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Inside...

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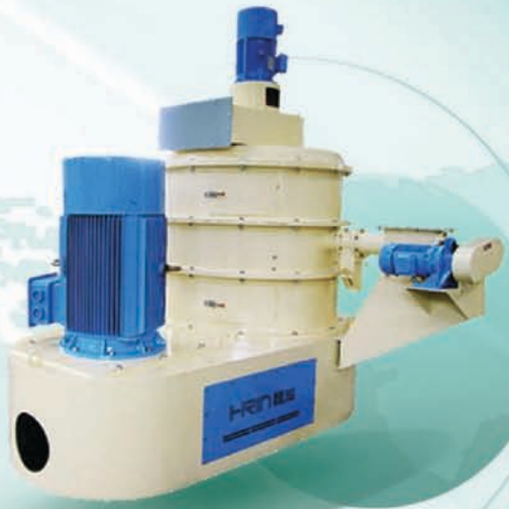

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Aqua International

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CMFRI brings consumption of Live Oyster into news

Dear Readers,

The December 2019 issue of ***Aqua International*** is in your hands.

In the News section, you may find news about a shocker, a US lab report reveals that premium brands of processed iodised salt sold in India allegedly contain alarming levels of carcinogenic and harmful components like potassium ferrocyanide. According to Shiv Shankar Gupta, Chairman of Godhum Grains & Farms Products, the test by American West Analytical Laboratories has revealed that potassium ferrocyanide levels are an alarmingly high in Sambhar Refined Salt at 4.71 mg/kg, at 1.85 mg/kg in Tata Salt and 1.90 mg/kg in Tata Salt Lite.

In continuation of a massive drive to remove plastic wastes from water bodies, the Central Marine Fisheries Research Institute (CMFRI) seeks the support of students and the public to become a part of its 'Blue Green Brigade', a voluntary team to keep water bodies plastic free. The brigade is functioning under CMFRI's 'Nirmaldhara' project, which is being implemented by the institute aiming to rejuvenate coastal water resources. College students and those interested in environmental conservation can now become a member of the Blue Green Brigade to join with CMFRI research team in creating public awareness and other activities for a clean and healthy water ecosystem.

Live oyster was the major attraction at the three-day food and agri-aqua festival held at Central Marine Fisheries Research Institute (CMFRI). A food item with rich medicinal value, oyster was brought to the fest from the farm fields after depuration. (Depuration is the process of expelling contaminants from gills and guts of oysters by providing them with good purified seawater before they are used for consumption). When came to know of its health benefits, people were eager to consume the oyster live. Experts from CMFRI told the public that live consumption of oyster would help not to lose its medicinal value.

Directorate of Research, Extension and Farms (DREF) wing of West Bengal University of Animal and Fishery Sciences (WBUAFS), Kolkata had organized two three-day capacity building and skill development training programmes on fishery and aquaculture entitled 'Best management practices in fish seed production' with financial support from National Fisheries Development Board, Hyderabad.

Rising feed costs will drive advances as fishmeal and fish oil prices continue to grow rapidly, and the ongoing transition from extensive and semi-extensive to intensive aquaculture production supports greater feed demand. However, higher fish product prices due in large part to increasing feed costs will result in slower growth in global per capita fish consumption, and bring advances in world aquaculture demand to more sustainable levels.

The US restrictions on wild-caught shrimps from India will continue for the time being, as the US Department of State has again denied permission for the entry of the harvested seafood variety in that market.

The decision comes in the wake of the recent inspection by the National Marine Fisheries Service (NMFS) under the US Department of State to assess the wild-caught shrimp harvesting systems in India.

To give a fillip to aquaculture in waterlogging-affected Muktsar district, the Fisheries Department is planning to hold a fair to inform public about the nutritional value of fish and shrimp. Besides, the department is waiting for the approval of biofloc culture cost-effective technology in which toxic material such as nitrate, nitrite and ammonia can be converted to proteinaceous feed. Officials said the announcement of 50 per cent subsidy on the recirculating aquaculture system was also awaited. Further, to promote shrimp farming in the area, the state government is about to open a Demonstration Farm and Training Centre at Ennakhera village in Malout sub-division.

M.A.Nazeer
Editor & Publisher
Aqua International

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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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Premium salt in India contains deadly cyanide US report

In a shocker, a US lab report reveals that premium brands of processed iodised salt sold in India allegedly contain alarming levels of carcinogenic and harmful components like potassium ferrocyanide, an activist said here on Tuesday.

According to Shiv Shankar Gupta, Chairman of Godhum Grains & Farms Products, the test by American West Analytical Laboratories has revealed that potassium ferrocyanide levels are an alarmingly high in Sambhar Refined Salt at 4.71 mg/kg, at 1.85 mg/kg in Tata Salt and 1.90 mg/kg in Tata Salt Lite.

Nowhere in the world is potassium ferrocyanide - a deadly poison - is permitted for use in the edible salt industry or for that matter in any other food items, said Gupta, who has launched a mission "to rid salt of harmful substances, expose corrupt practices by the salt industry and help provide healthy and safe natural variants of salt to the masses".

"Leading companies in the edible salt manufacturing industry simply repackage industrial waste laden with hazardous chemicals like iodine and cyanide and market it as packaged edible salt, making people vulnerable to diseases like cancer, hyperthyroidism, high blood pressure, impotence, obesity, kidney failures etc," he told media persons here.

He accused the companies of adapting "dangerous and undisclosed processes such as bleaching, adding a plethora of dangerous chemicals like iodine and cyanide to 'refine' the salt".

Gupta alleged that the poisonous cyanide compounds are freely used by leading salt manufacturers in India, while iodine, which is already present in natural salt, is artificially added, virtually rendering the salt a poison.

He said that the country's natural salt industry - spread across Gujarat's Kutch, Madhya Pradesh and Rajasthan - has been systematically destroyed by successive governments which hailed "iodised salt" as a healthy alternative.

"Declaring salt from these salt pans, which is naturally suited for human consumption, as inedible is one of the biggest scams in post-Independent India. This is one of the worst cases of corporate greed and corruption with the livelihood of workers in the indigenous salt industry at stake," Gupta claimed.

A strong nexus between the government and industrial lobbies is cheating workers of the indigenous pan salt industry, where it is found in natural form, but it sold at exorbitant prices, leaving the consumers with no choice but to buy the cheap, chemical-laced variants, he added.

He accused the government departments entrusted with the task of ensuring quality standards in the production of branded salt of being "inert".

"RTI applications show that none of the big salt manufacturers have applied for testing or licensing with the FSSAI, which - on its part - has been unambiguous on how refined salt is produced. Moreover, food testing labs in the country are not equipped to measure the quantity of cyanide in salt," he claimed.

Tata Chemicals, which makes the Tata Salt brands, on Wednesday said its salt is "safe and harmless" for consumption. The company said that India is among countries like US, Europe, Australia and New Zealand that have permitted the use of potassium ferrocyanide in salt. The level permitted by regulator Food Safety and Standards Authority of India (FSSAI) is lowest at 10 mg/kg, and the Codex Alimentarius - an authoritative guideline on food safety - has declared potassium ferrocyanide as safe for consumption at levels of 14 mg/kg, the company said.

The company said potassium ferrocyanide content in its brands is "well within permissible limits" and is "safe and harmless" to the human body when consumed as per approved levels, adding that iodine is another essential micronutrient needed by the human body daily in small quantity, and is part of the government's efforts to address the issue of Iodine Deficiency Disorder (IDD).

"Since 1983, Tata Salt has partnered with the government in this (IDD) initiative and played a pivotal role in the battle against iodine deficiency. As per FSSAI, adequate salt iodisation has saved four billion IQ points in the past 25 years," the company said.

Plastic free water bodies: CMFRI invites public to join 'Blue Green Brigade'

Kochi: In continuation of a massive drive to remove plastic wastes from water bodies, the Central Marine Fisheries Research Institute (CMFRI) seeks the support of students and the public to become a part of its 'Blue Green Brigade', a voluntary team to keep water bodies plastic free. The brigade is functioning under CMFRI's 'Nirmaldhara' project, which is being implemented by the institute aiming to rejuvenate coastal water resources. College students and those interested in environmental conservation can now become a member of the Blue Green Brigade to join with CMFRI research team in creating public awareness and other activities for a clean and healthy water ecosystem.

The environmental division of CMFRI launched the 'Nirmaldhara' project two years back on the grounds that the public water bodies in Cochin corporation, Mulavukadu panchayat and Elamkunnapuzha panchayat were on a deteriorating stage owing to accumulation of excess amount of plastics creating troubles for fishermen and aqua-farmers.

"Effective public participation will give a fillip to the campaign in clearing the accumulation of plastic litter in the water bodies so as to improve the water quality and resource status of the coastal belt of Ernakulam district", said Dr V Kripa, Head of the fishery environmental division of CMFRI and added that 'Blue Green Brigade' would bring this campaign into a wider platform. "Excess amount of plastic wastes in water bodies have badly affected flow of water and led to many ecosystem changes. In addition, many harmful microbes are increasingly proliferating in these water bodies posing danger to human health", she said. The brigade would join CMFRI team in awareness programmes, cleanliness drive and other waste management measures. We hope college students, including NSS volunteers and the general public interested in volunteering for environmental cause to join the 'Blue Green Brigade', she added.

Those willing to become part of the brigade may send their expression of interest to the CMFRI at vasantkripa@gmail.com. Phone 9495317131.

Live oyster a big hit at CMFRI fest

Live consumption of Oyster would help not to lose its medicinal value

People watching a visitor who consume the live oyster at the food and agri-aqua festival held at the CMFRI on Friday

Kochi: Live oyster was the major attraction recently at the three-day food and agri-aqua festival held at Central Marine Fisheries Research Institute (CMFRI). A food item with rich medicinal value, oyster was brought to the fest from the farm fields after depuration. (Depuration is the process of expelling contaminants from gills and guts of oysters by providing them with good purified seawater before they are used for consumption)

When came to know of its health benefits, people were eager to consume the oyster live. Experts from CMFRI told the public that live consumption of oyster would help not to lose its medicinal value. A women self-help group, who undertake the farming of oyster in Moothakunnam under the guidance of the CMFRI, was supplying the oyster at the festival that concludes on Saturday.

According to experts, ooysters are rich in protein, lipids, carbohydrates, minerals (calcium, iron, copper, zinc, phosphorus). It is good source of vitamins, omega 3 fats and consumption of oyster will boost memory and brain functioning. Pproteins in oysters are high in tyrosine, an amino acid that is used by the brain to help in regulating mood and adapting to stress. Oysters are low in fat, cholesterol and calories and can thus be enjoyed by everyone, if consumed in moderation.

The farmed oysters are very rare in the market and a large number of people rushed to the CMFRI festival to utilize the opportunity for consuming this seafood. "Normally, star hotels collect the farmed oysters from us soon after the harvest", said Praseela Shaji, a member of the women self-help group.

People were also busy buying olive saplings and different varieties agriculture produces at the fest.

Concern over unsafe food

A discussion held as part of the festival raised concern over the toxic food items dominating in the market. Use of pesticides in agriculture crops and chemicals in food varieties to keep them 'fresh' for long period were posing serious health issues, said P B Dileep, Food Safety Officer at the discussion. He said that the food safety department was in the process of intensifying its mission to check unhealthy and unsafe food items in the hotels. A discussion on crop management was also held on Friday.

Prof K V Thomas having the live oyster at the food and agri-aqua festival being held at the CMFRI on Friday

NFDB-funded training programme for fish farmers at Basanti, WB

Inauguration of 2nd training programme

DREF (Directorate of Research, Extension and Farms) wing of West Bengal University of Animal and Fishery Sciences (WBUAFS), Kolkata had organized two three-day capacity building and skill development training programmes on fishery and aquaculture entitled 'Best management practices in fish seed production' with financial support from National Fisheries Development Board, Hyderabad. It were organized at Joygopalpur Gram Vikash Kendra, Block and PS Basanti, Dist. South 24 Pgs, West Bengal during November 18-20 and Nov 21-23, 2019. Fifty fish farmers from 11 Gram Panchayats of Basanti Block and few from Sandeshkhali-II Block (both rural Blocks in Indian Sundarbans region) of Dist. North 24 Pgs participated in each of the training as trainees.

Among other invited trainers, News communicator Subrato Ghosh participated as resource person in the entire first day of 2nd training on 21/11/2019. He discussed different technologies like nursery pond management for IMC spawn and means to increase their survivability, composite carp culture, farm-made pelleted fish feed preparation for major carps, indigenous Magur culture in small, seasonal village ponds and highlighted (on request of trainees) on mud crab farming & fattening in small tide-fed earthen enclosures with help of audio-visual aids. In addition to production of sub-adult and table-size major carps, professional fish farmers in these two freshwater-cum-brackishwater Blocks practice Liza parsia and Liza macrolepis polyculture in freshwater ponds, freshwater prawn Macrobrachium rosenbergii monoculture both in freshwater and moderately saline ponds, farming and fattening of mud crabs Scylla serrata and S. olivacea. Seeds of mullets and Scampi are available in brackishwater river channels of Sundarbans region, which are sustainably captured during early summer and post-monsoon and supplied to fish farmers.

Ghosh imparting training

Trainees stated that they do not draw out groundwater for fish culture as Basanti's groundwater resource is under stress. Freshwater aquaculture is only rain-fed. Many fish farmers have experienced considerable mortality of growing carp spawn in nursery and rearing ponds, which were procured from local fish seed traders but not of good quality. Recently fish farmers of Basanti, Sandeshkhali-II and adjacent coastal Blocks suffered loss due to effect of cyclonic storm 'Bulbul' that occurred during November 9-10, 2019. Branches of large trees with leaves fell in fish ponds in Bulbul-hit areas, and, along with sudden rain altered physico-chemical parameters of pond water. It caused considerable mortality of fish seed and table fish. Main coordinator of these two training programmes was Dr B. K. Chand, Deputy Director of Research, DREF, WBUAFS. Dr Chand was formerly co-PI of the ICAR-NICRA project entitled 'Development of Climate Resilient Aquaculture Strategies for Sagar and Basanti Blocks of Indian Sundarbans' implemented by WBUAFS.

Latest Research Report to uncover key Factors of Global Water Treatment for Aquaculture Market

Rising feed costs will drive advances as fishmeal and fish oil prices continue to grow rapidly, and the ongoing transition from extensive and semi-extensive to intensive aquaculture production supports greater feed demand. However, higher fish product prices — due in large part to increasing feed costs — will result in slower growth in global per capita fish consumption, and bring advances in world aquaculture demand to more sustainable levels. The corresponding moderation in world aquaculture output will be particularly significant in China, which is forecast to grow at a slower pace than not only the rest of the Asia/Pacific region, but also South America and the Africa/Mideast region.

Asia was the largest and one of the fastest growing

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US restrictions continue to hit exports of wild-caught shrimps

Allegations of lack of turtle-excluding devices in fishing nets behind ban

The country's marine export basket comprises shrimps from aquaculture farms, with the Vannamei and Black Tiger species enjoying good demand

The US restrictions on wild-caught shrimps from India will continue for the time being, as the US Department of State has again denied permission for the entry of the harvested seafood variety in that market.

The decision comes in the wake of the recent inspection by the National Marine Fisheries Service (NMFS) under the US Department of State to assess the wild-caught shrimp harvesting systems in India.

The US had temporarily disallowed imports of wild-caught shrimps following reports of the absence of turtle-excluding devices in the fishing nets. However, the NMFS has clarified that aquaculture (farm-raised) shrimp harvested in India is eligible to enter the US market.

India's Marine Products Export Development Authority (MPEDA) has already contested the observations of the NMFS team and placed its plea before the Commerce Ministry for further action, sources in the sector said.

The US is the major market for Indian wild caught shrimps. The restrictions have impacted shrimp exports, which have registered a 10-15 per cent drop in shipments. Seafood exporters from Kerala will be affected most by the ban, as they focus more on small-size shrimps such as Poovalan and Karikkadi. Their exports to the US market are estimated at $300 million per year.

Export impact

India's shrimp exports to the US were around ₹15,000 crore, of which the share of wild-caught shrimps was around 11 per cent. The country's marine export basket also comprises shrimps from aquaculture farms, where species such as Vannamei and Black Tiger enjoy good overseas demand.

"We have taken up the matter with the Commerce Ministry through MPEDA to discuss the issues with the US authorities," a leading seafood exporter Kerala, Tamil Nadu and Odisha have already enacted legislation mandating trawlers to install turtle excluding devices; other coastal States are expected to follow shortly," the source said.

"Exporters have also requested the Ministry to take up the matter with the US authorities so that the catch from these three States can be exempted from the US restrictions. As an immediate measure, they have even offered to install American devices on trawlers. "We have requested the government to take up all these matters with the US authorities," the source said.

Besides, the Central Marine Fisheries Research Institute (CMFRI) has been entrusted to carry out a survey of turtle sightings on the West Coast. Turtles nest mainly in Odisha, where the State government has taken strict measures to protect the species, the source added.

According to Charles George, President of the Kerala Matsya Thozhilali Aikya Vedi, the restrictions will have a cascading effect on the State's fishery sector, as the wild-caught varieties amount to about 35,000 tonnes per year.

Of this, the majority is exported to the US.

Since the sector is already facing a crisis, fresh restrictions will hit ancillary sectors such as processing and trawling, leading to job losses, said George.

He alleged that it was the slowdown in the US economy that prompted the authorities to continue with the ban, as the current business environment has affected the purchasing power of people there.

Fresh schemes to boost aquaculture

Waterlogging-affected farmers to benefit

Officials said the announcement of 50 per cent subsidy on recirculating aquaculture system was also awaited.

To give a fillip to aquaculture in waterlogging-affected Muktsar district, the Fisheries Department is planning to hold a fair to inform public about the nutritional value of fish and shrimp. Besides, the department is waiting for the approval of biofloc culture — cost-effective technology in which toxic material such as nitrate, nitrite and ammonia can be converted to proteinaceous feed.

Officials said the announcement of 50 per cent subsidy on the recirculating aquaculture system was also awaited. Further, to promote shrimp farming in the area, the state government is about to open a Demonstration Farm and Training Centre at Ennakhera village in Malout sub-division.

Some officials, however said, "At present, 50 per cent subsidy under the Rashtriya Krishi Vikas Yojana is being offered on normal fish ponds, but the amount for the ongoing fiscal year has not been released yet."

Notably, Muktsar district has 1,950 acres under fisheries and 150 acres under shrimp farming. This year, 180 acres have been brought under fisheries and 40 acres under shrimp farming. While the price of fish depends on its size and variety, shrimp on an average fetches Rs 300-330 per kg in the wholesale market.

RK Kataria, Assistant Director, Fisheries, Muktsar, said, "The new schemes are expected to give a major boost to the aquaculture in the district. The waterlogging-affected farmers are benefitting from aquaculture."

However, sources said after the closure of 90 per cent subsidy scheme, there were only a few takers for the fisheries. In the past, some ponds were destroyed during the rains.

South Korea, Philippines sign MoU on aquaculture cooperation

South Korea Ministry of Oceans and Fisheries (MOF) has announced the signing of a memorandum of understanding (MoU) between Korea and the Philippines on aquaculture management and trade cooperation

The MoU was signed by William D. Dar, secretary of Agriculture of the Philippines, and Moon Seong-Hyeok, MOF minister.

The MoU aims to promote collaboration between both countries in science/ technology data and information exchange on fisheries and fish farming and to improve promotion/ investment in fisheries areas.

MOF stated that both countries agreed to hold regular joint committee on fisheries (annual committee to be held alternatively) and to establish a ground to expand fisheries cooperation with the Philippines.

In the oceans and fisheries sectors, Korea and the Philippines signed several MoUs such as STCW Agreement (2005) in maritime affairs sector, MoU on Maritime Safety Cooperation (2017), MoU in oceans sector between Korea Hydrographic & Oceanographic Agency and the Philippines National Mapping & Resource Information Authority (2015), and MoU on port development cooperation (2012).

However, this is the first MOU on the fisheries area, which shows that a final foundation has been laid for comprehensive bilateral cooperation in all oceans/ fisheries areas between two countries.

Minister Moon Seong-Hyeok said, "This MoU has set up a foundation for all areas of Korea-Philippines oceans/ fisheries cooperation. MOF plans to continue cooperation through Korea-Philippines joint fisheries committee so that fisheries industries of both countries can mutually develop."

Dutch company chooses Down East town as home for its multimillion-dollar fish farm

A Dutch company has reportedly selected the Washington County town of Jonesport for a multimillion-dollar, land-based aquaculture facility to grow yellowtail, a type of fish beloved by chefs and sushi aficionados.

Kingfish Zeeland settled on the historic fishing community roughly 20 miles from Machias after exploring other potential sites along the Maine coast, according to reports in local and seafood industry media. Kingfish Zeeland's envisioned yellowtail facility is at least the fourth major land-based aquaculture operation proposed in recent years in Maine, which is experiencing a surge in "farming" for fish, shellfish and other marine products.

Company representatives were expected to discuss their plans Wednesday night during a special town meeting in Jonesport. The company did not respond to a request for additional information Wednesday, and a member of the Jonesport Board of Selectmen said town officials are waiting for Wednesday's meeting before commenting.

"We are anxious to hear their presentation," Selectman William Milliken said.

Land-based salmon farm in Belfast could signal shift in U.S. aquaculture

Based in the Netherlands province of Zeeland, Kingfish Zeeland has been rearing what they refer to as "Dutch yellowtail" in a land-based facility for several years. Also known as "recirculating aquaculture systems," the facilities raise fish in massive tanks or pools on land rather than in large pens in coastal waters or the open ocean.

Yellowtail generally refers to several species of tuna-like fish that have become enormously popular with chefs and consumers of sushi. The yellowtail kingfish produced by Kingfish Zeeland is the only yellowtail certified by the Aquaculture Stewardship Council and the Best Aquaculture Practices as being sustainably produced, the company said.

"Sustainability and respect for our fish and the environment are key values at Kingfish Zeeland and form the basis for our design, operations and technology decisions," the company's website says. "We go to great effort and expense to ensure that our operations are safe and healthy for our customers, stress-free and humane for our fish, and have a minimum impact on the surrounding nature."

The Machias Valley News Observer first reported last week that Kingfish Zeeland representatives planned to present their proposal to Jonesport residents on Wednesday. Several seafood industry news organizations also reported Wednesday that the company had chosen Jonesport for the facility.

This is the latest example of how Maine is poised to become a top destination for land-based aquaculture operations thanks to the state's commercial fishing heritage, industry infrastructure and workforce. Additionally, aquaculture companies are drawn to Maine because of the relative close proximity to major seafood markets and restaurants in Boston, New York, Montreal and other cities.

The company Whole Oceans is moving forward with plans to build a large Atlantic salmon aquaculture facility on the site of the former Verso Paper mill in Bucksport. That project has received considerably less local opposition than Nordic Aquafarms' proposal to build another, large-scale salmon farm on land in Belfast.

A third company, Aquabanq, hopes to build another salmon aquaculture facility in the middle of Maine's North Woods in Millinocket. Meanwhile, the Maine Department of Marine Resources is processing a flood of permit requests for smaller-scale aquaculture – particularly oysters and other shellfish – all along the Maine coastline.

Latest Research Report to uncover key Factors of Global Water Treatment for Aquaculture Market

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aquaculture producing regions from 2002 to 2012, with China alone accounting for 61 percent of global aquaculture production and 51 percent of aquaculture supply demand in 2012. While growth in Chinese demand for aquaculture supplies and equipment is expected to moderate, demand in the rest of the Asia/Pacific region is expected to grow rapidly, with only the Africa/Mideast region exhibiting faster gains. Central and South America is also expected to significantly expand its presence in the global aquaculture industry through increased production and higher demand for aquaculture inputs. More mature markets, such as Europe and North America, are also expected to show healthy growth in line with the more modest expansions expected in aquaculture production from these regions.

The global Water Treatment for Aquaculture market is valued at xx million US$ in 2018 is expected to reach xx million US$ by the end of 2025, growing at a CAGR of xx% during 2019-2025.

This report focuses on Water Treatment for Aquaculture volume and value at global level, regional level and company level. From a global perspective, this report represents overall Water Treatment for Aquaculture market size by analyzing historical data and future prospect. Regionally, this report focuses on several key regions: North America, Europe, China and Japan.

Key companies profiled in Water Treatment for Aquaculture Market report are Aquafine, Pentair Aquatic, Veolia, Xylem, Atg, Blue Ridge Technology, Spartan, Wmt and more in term of company basic information, Product Introduction, Application, Specification, Production, Revenue, Price and Gross Margin (2014-2019),

Focus on aquaculture for economic growth: Union MSME Minister Pratap Chandra Sarangi

The Minister urged for concerted efforts in making aquaculture profitable by strengthening value chain

Bhubaneswar: In order to achieve the goal of USD 5 trillion economy and double farmers' income by 2022, focus needs be shifted to aquaculture that has immense potential to provide adequate employment and generate more revenue, opined Union Minister of State for Animal Husbandry, Dairying, Fisheries and MSME Pratap Chandra Sarangi.

Inaugurating the 4th Pillay Aquaculture Foundation (PAF) Congress on 'Increasing Aquaculture Production in India' at Central Institute of Fresh Water Aquaculture (CIFA) here on Friday, Sarangi said aquaculture can meet the nutrition requirement of thousands of poor at a minimal cost and save them from malnutrition.

"Pollution and climate change are major threats for aquaculture sector. Awareness among people is the key to stop use of plastics and keep water bodies safe and pollution-free, so that quality products can be produced for our consumption and trade," he observed.

The Minister urged for concerted efforts in making aquaculture profitable by strengthening value chain. Scientists and planners should bring knowledge and innovation to common farmers and technology should be used to sustain the ecosystem besides the judicious use of chemicals and fertilizers, he added.

The three-day PAF Congress organised to pay tribute to TVR Pillay, considered as father of modern aquaculture, has brought together various stakeholders to deliberate on synergising efforts of national and international agencies for development of the sector.

Deputy Director General (Fishery Science) of Indian Council of Agricultural Research (ICAR), New Delhi, J K Jena said future aquaculture has to be knowledge intensive rather than input intensive. He announced naming Agri-Business Incubation (ABI) facility of the institute after V R P Sinha, founder Director of CIFA.

OUAT Vice-Chancellor P K Agrawal called for enabling policy support to farmers. He hoped that fisheries education and research in Odisha would get a boost from the newly formed Fisheries Ministry at the Centre.

The Minister felicitated 10 innovative farmers/ entrepreneurs for their exemplary accomplishment in aquaculture. Two mobile apps IndAqua and TreatmyFish, developed >> in Odia, Hindi and English were released on this occasion.

Secretary of Fisheries and Animal Resources Development department R Raghu Prasad, CIFA Director BR Pillai and PAF Secretary P Keshavanath also spoke.

'Coastal communities involvement vital for blue economy'

No blue economy can be effective without the participation of the coastal communities and it needs to be integrated with gender equality, said V.N.Attri, Professor Chair of Indian Ocean Rim Studies.

The implementation of blue economy in Indian Ocean Region (IOR) including in India should have the involvement of small and marginal fishermen and women to achieve its full objective, he said in a technical session 'Blue Economy as a new emerging paradigm in IOR and beyond' at the international conference Aquabe 2019 here.

The concept of blue economy emphasises on the use of local raw material to create a supply chain of marine and aqua resources of which the role of marine fisheries and inland aquaculture is important. The objective of blue economy is to empower local communities; creating job opportunities and accelerating both state domestic product and gross domestic product (GDP) of the country. If implemented properly, the concept has the potential to increase SDP and GDP even at double digit level, he said.

Addressing a special session on Somalia Yemen Development Programme organized as part of IORA, A Ramachandran, Vice Chancellor, Kerala University of Fisheries and Ocean Studies (Kufos) pointed out that innovation and skill development are the two major spheres which were found lacking in Somalia and Yemen."We are willing to share our skills and innovations with fishermen of these two countries which will be a win-win situation for all stakeholders," he said.

Kufos has set apart seats for students from other countries in all its academic programmes. "What we are bothered about is the employability of students passing out from the 32 fisheries colleges in India. The National Skill Mission has been launched to resolve this issue and we are sure that it will pay rich dividends, he said.

Nomvuyo N Nokwe, Secretary General, IORA said that the member countries would chalk out an action plan within six months to resuscitate the fishing sector in Somalia and Yemen based on the wealth data provided by Kufos.

NFDB Sponored ToT Programme at ICAR-CIFA

Bhubaneswar: ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar conducted a 5 days Training of Trainers (ToT) programme on Hands-on-training "Fish Health and Environment Management in Freshwater Aquaculture" during 19-23 November 2019, sponsored by National Fisheries Development Board, Hyderabad, under Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, Govt. of India.

The programme was inaugurated on 19.11.2019 by Dr Manas Kumar Sinha, Senior Executive, NFFBB, NFDB, Kausalyganga, Odisha; Dr S. S. Mishra, Head of Division & Course Director, ICAR-CIFA, Bhubaneswar, Dr Munwar Marandi, District Fisheries Officer, Nabarangpur, Odisha and Dr P. Swain, Principal Scientist, CIFA. Thirty two participants including State Government Fisheries Officials, Farmers and Entrepreneurs from 11 States and Union Territories viz. Haryana, Uttar Pradesh, Madhya Pradesh, Maharashtra, Tamil Nadu, Pondicherry, New Delhi, Telangana, Andhra Pradesh, Chhattisgarh, West Bengal and Odisha, participated in the programme. Dr P. Swain, Co-Course Director welcomed the guests and participants and briefed about ICAR-CIFA activities and its role as a hub for freshwater aquaculture research in India.

Dr S. S. Mishra, in his opening remarks, briefed about the prospective of this NFDB sponsored training program for skill development of fishery officials, entrepreneur and farmers on varies aspects of fish health management including pond water quality management. He emphasized on three major components of blue revolution i.e. quality seed production, quality feed and health management of culture environment as key to sustainable production system. Dr P.K. Sahoo, presented importance of health management especially parasitic diseases, which have been a cause of concern in many parts of country. He emphasised importance of maintaining ideal water quality parameters for healthy fish production.

Dr M. Marandi, DFO, Nabarangpur appreciated the efforts of ICAR-CIFA in conducting such type of skill development programme and Training of trainers' programme over the years for the cause fisheries and aquaculture development in the country. Dr M. K. Sinha, Senior Executive, NFDB, Kausalyaganga, explained the objectives of the NFDB sponsored ToT programme and remarked that, the programme will contribute towards fulfilment of the dream of Hon'ble Prime Minister towards doubling farmer's income by 2022. He also delineated the scope, potential of the >> country resources for fish production and impact of intensified aquaculture on disease prevalence as well. Mr S. N. Sahoo, Scientist & Course Coordinator, proposed vote of thanks on this occasion.

Walleye can be a valuable addition to aquaculture operations

AMES, Iowa – Aquaculture producers looking for a new opportunity may want to consider the benefits of raising walleye.

The firm, white flesh and mildly sweet flavor make walleye "a favorite seafood choice in North America and northern Europe," according to the Freshwater Fish Marketing Corporation, and a newly released technical bulletin called "Production of Walleye as Potential Food Fish" (tinyurl.com/t8jdbx6).

Joe Morris, professor and extension aquaculture specialist at Iowa State University, said walleye have actually been identified as one of the top six potential species of aquaculture in the United States.

"Walleye is a valued and a desired species for the consumer in the Midwest," said Morris, who also serves as director of the North Central Regional Aquaculture Center, based at Iowa State.

The publication outlines the challenges and opportunities of raising walleye – including production and retail costs.

Walleye have a retail price range of $6-12 per pound, with high prices of $20 per pound or more to select white-table markets.

Walleye are adaptable to pond, cage and tank culture systems, as well as pond systems, but require a little more work to train to habituation to feed on commercial diets, according to Morris.

Producers need to think critically about their marketing efforts, how much fish they can supply and of what size. For most markets, an 8-10 oz. walleye fillet is desirable for restaurants and wholesalers; 4-6 oz. skinless frozen fillets are considered as ideal size for individual portions.

The publication explains the tank and pond requirements, nutritional needs and other steps to producing market-ready walleye.

Walleye require a higher feed protein content, and result in a high-protein finished product. Skinless fillets from tank-cultured walleye have a protein content of about 20% and a fat content of less than 1%, according to the publication.

The publication offers useful comparisons to other fish species, with information compiled by university researchers and state and federal agencies.

Tools and Aquaculture for Aquaculture Sustainability

The European Aquaculture industry is set to benefit from tools and guidance for aquaculture sustainability, developed by the EU-funded Horizon 2020 TAPAS project.

The aquaculture industry is at the forefront of European 'Blue Growth'. Aquaculture has been identified by the EU as one of five key industries that have the potential to deliver sustainable jobs to people in Europe, and aquaculture products are increasingly important in feeding a growing population. However, the sustainability of this industry is increasingly under the spotlight as the needs of people and economic growth need to be balanced with safeguarding the environment and the ecosystem services it delivers. Deficiencies in the planning and licensing stages of aquaculture are contributing to a slow growth of the European aquaculture industry, leading to a reliance on imports and missed opportunities for exporting European products.

It is this challenge that inspired the €7m EU-funded Horizon 2020 project, TAPAS (Tools for Assessment and Planning of Aquaculture Sustainability). The project, which will be completed in February 2020, will deliver a suite of tools and guidance for use by both aquaculture developers and regulating authorities across Europe.

Led by Professor Trevor Telfer of the University of Stirling, TAPAS is a collaboration between 15 European partner institutions that aims to address key sustainability challenges in the European aquaculture industry. The consortium has developed new and tested existing environmental models required by both the aquaculture industry and regulatory authorities to make better informed decisions regarding where aquaculture should take place, assessing the environmental impacts that it may have, and addressing the ecosystem services provided.

The sustainability challenges that drove the development of this project are faced during the planning and licensing stages of aquaculture development. Firstly, the policy and regulation that underpins the planning of aquaculture is inconsistent between European countries, and in many cases is poorly underpinned by robust scientific data and models.

Regulatory and licensing frameworks vary by country, leading to disparity between European countries, and inadequate licensing processes has played a part in the slow growth of the aquaculture industry in Europe compared to the global industry. Secondly, a lack of appropriate sites for aquaculture in Europe has been a bottleneck to development and can undermine the sustainability of the industry. The suitability of a site for aquaculture depends on multiple environmental, social, legal and economic issues, and an inappropriately sited development can lead to environmental damage, unprofitable business and the undermining of the aquaculture industry in public perception.

"The existing tools needed by aquaculture industry to make the thorough sustainability assessments are often difficult to understand, making them inaccessible to those they are aimed at," says Professor Telfer. "The regulatory and licensing process in Europe needs to be more transparent, with better communication of decision-making and regulatory frameworks. This would not only improve the industry itself, but also public perception of aquaculture."

Addressing sustainability challenges

The TAPAS project has been funded by the European Commission under the Horizon 2020 project to address these sustainability challenges. Focussing on the licensing stage, the industry and planners will have access to the tools and guidance that have been developed by the project partners over the last four years. License applicants will be supported through the provision of tools to aid site selection, assessment of carrying capacity, predicting nutrient and waste dispersion and other key parameters that will aid better decision-making and adaptation at the outset of a development.

Regulating authorities, including those involved in marine spatial planning and in the review of license applications, will have access to best practice guidance on developing regulatory frameworks and tools to aid the assessment of aquaculture license applications. By reviewing existing regulatory practices and methods as well as available tools and technologies used during the aquaculture licensing process, the team have been able to develop improved tools and methodologies as well as guidance on how the Europe-wide industry can be improved.

The TAPAS team have taken a diverse approach to developing these tools and guidance. A pan-European coordinated effort has seen data gathered through fieldwork, ongoing monitoring and earth

observation. Case studies throughout Europe have tested and validated the approaches developed by the team to ensure scientific rigour and reliability in the tools that will be provided to the industry.

A range of species including salmon, trout, sea bass, sea bream, carp, oysters and mussels have been covered by the case studies, which include both marine and freshwater environments. The production environments and technologies are also representative of those used in European aquaculture, ensuring that the tools are well-aligned with the industry which they are intended to support.

For these tools to remain relevant, the necessary data must be available to users.

Traditional data collection methodologies can be time-consuming and expensive, requiring skills and resources not always available to those who need the data. To address this, TAPAS has evaluated and developed more efficient, in-situ monitoring technologies to aid data collection. These include the use of earth observation data collected by the Sentinel satellites as part of the European Commission and the European Space Agency's Copernicus programme, as well as the use of autonomous underwater vehicles (AUVs) and optical sensors for underwater monitoring of aquaculture sites.

The Aquaculture Toolbox

Innovative approaches to production have been explored. Integrated Multi-Trophic Aquaculture (IMTA) is one such system, in which species of various trophic levels are cultured in an integrated system, allowing waste products to be utilised as fertiliser or food for another. The project has tested applied approaches to IMTA and has developed guidance and tools to assess the implementation of this production system, with its potential to minimise environmental impacts and provide ecosystem services.

TAPAS has worked closely with aquaculture stakeholders in developing these tools to ensure that they are well aligned with the industry's needs. The project team have consulted with regulators and industry accreditors, including the Aquaculture Advisory Council (AAC), European Aquaculture Technology & Innovation Platform (EATiP), Federation of European Aquaculture Producers (FEAP), national producer organisations and EU Directorate-Generals (DGs). By engaging with these organisations throughout the project, the TAPAS team have ensured that the project outputs are relevant and beneficial for the aquaculture industry across Europe.

As the TAPAS project enters its final months, the team are preparing to launch the Aquaculture Toolbox, a web-based decision support framework that will host the tools and guidance from the project. The team have worked hard to make the Aquaculture Toolbox accessible and easy to understand for a range of users from industry, policy and planning.

The platform distils four years of research into a suite of modelling tools, guidance tools and recommendations, illustrated by examples of where and how the available tools have been applied in real-world situations so far. It is expected that the Toolbox will improve the efficiency and transparency of aquaculture licensing in Europe.

The future of European aquaculture depends on securing the sustainability of the industry. The TAPAS project has filled a gap in aquaculture development that threated to compromise this sustainability, and will deliver key benefits in ensuring streamlined, efficient and data-informed licensing and regulatory frameworks across Europe. With this help, the European aquaculture industry can continue to develop and fulfil its potential to deliver sustainable Blue Growth for European nations.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 678396.

Global meet on blue economy in Kochi

The Kerala University of Fisheries and Ocean Studies (KUFOS) is organising Aquabe 2019, the country's first international conference on blue economy and aquatic resources, at Hotel Le Meridien here from November 28 to 30.

As many as 500 stakeholders representing various countries, including researchers and policymakers, are expected to participate in the three-day conference to explore the potential of development and growth of the economy through sustainable exploitation of sea and inland water resources.

A Ramachandran, Vice-Chancellor, Kufos, and chairman of the organising committee, pointed out that oceans cover 72 per cent of the earth's surface and provide a substantial portion of the global population with food and livelihood. By virtue of its strategic location in the Indian Ocean region, India, especially Kerala, which has 588-km coastline, has great potential to grow its blue economy in a sustainable, inclusive and people-centered manner, he said.

The focus area was recognised at the 14 Indian Ocean Rim Association ministerial meeting in Australia in 2014. The theme of Aquabe 2019 is based on the IORA guidelines, with a special reference to Kerala, Ramachandran said.

The Ministry of External Affairs is organising a special session in association with IORA for the benefit of Somalia and Yemen. The two-day session will be dedicated to capacity building of fisheries professionals from these two countries.

An all-India conclave of aquaculture farmers, which will focus on ground-level issues and requirements, will also be held on the occasion.

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AQUACULTURE

The Blue Revolution with NCH Life Sciences

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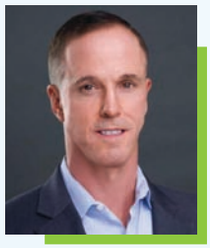
Aquaculture is both one of the oldest and youngest agricultural sources of protein in the world. There is evidence of aquaculture practices that date back around 6000 years. However, large scale intensive farming of aquaculture is a much more recent innovation. The FAO reports that in 2016, the total cultured production of all aquatic species exceeded the total marine catch, and aquaculture continues to grow by over 8% each year.

The top 5 producers in the world today are China, India, Indonesia, Vietnam, and Bangladesh. By weight, finfish accounts for the largest percentage of production (67.6%), followed by mollusks (21.4%) and crustaceans (9.8%). This is a long way from 1950 where cultured species accounted for only a tiny fraction of harvested aquatic species. New and reliable sources of animal protein are essential for feeding an expected population of 9.7 billion people in 2050.

The biggest concerns facing aquaculture today are disease pressures and water quality issues. With high intensity culture, the risk of economic loss can be enormous. Biological diseases are present in the environment naturally, but aquatic species are more susceptible under high stress. Maintaining good water quality with low disease pressures is critical for preventing losses. Also, maintaining good water quality is important for mitigating environmental harm presented by hyper-eutrophication of downstream watersheds.



Christopher Zetana
Vice President,
NCH Life Sciences

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Ecocharger Pond powder

Enhance the action of NCH Probiotic system to improve animal health and water quality.

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Dissolving bags – easy to apply – no spraying or handling hazardous chemicals.

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Make sure to follow NCH Life Sciences on LinkedIn and website **www.nchlifesciences.com** to stay informed on everything happening within our business.

Application of Hurdles in Post Harvest Preservation

Highlight Points

Hurdle is a preservative factor which disturbs the homeostasis of microorganism; none can overcome all the hurdles applied during post-harvest preservation. A critical concept of hurdle technology (HT) is to achieve multitarget effect and its basic principle is to combine different hurdles at lower intensity to attain mild preservation with minimal effects on sensory and nutritional attributes of that particular food.

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ABSTRACT:

Hurdle technology was developed as a new concept for production of safe, stable, nutritious, tasty and economical foods. The basic principle is to combine different preservation technique in order to achieve multitarget, mild but reliable preservation effects. Nowadays, consumer demands for fresh like foods which can be made by applying mild preservation techniques. Mild preservation is achieved by combining already existing traditional or novel preservation techniques with its least intensity.

INTRODUTION:

Hurdle technology also called barrier technology. Each preservative factor is considered as hurdle that any microorganisms present should not be able to overcome. Commonly used hurdles are temperature, water activity (aw), pH, redox potential, preservatives and so on. If higher the hurdles, greater influence on microbial stability and contributes to safety of food. This concept is used unconsciously in many traditional foods. But it was re-invented some 15 years ago in food industry to design effective process for different food with minimum changes in sensory attributes.

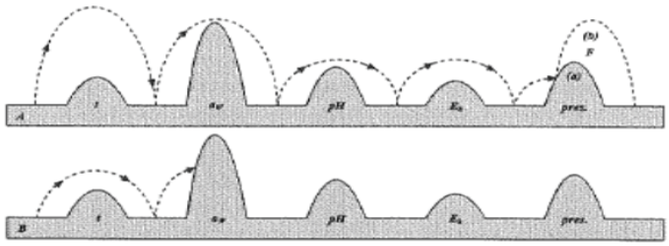
TYPES OF HURDLES FOR FOOD PRESERVATION

Types of hurdles	Examples
Physical hurdles	Electromagnetic energy(microwave, radiation) High temperature(blanching, pasteurization, baking) Low temperature (chilling, freezing) Packaging(active and vacuum packaging, edible film)
Physical non thermal hurdles	High hydrostatic pressure, pulsed electric field and pulsed light.
Physicochemical hurdles	Co2,O2, O3, Ethanol, Lactic acid, Lactoperoxidase, Low pH, Low aw, Maillard reaction, Smoking, Nitrite/Nitrate, Sulfite and Spices
Microbiological hurdles	Competitive flora, Protective cultures and Microbial products

MODE OF ACTION:

Hurdle technology is a critical concept of mild preservation of foods. Hurdles will control microbial spoilage and food poisoning, leaving desired fermentation processes unaffected. Individual hurdles applied at lower intensities acts "synergistic" with one another in order to achieve safety and also stabilizes the sensory, nutritive and economic properties of a food.

Fig.1 illustrates food containing six hurdles high temperature during processing ,low temperature during storage, low water activity, acidity (pH), low redox potential (Eh) as well as preservatives. Some microorganisms can overcome a number of hurdles but none can jump over all hurdles. Finally food is stable and safe for long duration (Theoretical cases). **Fig 2** illustrates hurdles are applied at different intensity like water activity and preservatives are main hurdles whereas pH, storage temperature, redox potential are minor hurdles. Intensity usage of individual hurdle is greatly reduced while combining preservative techniques. The number of hurdle application directly influence of product stability



HURDLES TO PRESERVE A FOOD AND ITS CORRESPONDING PROCESS

PARAMETER	CORRESPONDING PROCESS
F: High temperature	Cooking, frying
T: Low temperature	Chilling, freezing
aw: water activity	Drying, salting, sugar addition
pH: Acidity	Acidification
Eh : Redox potential	Renewal of oxygen
Preservatives	Cure, smoking, additives

EXAMPLE: FERMENTED SAUSAGE

Using hurdle technology, salami type fermented sausage can be produced that are stable for extended period of time. In early stage, preservative used as hurdle like salt and nitrite which inhibits many bacteria, however some bacteria multiply uses oxygen there by drop in Eh. Which inhibits aerobic organisms and favours lactic acid bacteria it leads to acidification and decrease in pH. During long storage, aw of sausage decrease with time. All these combined effects become main hurdles in later stage leads to extended shelf life.

MICROBIAL INACTIVATION BY HURDLES:

An important phenomena, which deserves attention in food preservation is homeostasis of microorganisms. Homeostasis is the strong tendency to uniformity and stability in internal status of microorganisms. Hurdle acts as stress factor and disturbs the transport across cell membrane, imbalance in osmoregulation, alters genetic makeup. Microbes strain in every possible repair mechanisms to overcome a hostile environment, become metabolically exhausted and die. Metabolic exhaustion leads to auto sterilization. Some microbes will generate stress shock protein induced by heat, pH, water activity, etc. Activation of genes for the synthesis of stress shock protein could not able to cope with stress situation if different stress or hurdles are received at same time .These makes microorganisms to become metabolically exhausted.

HOMEOSTATIC RESPONSES TO STRESS BY MICROORGANISMS

STRESS FACTOR	HOMEOSTATIC RESPONSE
Low level of nutrients	Generation of viable non-culturable forms
Lowered pH	Extrusion of protons across the cell membrane
Lowered water activity	Osmoregulation, accumulation of compatible solutes
Lowered temperature	Change in membrane lipids affects growth
Raised temperature	Changes in membrane lipids affects growth
Raised level of O2	Production of enzymes(peroxidase, catalase), oxygen derived free radicals
Preservatives	Lowered pH
Biocides	Reduction in cell wall/ membrane permeability
High hydrostatic pressure	Low spore water content
Ionizing radiation	Repair of single strand breaks in DNA

CONCLUSION:

Researchers have increasing interest in design and application of hurdle technology in food preservation. It is expected that this development will proceed in near future. Certain works on new hurdles like antimicrobial agents from plants, active packaging, processing technologies such as ultra-high pressure, high electric field pulses etc. paves the way for new invention in hurdle technology. This technology minimally affects sensory attributes of food. Innovation in hurdle technologies offer benefits to food industry with respect to increased product quality and assured safety.

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Quest of indigenous leaf meal based feed: Possible alternatives for valued aqua feed ingredients

Highlight Points

▶Present demand and price of DORB (de-oiled rice bran) drives the aqua feed industry in search of alternative sustainable and renewable resources. ▶Leaf meal may be a possible alternative for valued aqua feed ingredients for the growing feed industry. ▶Presence of anti-nutritional factors (ANF's) and high crude fibre content reduces the digestibility, bioavailability and utilization of nutrients in leaf meal based diet. ▶Strategies like extrusion cooking, supplementation of essential amino acids (lysine and methionine) and exogenous enzymes, fermentation, leaf protein concentrate, use of feed attractant can increase the accepatability of leaf meal. ▶Among all these approaches, fermentation technology may be an economical, suitable and promising one.

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Introduction

World aquaculture is rapidly growing with the production of 171 mmt between 2016-17 (FAO, 2018); however, the land and water scarcity will be a challenging factor in the coming years for aquaculture activity. This probably gives rise to the intensive and super-intensive aquaculture practices that entirely direct reliance on the artificial feed, which is a significant input in the successful intensification of aquaculture. Fish needs more dietary protein than land animals of which fish meal and soybean meal are primary protein source due to their superior nutritional quality including god amino acid profile and unknown growth factors. However, the rising cost, adulteration and static supply of fish meal and soybean meal create shortages and demands competing with human consumption (Kumar et al., 2010) causing significant constraint to the aqua feed industries. Aside from fish meal and soybean meal, other ingredients like de-oiled rice bran (DORB) and rice bran are also used as low-cost energy source ingredients having around 16 % and 11% crude protein (Sereewatthanawut et al., 2008) respectively. In India, the carps together contribute to more than 82% of total aquaculture production. About 97% of the carp feeds used by Indian farmers are farm-made (Ramakrishna et al., 2013) of which DORB incorporated above 80% along with the oilcakes (10-20%) as it is the cheapest agricultural by-product, readily available and well accepted by the carps. DORB and rice bran production for 2017/18 is 6.02 and 10.86 mmt, respectively (Meda, 2017). However, considering the growth of aquaculture and increasing demand for aqua feed (about 23 mmt), the present DORB production is not going to sustain the feed based aquaculture activity. Moreover, DORB is the major ingredient in the cattle and poultry feed; therefore, a substantial hike in the price of DORB in the coming years is apparent. Again, because the DORB trade indulges in unchecked hoarding, the cost of DORB rose by 40% (Economic times, 2013). Government policies in this sector are also futile that allow export of farm residue such as DORB to the global poultry industry or used in producing bio fuel. Why allow export when our local requirement is high. Hence, aquaculture researchers are emphasizing the replacement of these valued ingredients by alternative indigenous ingredients from sustainable and renewable resources.

India is a global hotspot for plant biodiversity representing about 11.8 % of the world's flora. The terrestrial plants, primarily leaf can be an excellent substitute, either partially or completely of protein and energy sources. Because of their reasonable protein content, low price and consistent availability, plant proteins are often an economically and nutritionally viable source of protein (Davis & Arnold, 2000). However, their use is often limited in fish due to lysine and methionine deficiency, anti-nutrients and high fibre content. The development of new processing technologies for the removal of ANF's (anti-nutritional factors) has promoted their increased use as a protein source in the fish feed. In an economic

point of view, plant leaf meal based diet will always be a good alternative to protein and energy source ingredients. In contrast, many plants have nutraceuticals attributes as they contain a high number of phenolic compounds, flavonoids and fatty acids which are known for its immunomodulatory role. The use of plant protein in fish feed not only reduces the cost of feed but also reduces the excretion of total ammonia and phosphate in the water. However, effective utilization of these plant ingredients needs prior information of its digestibility and ANF's content which again related to the digestive capacity of the target culture species. Some of the potential plant ingredients used in fish feed are summarized here-

(1) Sweet potato leaf meal (SPLM)

The leaf of sweet potato, Ipomoea batatas is a cheap protein source with a protein content of 23.9% Crude protein (CP), 5.5 % crude lipid (CL) and 8.3% crude fibre (CF) (Meshram et al., 2018). It has a good mineral profile with a high content of vitamins such as A, B, C and E. However; the major ANF's are phytate, trypsin inhibitor, alkaloid, oxalate, tannin and cyanide. This can be reduced by soaking or fermentation of leaf before inclusion in fish feeds. Meshram et al. (2018) found that fermented SPLM can replace 100% DORB in the diet of L. rohita with better growth performance and higher gene expression of IGF-1. A study by Adewolu (2008) and Da et al. (2012) showed that sweet potato leaf meal has good potential for use as protein sources in Tilapia zilli and Pangasianodon hypophthalmus diet up to 15% level and 20% respectively without compromising the growth performance of the animal.

(2) Cowpea leaf meal

In Sea bass, Eusebio (2004) showed that cowpea leaf meal could be used to replace 18% of soybean meal based diet and the growth performance was similar to that of soybean meal based diet. However, the apparent protein digestibility was lower than that of soybean meal based diet but the amino acid profile was significantly higher in cowpea leaf meal. Eusebio (2004) found similar apparent digestibility of protein of white cowpea meal to those of the fish meals, squid meal and shrimp meal (94–99%) in groupers. The growth performance was also similar to that of reference diet with 45% dietary protein and suggested that white cowpea meal can be incorporated as a protein source in the practical diet for grouper at 20.5% of the diet. In shrimp, the apparent protein digestibility (APD) of white cowpea meal was 87%, greater than that of soybean meal (82%).

(3) Morus indica (Mulberry) leaf meal

Mulberry leaves are rich in protein (28.60%) (Mondal et al., 2012), vitamins and minerals, have low levels of anti-nutritional factors (ANF's) such as phenols and tannins, used as a protein source in ruminant feeds. A higher inclusion level of up to 65% (with crude fibre content of 5%) fermented and 24% raw mulberry leaves resulted in higher growth and digestibility in Heteropneustes fossilis and L. bata respectively (Mondal et al., 2011; 2012).

(4) Colocasia esculenta (Taro) leaf meal

Taro leaves have CP of 31.15% (boiled) (Mathia & Fotedar, 2012) and have high levels of calcium, phosphorous, iron, vitamins A, C, B1 (thiamin), B2 (riboflavin) and B3` (niacin). However, the main ANF calcium oxlalates limits its usability as animal feed but using boiling water and subsequent leaching, while insoluble oxalates are made less bioavailable by adding more calcium. In tilapia, Mathia and Fotedar (2012) showed 100% replacement of fish meal with taro leaf.

(5) Solanum nigrum (Black nightshade)

Black nightshade leaves contain a higher amount of 32.3% CP, 20.0% carbohydrate, 26.9% fiber and 6.6% ash (Gqaza et al., 2013), while ANF's detected were tannins, alkaloids and flavonoids. This leaves can be treated as a nutraceutical supplement as it has health benefits along with the growth promoting effects. Haniffa et al. (2011) investigated the use of S. nigrum extract as an immunostimulant for pearl spot juveniles against the fungus Aphanomyces invadens and proved to be most efficacious as immunostimulant.

(6) Zanthoxylum acanthopodium, Clerodendon colebrookianum, Oenanthe linearis and Houttuynia cordata (Fish mint)

These plants are locally available in the northeast region of India. The protein content of the leaves is 28%, 26%, 21% and 12% for Zanthoxylum acanthopodium, Clerodendon colebrookianum, Oenanthe linearis and Houttuynia cordata respectively (Seal, 2011). The phenolic compounds were also reported to be higher in these plants, therefore, having good radical scavenging and antimicrobial properties. Houttuynia cordata leaf has excellent antimicrobial and antioxidant properties (Tok et al., 2015) and could attribute for health benefit in fish. Garg et al. (2019) reported that supplementation of 10 g H. cordata leaf meal/kg feed is beneficial in the diet of rohu L. rohita.

(7) Ipil-Ipil (Leucaena leucocephala) leaf meal

Leucaena leucocephala leaf meal contains about 24% CP, 3-5% CL and 14% CF (Debnath et al., 2016). The balanced amino acid composition of leucaena leucocephala is a good source of quality protein and is much cheaper than most of the other protein feeds. Leucaena leucocephala contains a toxic alkaloid known as mimosine which has a detrimental effect on the reproduction of fish (Corazon et al., 1988); however, soaking of leaves effectively extract the mimosine. Corazon et al. (1988) recommended optimum dietary inclusion level upto 40% without affecting the reproductive performance of nile tillapia. Zamal et al. (2008) observed that leucaena leaf meal at the level of 15% have good nutritive values and have a significant increase the growth performance, FCR, FCE measures of O. niloticus. Again, 25 % soaked leucaena leaf resulted in better growth performance of L. rohita (Hassan et al., 1994). Considering high protein content and low anti-nutritional factors present, ipil-ipil leaf meal could be a potential substitute for protein and energy source ingredients in fish feed.

(8) Cassava leaf meal

The nutritional profile of Cassava leaf has 21%, 24%, 8.5%, 6.5% and 1.45% CP, CF, ash, CL and calcium respectively (Da et al., 2012). It has a well balanced amino acid profile even higher than that of defated soybean meal (Eusebio et al., 1999) but deficient in sulphur containing amino acid methionine. Cassava leaf meal have been used as a dietary feed ingredient for O. niloticus after soaking and sun-drying to reduce the presence of cyanogenic glucosides. Hassan et al. (2017) reported that this leaf meal could be used upto 20% in the diets for african catfish Clarias gariepinus.

(9) Papaya leaf meal

It has high crude protein content (30% CP) with low crude fibre levels (5%) (Onyimonyi et al., 2009). Papaya leaf meal contains a proteolytic enzyme, papain (5.3%), which increases protein digestion and thus accelerating growth of fish. At the level of 16% unsoaked papaya meal diet fed to P. monodon post larvae resulted in better growth and nutrient utilization (Penaflorida, 1995).

(10) Dhaincha (Sesbania aculeata) leaf meal

Dhaincha (Sesbania aculeata) is a shrub of Fabaceae family, widely distributed across the Indian sub-continent. It can easily be grown abundantly with little cost and agronomical care; thus, makes it much cheaper than other essential feed ingredients. It is primarily used as a nitrogen fertilizer during newly formed pond where it is sowed and then allowed to shades the leaves at the bottom followed by filling with water. Leaves were high in protein content; thus, microbial decomposition leads to increase nitrogen content in the pond. Its leaves were reported to contain 22-30% crude protein (Kaitho et al., 1998). In L. rohita, the inclusion level of 5% leaf meal resulted in better growth performance (Devi et al., 1999). It is a good source of essential fatty acids but deficient in essential amino acids except for leucine, tryptophan and histidine.

(11) Moringa (Moringa oleifera) leaf meal

The fresh leaves of Moringa oleifera or 'drumstick' contain 26.4 % CP (Egwui et al., 2013) and drying, soaking and grinding the leaf into powder could reduce the antinutritional factors. Saponins and phenols are the major ANF's present in the leaves with the good essential amino acid profile. Inclusion level can be between 5-15% for better utilization of the leaves. Tekle & Sahu (2015) reported that the ethanolic extracts of moringa flowers have antioxidative and antimicrobial properties in Nile tilapia.

(12) Aquatic weed leaf meal

Azolla, Water hyacinth, Ipomea aquatica and duckweeds are aquatic weeds having potential to use as aqua feed ingredients. The crude protein content is 19-31%, 25-30%, 23% and 15-30% with the inclusion level of 45%, 25% (fermented), 20% and 15% respectively in the diet of Indian major carps. However, major constraint is high crude fibre level in these aquatic weeds.

Conclusion

Considering the present vives in validating leaf meal based feed, department of Fish Nutrition and Feed Technology, ICAR-Central Institute of Fisheries Education, Mumbai are working on 'Green Feed for Carps' project. Under this, they have screened the ANF's present and nutritional profile of the indigenous leaf's (Sweet potato leaf, Sesbania aculeata (Daincha), Leucaena Leucocephala leaf, Houttuynia cordata, Cajanus cajan) and experimental results with fish in tanks and ponds are encouraging.

Despite having good protein content in indigenous plant ingredients, fish have moderate acceptance have resulted in inferior to comparable performance with the unconventional diets. This is due to lower digestibility and bioavailability of nutrients for utilization and retention by fish because of anti-nutrients present in leaf meal. However, to increase acceptability of leaf meal based feed, (1) modification in processing like extrusion cooking (cause gelatinization of carbohydrate and removal of ANF's), (2) pre-enzyme treatment, (3) use of leaf protein concentrate, (4) use of exogenous enzymes, (5) dietary supply of essential amino acids (methionine and lysine), (6) use of fermented leaf meal, (7) use of feed attractant. Out of these approaches, the fermentation process is promising as low-cost fermenter can be designed on the farm. Finally, it is very much essential to provide information on the key ANF's present in the leaf, tolerable limit of ANF's by the culture species and screening of phytochemicals or bioactive compounds that augment immune functions. Further studies are promising to establish the potentiality of utilizing leaf meal in the diet of fish.

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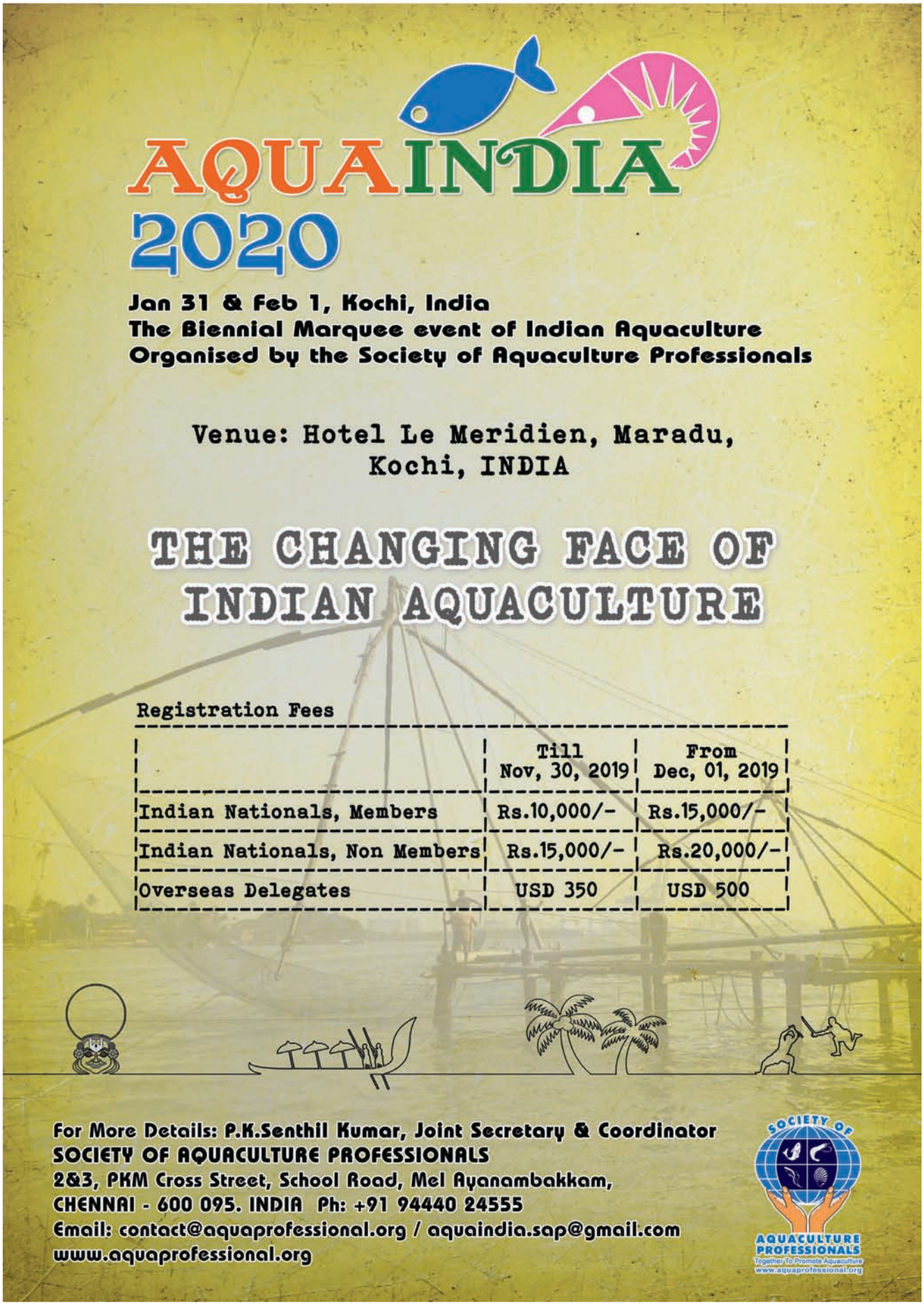

Selective breeding and their benefits in fish production

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Introduction

Aquaculture is the fastest food producing industry in the world. Improvement in the biological productivity of fish is an important part of increasing the future aquaculture production. Selective breeding is the process of using desirable traits within a population to improve production quality, efficiency and sustainability. In addition to this selective breeding programs include selection, crosses and hybridizations, and chromosome manipulation of fishes. Selection was poorly applied in inland fishes mainly in trout, carp and tilapia. The most common selection goals in fish breeding programs are growth rate, feed conversion, disease resistance and survival, quality and meat yields.

One of the well-known examples for selection breeding is GIFT (Genetically Improved Farmed Tilapia). It has played an important role in the expansion of Nile tilapia culture (now reported in 87 countries) by maintaining high levels of genetic variation and genetic selection for important traits and also helps to avoid the negative impacts of poor genetic management or inbreeding resulted in superior performance of the fish (Gjedrem, 2012).

Selection Methods

The genetic variation of the trait to be selected does not suffer problems (e.g. bottlenecks, inbreeding) created by earlier genetic mismanagement. The important selection methods are pedigree selection, individual selection, family selection, within-Family selection and combined selection.

Pedigree selection usually uses data or information from the parents and grandparents. It is most interest for young animals without data on their own performance. So foe these type of animals the best estimate of their breeding value is the average breeding value of their parents.

Individual selection solely based on the individual's phenotype. It does not require the maintenance of pedigree records or individual identification. Individual selection is easy to perform but it is only possible for traits that can be measured or recorded on live animals, since live animals are naturally considered as bloodstock for the next generation. By contrast, individual selection is not suitable for situations in which the estimation of breeding values requires slaughter of the animals (e.g. carcase and flesh quality traits) or challenge of some sort (e.g. selection for salinity tolerance or for disease resistance).

Family selection is much more efficient than individual selection for threshold traits like survival and age at sexual maturity, particularly for traits with low heritability. In family selection, full –sibs will share average half of their gene alleles in common, while half-sibs share one quarter of their identical gene alleles. Before applying family selection, it is necessary to know the percentage of each individual and hence to maintain good pedigree records. Individual tagging is used to record the process. But tagging is difficult at the time of hatching. So each full-sib family must be reared in separate units from egg stage to the feeding stage until the reach sufficient size to be physically tagged. Environmental effect has some impacts during this period (Each family have a common environment that is different from other families). Use of genetic markers instead of physical tagging can minimize these common environmental effects.

Within- family selection requires identification of the families. When within-family selection applied, families are tested by maintaining them in separate tanks, cages, hapas or any other means of containment, without necessarily tagging the fish. Within-family selection is advantageous when there is a large component of environmental variance common to members of the same family.

Combined selection is based on individual selection as well as information from relatives. The information from the relatives can increase the accuracy of the estimation of breeding values. This is not possible with other methods like mass selection or within-family selection.

Genetic improvement strategies

Strategies mainly categorized as long-term strategies and short-term strategies. In long-term strategies, selective breeding used for improving growth rate, Body confirmation, Body confirmation, Physiological tolerance (stress), Disease resistance, Maturity and time of spawning and gene transfer. Hershberger et al. (1990) reported that mass selection gave 20% increase in growth rate of Coho salmon after 10 generations. Coho salmon with a growth hormone gene and promoter from sockeye salmon grew 11 times (0-37 range) as fast as non-transgenics (Devlin et al., 1994). High heritabilities in common carp, catfish and trout were determined by (Dunham, 1995 and Tave, 1986).

Short term strategies include Intra-specific crossbreeding, Sex reversal and breeding and Chromosome manipulation. (Dunham, 1995 and Tave, 1986) explained there is no heterosis in Chum salmon and largemouth bass. But heterotic growth was seen in 55 and 22% of channel catfish and rainbow trout crosses. Dicentrarchus labrax triploids showed inconsistent growth in relation to diploids and had lower GSI (Knibb, 1997).

Benefits of selective breeding programs

Genetically improved stock can enhance growth, survival and disease resistance. Gjedrem (1983) was carried out selective breeding of red sea bream Pagrus major for more than 25 years. He found that as selective breeding was repeated, the body weight of broodstock will be increased. Within-family selection was practiced in Nile tilapia (Oreochromis niloticus) for 12 generations to increase body weight at 16 weeks of age. Results showed that the selected group consistently had higher final body weights in tanks, hapas, and ponds (Bolivar and Newkirk, 2000).

Dickerson (1970) and Smith et al. (1987) was stated that selective breeding programmes can reduce cost per unit. A portion of this saving is retained by the producer, while a portion is also passed on to the consuming public (Pearson and Miller, 1979). Gjerde and Olsen (1990) found that the genetic gain to be 10% per generation for growth rate and 3% for age at sexual maturation. In case of disease resistance little is known about Atlantic salmon. (Storset et al., 2007) reported that Atlantic salmon bred for high resistance showed higher survival compared with salmon bred for low resistance. However, Gjedrem (2010) stated that several diseases with relatively high heritabilities are included in the breeding goal. Family based selective breeding programme can enhance resistance to a typical disease in Atlantic salmon (Robinson and Hayes, 2008).

Selective breeding improved utilization of resources in aquaculture industry. Feed utilization represents more than 50% of the total costs in intensive farming. Thodesen et al. (1999) the feed conversion ratio (FCR) of Atlantic salmon was improved by 20% during five generations of selection results in higher growth rate per generation.

Conclusion

Selective breeding is the best way to improve fish production. Different selection methods are responsible for genetic variation thus results in higher growth, disease resistance and survival. However, selective breeding programmes facing challenges like inbreeding depression. So, innovative ways should come forward to overcome these problems. For the successful breeding programme we should develop enough knowledge on phenotypic and genotypic characters of different traits.

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(More References can be provided on request)

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Fish squalene: a precious gift of nature

Highlight Points

Squalene($C_{30}H_{50}$) is an unsaturated hydrocarbon found in the liver oil of certain species of sharks. ▶Due to its excellent biological and nutritional properties it is widely used in clinical, pharmaceutical, cosmetic and food industry. ▶Global market demand for fish squalene is higher compared to squalene from other origins.

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Introduction

Squalene ($C_{30}H_{50}$) was discovered in 1906 by Mitsumaru Tsujimoto, a Japanese industrial engineer. In 1930, Dr Keijiro Kogami studied beneficial effects of squalene on health, and, Paul Karrer in 1963, founded that squalene also existed in human body. Squaleneis a polyunsaturated triterpene widely found in nature. Biosynthesis of squalene occurs in the skin and liver ofanimals and this synthesized squalene is carried by LDL and VLDL in circulating blood and largely secreted in sebaceous glands as a precursor to cholesterol.

Sources of fish squalene

The known richest source of fish squalene is the liver oils of sharks specially the Squadelidea family. Shark liver oil contain squalene about 60–70 percentage. Especially deep-sea sharks living in depths of 300 to 1,500 metres have large reserves of squalene.

Physicaland chemical properties of Squalene

- Molecular weight: 410.7 g/mol
- Appearance: colourless, transparent oily liquid

- Odour:Faint agreeable odour
- Density: 0.858 g/mL
- Melting point : −4.8°C
- Boiling Point:421.3°C
- Stability:Stable under recommended storage conditions.

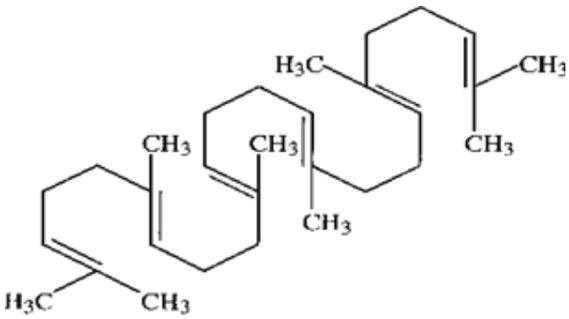

Fig. 1. Chemical structure of squalene

Clinical Applications of Squalene

1. **Squaleneas a drug carrier:** Squalene is widely used in emulsions either as the primary component or the secondary lipid. Squalene is emulsified using other diverse constituents which were used for antigen supply. They are frequently used to carry vaccines and drugs into the body.
2. **Anti-cancer Properties of Squalene:** It is known that sharks are rich sources of squalene and it has been reported that absence of cancer in sharks is associated with such high squalene levels. Additionally, Mediterranean people are known to be less effected by cancer, whose diet content is rich in olive oil, is thought to be partially associated with squalene.
3. **Antimicrobial effects of squalene:** It has been reported that shark liver oil, which is rich in squalene and alkyl glycerol, is protective against bacterial and fungal infections particularly in the patients with atopic dermatitis and xerosis-related skin lesions.
4. **Detoxifying effect of squalene:** Squalene shows tendency to attach to non-ionized substances since it is nonpolar. It collects xenobiotic with high lipophilic property and helps them to be eliminated out of the body.
5. **Squalene and cholesterol metabolism:** When dietary squalene is absorbed, a certain amount turns into cholesterol. Biosynthesis of squalene occurs in the skin and liver in human and this synthesized squalene is carried by LDL and VLDL in circulating blood and largely secreted in sebaceous glands as a precursor to cholesterol.
6. **Squalenein skin protection:** Squalene is found in the skin as a protector against lipid peroxidation, which occurs due to exposure to UV radiation and other sources of oxidative damage. Higher squalene content on skin surface is known to reduce chain reactions of lipid peroxidation.
7. **Squalenein immune system:** Squalene is a strong antioxidant due to its large electron exchange capacity without being exposed to molecular disruption. Experimental studies have proven that dietary squalene supplementation boosts immune system performance and advances macrophage function.
8. **Weight and Cholesterol Control:** Consumption of Squalene from natural sources (olive oil, wheat germ, rice husk, or amaranth) can be part of an integral diet. Oral administration of Squalene can produce other benefits when ingested in the body and helps in weight loss and cholesterol control.
9. **Emollient and Moisturizer:** Squalene is a natural antioxidant molecule that protects cells from oxidative damage by exposure to ultraviolet light and other external sources; this molecule participates as a defense mechanism for the internal and external tissues of the skin in the human body.

Dosage and administration

Squalene is a liquid that is available in capsules for oral use. Doses of 500 milligrams to 4 grams are used by some cancer sufferers.

Global squalene market by end-user

Top 3 end-users in the global squalene market are cosmetics and personal care which share with 67.92% as of 2016. Second one is food supplements where squalene is used as a dietary product to the immune system. Third is the pharmaceutical industry in which squalene is used for various treatments such as the treatment of heart disease. Prices of shark-based squaleneare always 20 - 30% more expensivethan plant-based squalene.

Conclusion

Squaleneplays aremarkable range of applications in human day to day life, as anti-cancer agent, anti-oxidant,cosmetics, pharmaceutical drugs, vaccines and drug delivery etc. Acknowledging its wide range of applications, squalene has been called as a "precious gift" in Japan. Higher market value of squalene is due to its valuable biological properties and its numerous commercial applications which lead to a great global demand. But due to its less availability (it is expected that for extracting 1 ton of squalene, it requires about 3,000 sharks) the cost of fish squalene is expected to be higher. It opens to a new research approach for finding sustainable squalene extraction methods which can give higher yields.

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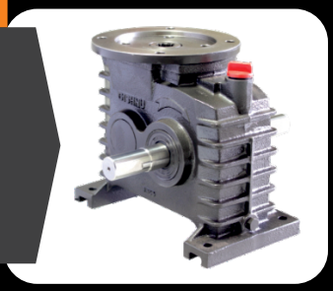
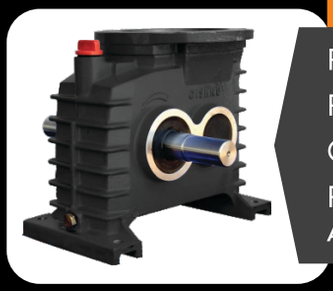
O/p RPM : 105, 120, 140 & 160
Power savings : 75%





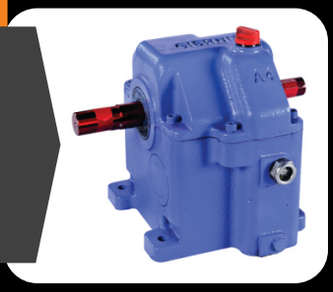
Type : A3 Aero RF (Aluminium)

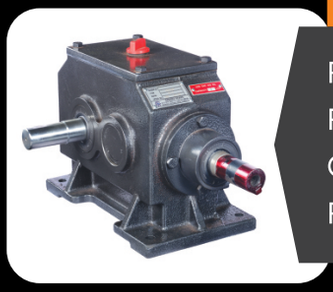
Range : 1 hp to 3 hp
Pedals : 4, 6 & 8
O/p RPM : 105 & 120
Power savings : 75%
Aluminium housing with Anti-rust coating

LONG ARM GEAR BOX

Type : A4 Single Side

Power savings : 70%
O/p RPM : 72 & 115
2 hp = 12 Pedals
3 hp = 16 Pedals





Type : GBH

Range : 3 hp & 5 hp
Pedals : 8+8 & 20+20
O/p RPM : 105 & 120
Power savings : 60%

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Immunohistochemistry in fish and shellfish

Highlight Points

Aquaculture remains essential sources of food, nutrition, income and livelihoods for hundreds of millions of people around the world. The disease poses one of the most significant threats to successful aquaculture and is now responsible for severely impending economic and socio-economic development in many countries of the world. Diagnostics play an essential role in aquatic animal health management and disease controlImmunohistochemistry (IHC) is an extension of traditional histology where formalin fixed paraffin wax-embedded tissue is sectioned and incubated with a pathogen-specific antibody.IHC is also widely used to analyze the molecules of interest to study their roles on the molecular, cellular or tissue level and has been widely used to aid researchers and physicians to evaluate tissue specimens of interest (healthy and diseased).

Zahoor Mushtaq

1. Introduction

Aquaculture remains essential sources of food, nutrition, income and livelihoods for hundreds of millions of people around the world. Theproduction of aquatic animalsfrom aquaculture in the year 2014 amounted to 73.8 million tonnes, with an estimated first-sale value of US$160.2 billion. The share of aquaculture to the global production of fish has risen continuously, reaching 46.8 percent in 2016. With 5.8 percent annual growth rate during the period 2001–2016, aquaculture continues to grow faster than other major food production sectors, but it no longer enjoys the high annual growth rates experienced in the 1980s and 1990s.The disease poses one of the most significant threats to successful aquaculture and is now responsible for severely impending economic and socio-economic development in many countries of the world. Diagnostics play an essential role in aquatic animal health management and disease control.Various methods have been developed to detect pathogens in aquatic animals which include traditional diagnostic methods and awide range of immunological and molecular techniques.The routinely used immunological fish diagnostics allow the detection of specific pathogens without first having to isolate the pathogen.

2. History of Immunohistochemistry (IHC)

A powerful microscopy-based technique known as Immunohistochemistry was invented during the 1940s (Coonset al., 1941)for visualizing cellular components like proteins or other macromolecules in tissue samples.The principle of IHC has existed since the 1930s. However, the first study using IHC was to identify Pneumococcal antigens in infected tissue using Fluorescein isothiocyanate (FITC) labeled antibodies (Coons et al., 1942).Afterward, enzymes as marked antibodieswere introduced that made it possible to visualize these reactions through optical microscopy, causing the technique to spread to a broad group of researchers and pathologists.

3. Technique

Conventional IHC involves immune staining of thin sections of tissues attached to individual glass slides. For comparative analysis a large number of small sections can be arranged on a single slide, a format commonly referred to as a tissue microarray. The technique has evolved over the time,and the significant improvements have been made in tissue fixation and sectioning methods, the introduction of enzyme labels (peroxidase, and alkaline phosphatase, colloidal gold), antigen/epitope retrieval, antibody conjugation, immunostaining methods, and reagents, as well as microscopy itself.

Many critical steps involved in IHC for identifying cellular or tissue constituents (antigens) utilizingantigen-antibody interactions using direct labeling of the antibody, or by use of secondary labeling methodare given in Fig.1. IHC consists of a tissue preparation phase, an antibody-staining phase, and a result analysis phase. The general procedure for IHC involves fixation of the tissue topreserve the epitopes and morphology.The routine process for IHC is to prepare formalin-fixed paraffin-embedded (FFPE) tissue blocks.Formalin fixation produces chemical

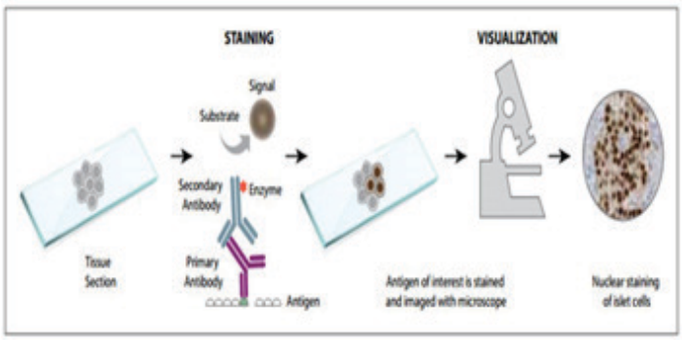

Fig. 1: IHC detection methods

cross-linking of proteins within the tissue resulting in termination of all cellular processes and freezes the cellular components to retain the conformation they were in at the time of fixation and also reduces or prevents degradation. Following appropriate fixation, further processing of the tissue is done and ultimately embedded in a paraffin block. The blocks containing the tissue are then subjected to a microtome for sectioning into thin slices (usually 4-10µm), transferred to glass slides and allowed to adhere before further processing. Selection of suitable antibody is critical for performing IHC.IHC has been performed using both polyclonal and monoclonal antibodies. Monoclonal antibodies from rabbit or chicken introduced recently are reported to give better IHC results for antigens that are difficult to stain (Kimet al., 2016). For appropriate results validation of the antibody by non-IHC methods such as western blotting or flow cytometry is also recommended. Subsequently, optimization regarding antibody dilution, incubation times, and blocking is necessary for controlled laboratory conditions. The specific antigen-antibody interaction is detected by immunostaining process andindirect method using labeled secondary antibodies. The most common detection systems includethe avidin-biotincomplex method, labeled streptavidin-biotin method, phosphates anti-phosphates method, polymer-based detectionsystem, and tyramine amplification system. For better discrimination of the target signal counterstaining (most commonly with hematoxylin) of chromogens is essential which additionally allows the pathologists to identify particular cell type and exact localization of the immunopositive.

4. IHC and disease diagnosis in aquaculture

Immunohistochemical techniques have been used in the detection of myxosporidian parasite Ceratomyxa shasta (Bartholomew et al., 1989) and PKX the etiological agent of Proliferative Kidney Disease (Adams et al., 1992). Immunohistochemistry in paraffin-embedded sections of swordtail Xiphophorus helleri, utilizing polyclonal antibodies anti-Mycobacterium bovis (BCG strain) and anti-M paratuberculosis,detected the mycobacterial antigens in tissues of the fish (Gomez et al., 1996). Also, the monoclonal anti-M. avium detected a positive reaction only in cells of kidney granulomas. These results validate immunohistochemical methods for diagnosingfish mycobacteriosis in formalin-fixed specimens.

Similarly, F. psychrophilusinfection in rainbow trout fry by applying immunohistochemical technique revealed the infection involves the monocyte-macrophage system extensively.The chronic stage of the disease results in colocalization of bacterium in skin ulcers and and also results in retinal inflammation. Evensen and Olesen (1996). Evensen and Olesen (1997) also visualized the presence of viral hemorrhagic septicemia virus (VHSV) peptides in situ using immunohistochemistry in naturally infected rainbow trout (Oncorhynchus mykiss). They described IHC a highly specific and sensitivetechnique for the specific detection of the N-protein of the virus using monoclonal antibodies and also reported that immunostaining could be a valuable supplement to virus cultivation during disease outbreaks. Evensenet al., (1994)detected R.salmoninarumin situ by using immunohistochemistry in paraffin-embedded tissue specimens from Atlantic salmon (Salmo salarL.) by use of monoclonal antibodies specific for the R. salmoninarum p57 protein.Lorenzen et al.,(1997) reported the 1st demonstration of Bacterial Kidney Disease (BKD) in Rainbow trout in Denmark using in situIHC.

Immunohisto chemistry has become a leading technique for Nodavirus diagnosis due to its quickness and sensitivity, and the minimal financial effort required. Immunohistochemical changes in the various histological sections of larvae, juvenile and adult sea bass (Dicentrarchuslabrax L.) treated with polyclonal anti-Noda rabbit IgG, recorded vacuolating necrosis in the brain, spinal cord and retina and liver endothelium (Mladineoet al., 2003).Immunohistochemical co-localization of Pasteurella skyenseantigens within Atlantic salmon, Salmo salarisa handy tool when trying to discriminate between some of the more common bacteraemias encountered in salmonids in Scotland (Foyle et al., 2003).

Sundlund et al., (2006) reported the use ofimmunochemistry to characterize infection in bivalves for the first time which led to the conclusion of pathogenicity of V. splendidusand V. pectenicidato scallop larvaeestablishing immunohistochemistryas a powerful tool for studies of diseases of larval bivalves. Immunohistochemistry with absorbed polyclonal antisera was found to be a powerful tool for verification of bacteria including demonstrating the presence of bacteria and pathological alterations in various tissues in larval groups of turbot Scophthalmusmaximus, halibut Hippoglossushippoglossusand cod Gadusmorhua that had suffered the highest mortality rates following Vibrio spp. challenge (Sandlund2010).Francisellanoatunensissubsp. orientalis(Fno) described as causative agents of chronic granulomatous and pyogranulomatous lesions in wild and cultured fish species were analyzed using a real-time polymerase chain reaction assay for the detection of the Fno intracellular growth loci C (iglC) gene and by immunohistochemistry for the demonstration of Fno antigen These diagnostic techniques have been reported to have enormous potential in retrospective epidemiological investigations (Soto et al., 2012). Bacterial-induced granuloma formation in Atlantic cod (Gadusmorhua L.) spleen induced by Aeromonas salmonicidassp. achomogenes (Asa), has been described by immune his to chemistry by Magna dottiret al., (2013). Immuno positive Photo bacterium damselae subspecies piscicidawas detected in tissues and organs ofboth acute and chronic form, suggesting that immunohistochemistry method can be used as a definitive diagnostic tool for natural acute and chronic forms of photobacteriosis in yearling cultured and brood stock of gilthead sea bream (Abu-Elalaet al., 2015). IHC appears of great interest to detectOsHV-1 quite early in oysters. Tissue distribution of ostreidherpesvirus1viralproteins corresponding to two

putative membrane proteins and one putative apoptosis inhibitor withininfected Pacific oyster, Crassostrea gigas using polyclonal antibodies revealed positive signals in the connectivetissue of different organs thus confirming the connective tissue tropism of the virus (Martenotetal., 2016).

5. Conclusion

Immunohistochemistry (IHC) is an extension of traditional histology where formalin fixed paraffin wax-embedded tissue is sectioned and incubated with a pathogen-specific antibody.IHC approach combines anatomical, immunological and biochemical techniques to image components in tissues. IHC is also widely used to analyze the molecules of interest to study their roles on the molecular, cellular or tissue level and has been widely used to aid researchers and physicians to evaluate tissue specimens of interest (healthy and diseased). In additionality to its simplicity to perform, it has the advantage to visualize the pathology associated with the infections in aquatic animals. As a result, IHC has become an essential tool in health care and pathology.

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(More References can be provided on request)

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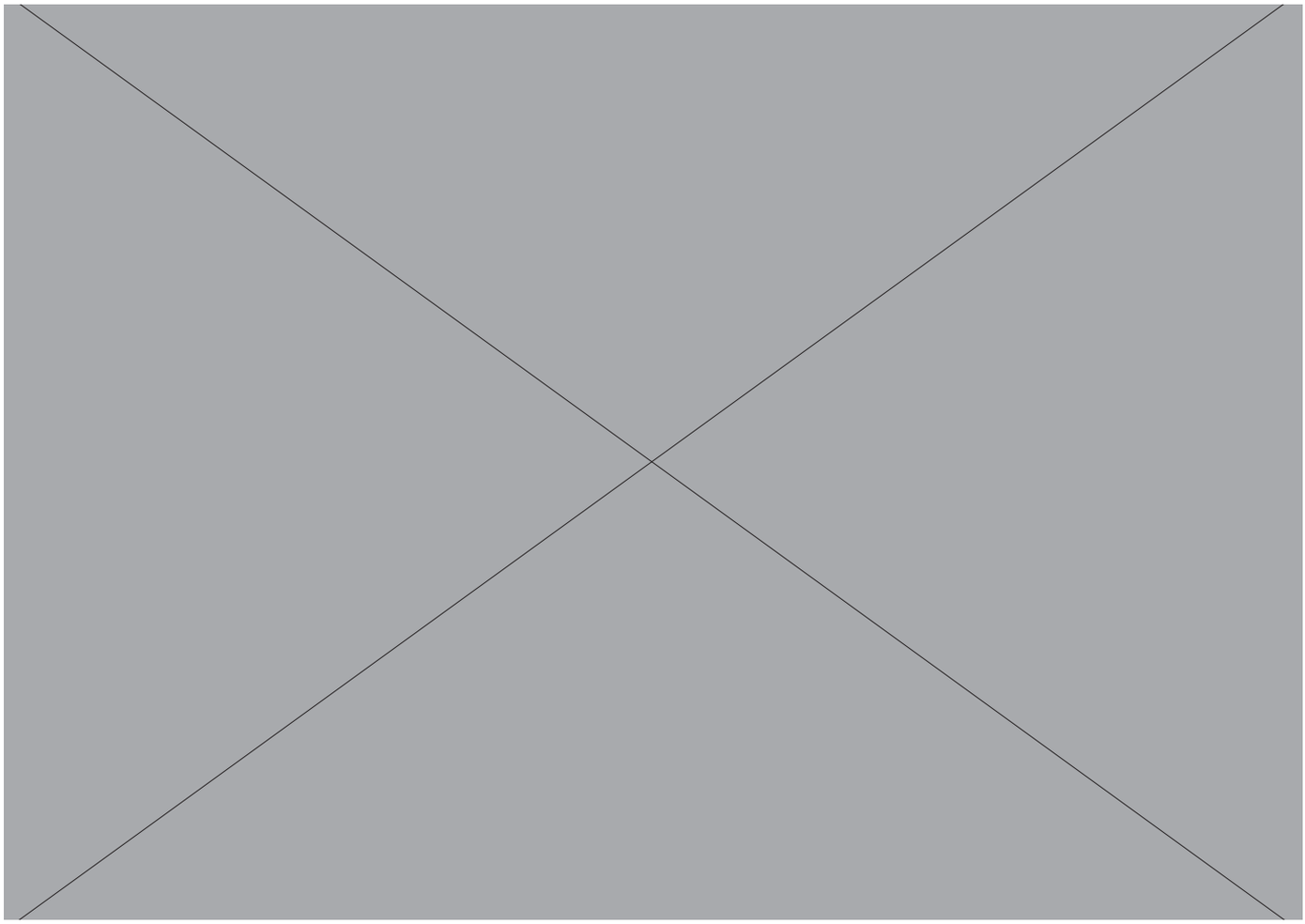

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