay of the local community is coconut and fish, caught mostly through traditional fishing methods (Modayil, 2006). It is estimated that about 13% of the total population of Lakshadweep are active, full-time fishermen and fisheries sector provide a livelihood to about 60% of the people of Lakshadweep.

Lakshadweep is off from the main land and facing less nutrient supply, but it contributes considerable quantity of fishes to other parts of our country. The people of these islands depend mainly on fishing as their livelihood and especially on tuna fisheries. They are also making by products of tuna in huge quantity for commercial purpose. Tuna is considered as maximum profitable species; however, its dwindling catch has been a great concern in Lakshadweep. Nowadays, the fishes that were caught from the Lakshadweep Sea were taken directly to the mainland, because of its demand. The fishes, which were brought to the Lakshadweep shore, were sold for the daily consumption of the islanders and the excess fish is then used for making masmin, a dry tuna fish.

'Masmeen', a traditional cooked, smoked and dried tuna fish product, originated from Maldives and also referred as 'Masmeen' or 'Masi' in India and 'Umbalakada' in Sri Lanka. It is a heavily smoked and hard-dried material obtained from tuna meat. This is a pure dried fish product, which retains the antioxidant and omega-3 of fresh fish. These benefits provide key marketing tools, which can make it as a profitable business.

In India, fresh tuna, which was landed in disdainful quantities, has low marketability because of its red meat. However, the main fish landing is only tuna. While exploring the opportunities for mounting income-generation for the islanders in Lakshadweep, it was found an option to enhance the income through value addition to tuna. The fabrication and marketing of masmin will contribute significantly to raise the income of small-scale to the large scale business in Lakshadweep.

Preparation

Masmin is prepared; adopting traditional methods, without adding any preservatives, still can be used for a quite long time. There are three steps are being involved for making masmin, they are as follows,

Boiling

The excess fish catch obtained were brought to the shore, where the masmin preparation was initiated. After cleaning the fish with fresh seawater, followed, head, intestine, tail, fins and bones of the fish were removed and it was sliced in to two halves longitudinally and it was again washed with seawater. The washed fishes were then allowed to

boil with raw seawater. After degutting and deboning, all the futile were dumped under the sand, near to the shore. Quantity of the sea water added for boiling the fish meat was one third volume of the fishes, allowed for boiling. In few occasion, small quantity of granulated salts will also be added, it depends the quality of the flesh. Coconut trunk was used for boiling and its takes around 4 to 5 hrs and followed it was allowed to cool for a day under normal environmental temperature. The remained water after boiling was again heated till it evaporates and forms as fish meat with salt mixture.

Smoking

After boiling and cooling, they were placed over a steel mess for the smoking process. Smoking is done to remove the moisture content available with the flesh and also to dry the same. Coconut husk are being used for smoking. The fleshes were arranged in a vertical position to get equal amount of smoke and dried equally. Smoking process is continued for around four hrs until, brown colour and smokey flavour develops.

Sliced tuna ready to boil

Process of smoking

Drying

Sun drying is the last step in making the masmin and its takes nearly seven days, depends sun light, which mainly help in remove the residual moisture. The smoked fishes are kept in a temporary stage established on the shore, which was made with the parts of coconut tree. The stages were built near the shore, so that the light rays fall directly, as the inner regions are fully covered with dense coconut trees. The stage was built in a triangular shape (upper portion), so that when sun's direction changes the opposite side's will also get the same light.

Process of drying

After drying the strips, they were collected and taken to the facility, where masmin is being packed and shared to the local shop's, those who are involving in the sales of masmin and bulk quantity will be transported to mainland. The advantage of the product is no preservatives and all the steps involved in the processess are traditional methods. The product is being sold for Rs. 450 to 500.

High protein with low calories

Protein is a key source of antibodies and enzymes for all living beings and makes up an essential role in muscles, hair and other body components. Dried fish provides an excellent source of protein with fewer calories than other meats. One hundred grams of dried fish contains about 80 percentage of protein with 300 calories, while other meats have more than twice the calories with far less protein. This profile leads the consumer to take dried fish, which is cost wise cheaper, compare with fresh fish and can store for a quite long period.

Nutritional profile

Most of the dried fishes contains little salt or cholesterol, while being high in essential vitamins and minerals. It also have low in saturated fat, which is known to aggravate or cause heart and blood-pressure problems. Utilizing this profile, retailers are able to legitimately claim the health benefits of the product. As an awareness of obesity, diabetes and heart disease continues to increase, the demand for dried fish will increase as well.

Benefits to mankind

As opposed to fresh or cooked fish, dried fish is firm to the touch. The act of chewing this kind of food helps to clean the teeth, removing tartar. Dried fish can also be softened if necessary by soaking it in water for few hours, transforming it back to a similar texture to fresh-caught fish. This ability is valuable for humans with dental issues that impede eating foods with a hard texture. The sellers can capitalize on these benefits in selling their product.

Conclusion

Masmin is a very popular fish processing method in Europe and Africa. Masmeen processing is an ideal option, because it requires less space and less time than drying, at the same time, improving the shelf life of the product can also be increased, so that the islanders can get attractive price for their product.

Tuna Masi, ready to cook

Masi powder, ready to cook

Reference can be provided on request

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Use of Phytogenic Compounds in Aquaculture

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Highlight Points

▶ Phytogenic compounds have a great potential to act as an alternative to antibiotics and feed additives in animal diet. ▶ The combination of different phytogenic compounds improves the feed efficacy and production in farm application. ▶ It can significantly reduce the occurrence of disease in shrimp and fish culture

Phytogenics are a group of natural growth promoters or non-antibiotic growth promoters that can be used as an additive in fish meal. They are derived from plant sources. Essential oils, flavonoids, tannins, saponins are some of the active ingredients of plants that can serve as feed additive. These are plant origined compounds added to animal diet to improve growth rate.The term phytogenics was coined by Australian multinational feed additive company DELACON and these were first introduced in 1980s to the market

Classification of phytogenic compounds:

a. Pungent Substances

Sources : Black pepper, Garlic, Ginger and Turmeric

Mechanism of action : Pungent substances activate reactions in the cells of the mucous membrane and increase blood circulation. They also improve metabolism and detoxify body. It is also found that pungent substances can increase the secretion of digestive juices and can form synergistic relation with essential oils

b. Saponins

Sources : Beans, Legumes, Potatoes, Tomatoes, Oats, Ginger, Red wine and Quinoa

Mechanism of action : Saponins are found to decrease ammonia and methane excretion from body into environment. Thus environmental pollution decreases and animal health increases. They act as antifungal, antioxidant, antiprotozoal and increase cell mediated immune response.

c. Bitter Substances

Sources : Hops, Gentian root andDandelion.

Mechanism of action : The bitter substances can stimulate taste buds in the tongue and act on gastric and pancreatic cells and increase their secretions. They can also enhance intestinal activities of trypsin, lipase and amylase. They enhance mucus production and shorten feed transmit time. They can improve nutrient assimilation in gut.

d. Essential Oils

Sources : Extracts from thyme, Star anise, Cinnamon, Clove and Rosemary.

Mechanism of action : Essential oils has quorum sensing ability that can be used to reduce the pathogenicity of harmful bacteria. They are antimicrobial, antioxidant, anti-inflammatory, immunomodulatory, hypolipidemic and increase the secretion of digestive enzymes.

e. Flavonoids

Sources : Onion, Citrus, Coffee, Tea and Grain.

Flavonoids gives plant yellow, orange and red colour

Mechanism of action : Flavonoids are antioxidant, antiviral, antiallergic, antiinflammatory. They are called as health promoting disease preventing component. Their antioxidative property exceeds that of vitamin C and E.

f. Mucilages

Sources : Flax seeds, Cactus, Psyllium, Fenugreek, Aloevera and chia

seeds.

Mechanism of action : Since the intestines are the key to good health, mucilages in animal feed can be used to stimulate the production of mucus and also to protect the intestinal mucosa. The mucilages are composed of polysaccharides that forms a thin protective layer on the mucosal surface and act as a protective barrier against pathogenic microorganisms. They possess anti-inflammatory, antispasmodic and anti-allergic properties and have a prebiotic effect. The intestinal microbiota can break the polysaccharides down into short-chain fatty acids, which serve as energy suppliers.

g. Tannins

Sources : oak tannins, chestnut tannins, mimosa tannins, and grapes.

Mechanism of action : Dietary tannins in animal feed can increase the amount of bypass protein. They form complex with proteins in diet and protect them from microbial degradation in the gut.

Phytogenics and their beneficial effects:

The effect of phytogenics is directly proportional to the factors like species of fish, extraction process and bioavailability of the active components rather than their dosage. Their

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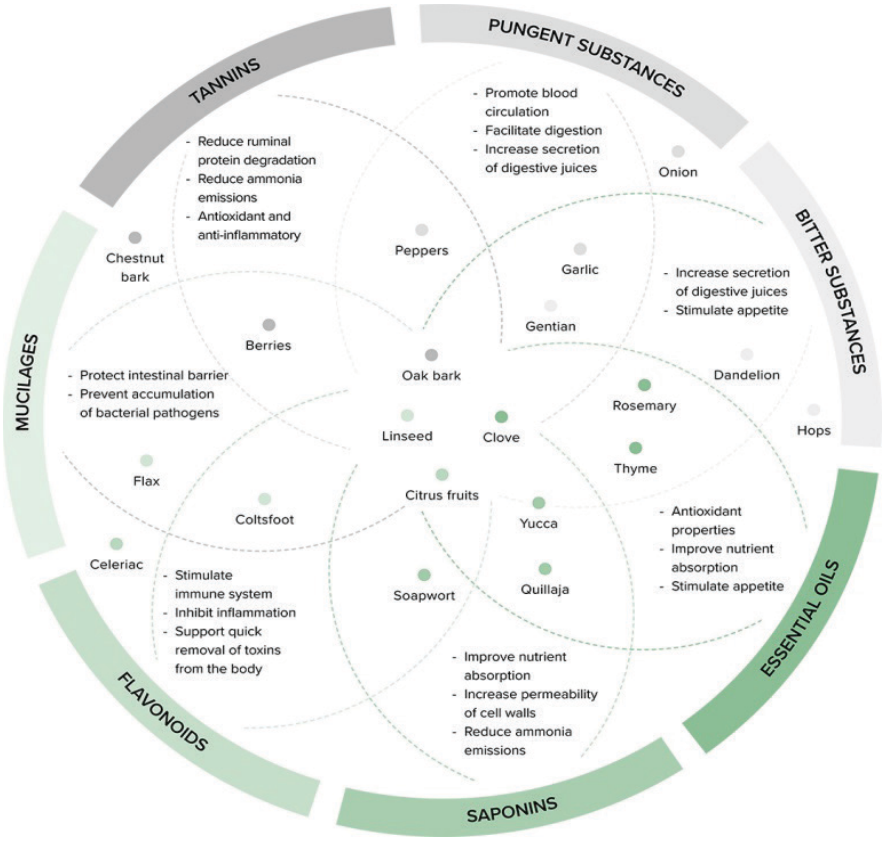

Phytogenic ingredients in the spotlight (Source:Delacon, *Performing Nature*)

potential mode of action is associated with increased feed palatability, digestive enzyme secretion, nutrient uptake and balance the gut microbiota.Phytogenics are known to boost innate and adaptive immunity when supplemented to the cultured shrimp. They modulate the intestinal microbiota by enhancing lactic acid bacterial growth and reducing the pathogenic microorganism proliferation.

Phytogenics affect the bacterial quorum sensing by reducing biofilm formation and toxin production, thus disease outbreak can be controlled. The quorum sensing inhibitors are phenolics, flavonoids, alkaloids. These inhibit N-acyl-homoserine lactone (AHL) synthesis thus their binding receptors efficiency, storage, transport, signaling and mechanism of secretion are greatly altered producing an antagonistic effect. They may lyse the bacterial cell wall, block protein and DNA synthesis, or inhibit the enzyme secretions. Phytogenic feed additives also decrease ammonia discharges through improved protein utilization, hence decreasing the loss of nitrogen to nature.

a. Phytogenics in stress control

For transport of fish and shrimp in live condition over long distances, we can anesthetize them. But anesthetics itself act as a stressor so an alternative is phytogenics. Clove oil is a widely preferred phytogenic compound. They not only anesthetize but also act as an antioxidant, antimicrobial and reduce stress. For transport bath or immersion treatment is sufficient but as for general stress control phytogenics must be incorporated into the diet.

b. Phytogenics in growth

Yucca, curcuma, ginger, astralagus, quillaja are some of the plants from which derivatives obtained are used to improve the growth and performance in whiteleg shrimp.In shrimp, diets containing papaya leaf meal resulted in better protein digestion, feed conversion ratio, specific growth rate and weight gain of *Penaeusmonodon*postlarvae (Peñaflorida 1995). This improved growth performance in shrimp was due to the presence of the enzyme, papain in papaya leaves.

Through processes such as matrix encapsulation, volatile essential oils can be stabilized and remain active throughout a greater section of the gastrointestinal tract. The matrix-encapsulated phytogenic feed additive was tested on white shrimp (*Penaeus vannamei*) at the Pearl River Aquaculture Institute in China. In this trial, the supplementation of shrimp diets with the encapsulated phytogenic compound resulted in 4 percent greater body length, a 14 percent gain in shrimp weight and an 11 percent improvement in feed conversion (RuiGoncalves and Goncalo Santos., 2015).

c. Phytogenics in disease control

Turmeric oil and *Gynura bicolor* are found to enhance the activity of lysozyme, prophenoloxidase and superoxide dismutase in vannamei thus their mortality to white spot syndrome and infection of *Vibrio harveyi* and *V.alginolyticus* are decreased to a great extent.RuiGoncalves and Goncalo Santos (2015) has reported the effects of matrix-encapsulated phytogenics on disease resistance in white shrimp. Shrimp were feed supplemented with the phytogenics for a period of 56 days. Later the shrimp were injected with 0.2 mL of pathogenic *Vibrio parahaemolyticus* at a concentration of 5×10^7/mL. The *Vibrio* is known to cause early mortality syndrome in shrimp. Shrimp that received the phytogenic additive had increased resistance against *Vibrio parahaemolyticus* in comparison with the control shrimp group. The mortality of shrimp fed the matrix-encapsulated phytogenic feed additive remained around 20 percent, while mortality rapidly increased in the control group.

d. Phytogenics in nutrient absorption by the intestine

The replacement of fishmeal by plant protein in aquafeed in an attempt to reduce feed costs and dependency on fishmeal can negatively affect feed efficiency. Plant raw materials are less digestible and can cause negative effects on the gastrointestinal tracts of culture animals. The presence of undigested nitrogenous compounds in the intestine favors the formation of ammonia and biogenic amines by the intestinal microbiota. These compounds are toxic and consequently lead to an imbalance of the intestinal microbiota. The resulting inflammatory processes and accelerated turnover of the intestinal tissue can lead to poor performance. Phytogenics may stimulate the digestive secretions, increase villi length and density, and raise mucous production

through an increase in the number of globlet cells. Through processes such as matrix encapsulation, volatile essential oils can be stabilized and remain active throughout a greater section of the gastrointestinal tract. As a result, phytogenics improve feed digestibility, especially for proteins and amino acids.Giannenas et al. (2012) reported significantly higher feed efficiencies (0.58 and 0.63) in rainbow trout fed diets containing carvacrol and thymol, respectively, compared to those fed the control diets.

After withdrawal of the use of antibiotics in feed there are a number of challenges faced by farmers. Cost-effectiveness in substituting antibiotics with alternatives is the most challenging one. Under this circumstance phytogenic compounds are the most promising alternatives to antibiotics, which have a large variety of active ingredients. However, their application in food animal production has been limited, largely owing to the lack of full understanding on the modes of action. With better understanding on the impact of phytogenic compounds on the components like, gut microbiota, gut physiology and immunology will pave way for the best use of phytogenic substances for economically effective and sustainable fish production

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More references can be provided on request.

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The Immune System of Shrimp

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Highlight Points

▶ Shrimp do not have the same immune system as vertebrates. ▶ This characteristic has a significant impact on shrimp farm management; it prevents these crustaceans from becoming immune to disease through vaccination. ▶ Since shrimp lack an adaptive immune system, innate immunity is their essential form of disease. ▶ This immunity acts as first-line protection from the disease and mortality threats that can potentially affect shrimp stocks.

Introduction

Penaeid shrimps include some economically important and aquaculture marine species, such as the Pacific white shrimp *Litopenaeus vannamei* and the black tiger shrimp *Penaeus monodon.* Disease outbreaks have caused massive mortality and a great loss to the shrimp cultivation industry.

Major shrimp pathogens:

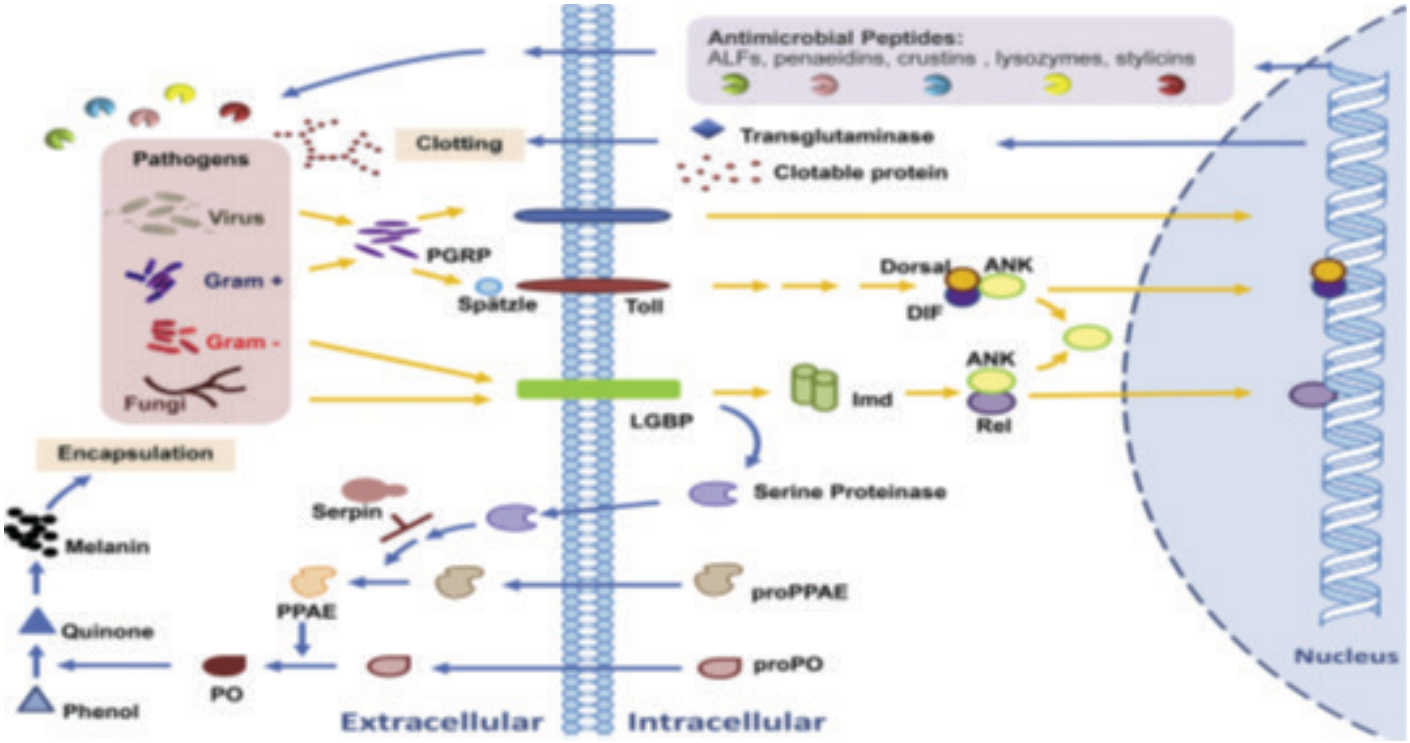
- White spot syndrome virus (WSSV)
- *Enterocytozoon hepatopenaei* (EHP)
- Yellow head virus(YHV)
- Infectious myonecrosis virus (IMNV)
- Bacteria in the genus Vibrio.

Lacking an adaptive immune system, shrimps rely on their effective cellular and humoral innate immune responses to combat invading microbes. The cellular immune reactions include phagocytosis, nodulation and encapsulation, whereas the humoral responses involve the synthesis and release of several immune proteins, such as antimicrobial peptides (AMPs), proteinase inhibitors and cytokine-like factors.

In crustaceans, including shrimps, major immune reactions take place in hemolymph, which contains three different principal types of hemocytes that are defined as the hyaline, granular and semigranular hemocytes. Pattern recognition proteins (PRPs) or pattern recognition receptors (PRRs) recognize and bind the microbial cell wall components and activate various immune responses. Understanding shrimp defense mechanisms in combination with different strategies can contribute to improve disease management.

Shrimp defense mechanisms

The innate defense system – also known as natural or non-specific defense system –includes both cellular and humoral components. Cellular defense components include all those reactions performed directly by hemocytes (phagocytosis, encapsulation, nodule formation). humoral components include the activation and release of molecules stored within hemocytes, such as anticoagulant proteins, agglutinins, phenoloxidase enzyme, antimicrobial peptides, protease inhibitors.



A schematic model of the shrimp immune system

Function of crustacean immune system

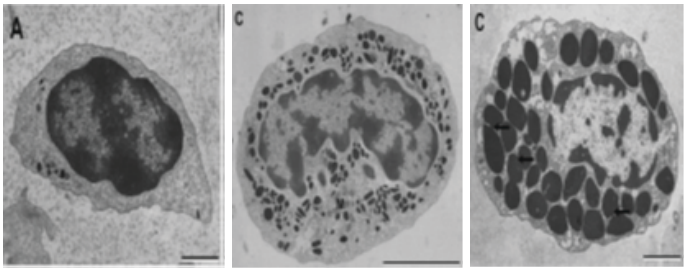
- Once the pathogen has crossed the outer defense barriers, hemocytes play an important role in the crustacean immune response.
- Participating in the inactivation of invading organisms, hemocytes are also involved in the regulation of different physiological functions.
- Hemocyte classification is based on the presence and size of 3 types of cytoplasmic granules:

  1) Hyaline.

  2) Semi-granular.

  3) Granular hemocytes.

Granular and semi-granular hemocytes have the ability of producing melanin by the pro-phenoloxidase system.



A) Hyaline *B) Semi-granular* *C) Granular*

Pathogen recognition

- The immune process is the recognition of microorganisms.
- This process is carried out by hemocytes through molecules that have the ability of recognizing structures in the cell walls of invading organisms, such as attachment proteins, and by the recognition of β-1,3-glucans, lipopolysaccharides, and peptidoglycans.

Phenoloxidase activity

The phenoloxidase system is stored and produced by semi-granular and granular hemocytes, and it can be activated by a minimum presence of microbes. Activation of the prophenoloxidase system results in the production of melanin, a dark-brown pigment responsible – among other processes – for inactivating foreign particles, and preventing their spread throughout the host body.

Antioxidant system

Antioxidant factors protect the shrimp from the cytotoxic effects caused by the cellular metabolism and oxidative stress generated by the disequilibrium of the reactive oxygen intermediates.The important role of the antioxidant enzymes as the immune response modulators. ROIs and reactive nitrogen intermediates (RNIs) are generated in phagocytic vacuoles. These molecules are capable of crossing the cell barrier and damaging the neighbouring cells. To prevent this damage, antioxidant defense strategies have been developed including enzymatic substance.

Phagocytosis

- Phagocytosis process, cells (hemocytes) ingest and destroy invading pathogens, foreign particles or modified (aged) cells of the body itself.
- Phagocytic cells destroy the internalized organisms by two routes,
- An aerobic process which uses NADPH or NADH as an electron donor, and reduces an oxygen electron to form the superoxide ion. This radical in turn changes to hydrogen peroxide (H_2O_2) spontaneously or by the action of the superoxide dismutase (SOD), producing a new oxygen molecule.
- The second, anaerobic process is attribute to the action of diverse microbicidal enzymes, such as lysozyme and low molecular weight AMP.

Encapsulation and nodule formation

- Encapsulation and nodule formation (Figure 4) are processes by which several hemocytes cooperate with each other aiming to stop the action of invading organisms.
- Semi granulocytes are responsible for the recognition of the invading agents and their encapsulation with proteins (76 kD) that work as an opsonins associated to the proPO activation system.
- These proteins act as a degranulation and adhesion factor for semi and granulocytes, and as an encapsulation promoter.
- These nodules undergo the subsequent activation of the proPO system, melanisation and destruction of microbes.
- **Melanization**
- Melanization plays an important role in the invertebrate defense mechanisms wherein a thick acellular capsule of melanin is generated around foreign objects.
- Melanin, a product of the proPO system, is a dark brown pigment with antibacterial properties that inhibits antigens.

Cytokines

- The activation of antimicrobial responses in invertebrates is mediated by cytokines which are produced by hemocytes.
- Heat shock proteins (HSP) or chaperonins are invertebrate cytokines which are capable of protecting and restoring proteins damaged by stress factors, such as high temperatures.

Clotting protein cascade

- Coagulation is used to prevent the loss of hemolymph through cuts and wounds in the exoskeleton, and to immobilization of invading pathogens.

Three types of hemolymph clotting Systems:

1. Type A consists of a rapid hemocyte agglutination without plasma coagulation;
2. Type B consists of cellular aggregation with limited plasma coagulation;
3. Type C is a limited cellular aggregation and lysis followed by plasma coagulation.

- Clotting proteins in plasma are converted to covalently joined polymers by a Ca++ dependent transglutaminase secreted by the hemocytes.
- The cellular clotting proteins can be activated by LPS or -1,3-glucan.

Humoral immune defens

Recognition molecules

- Lectins are non-enzymatic proteins or glycoproteins that act in opsonization, agglutination, phagocytosis and pathogen encapsulation.
- Invertebrate lectins are considered primitive recognition molecules capable of detecting carbohydrates which promote proPO system activation.
- The biological functions of PRPs are the initiation of a protein cascade and/or defense mechanisms' signalization routes and elimination of blood system invaders.
- TLRs on specialized antigen-presenting cells function as signal transducers by the way of nuclear factor #B, leading to the production of pro-inflammatory cytokines and the expression of costimulatory molecules on the cell surface.

Antimicrobial peptides

- AMPs have wide spectrum of activity, low specificity and are weakly cytotoxic to animal cells.
- These peptides make pores in the cell membranes of bacteria, fungi, parasites, enveloped viruses and even cancer cells, provoking an instability of ions and energy
  1. Peptides stabilized by intermolecular disulphide bonds.
  2. Peptides and linear polypeptides with "-helicoidal structures.
  3. Peptides and linear polypeptides with a high content of proline residues and/or glycine.
- Penaeidins are synthesized and stored in the granulocyte, and present Gram (+) antibacterial and antifungal activities.

Lysosomal enzymes

- Lysozyme degrades the mucopolysaccharides of Gram (-) bacterial cell walls.
- Modifies the molecular conformation of the cell surface, allowing their recognition by phagocytic cells.
- Lysozymes take part in the degradation of microbes within and outside hemocytes, and some play a role of sterases and chitinases.

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