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Inside...

Foundation Stone Laid for Phase IV of MPEDA's Aquatic Quarantine Facility

Wang Guorong, Chairman of Tinder

Tinder launching its Feed Mill Machinery in India

TNF University Develops Technology for Shrimp Feed

Induced Breeding: A Revolutionising Step towards the Fish Boom in India

Ontogenic Changes in Feeding in Fishes

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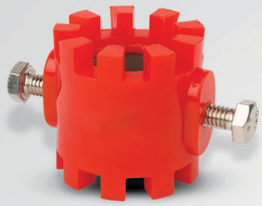


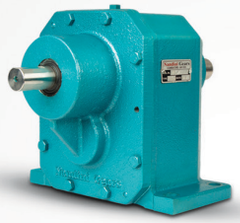
Spiral Stopper

Bevel Gear Box

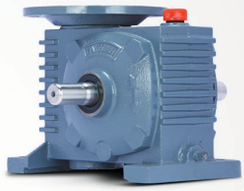
2 HP Motor

Spiral

Worm Shaft & Wormwheel



Spiral (Helical) Gear Box



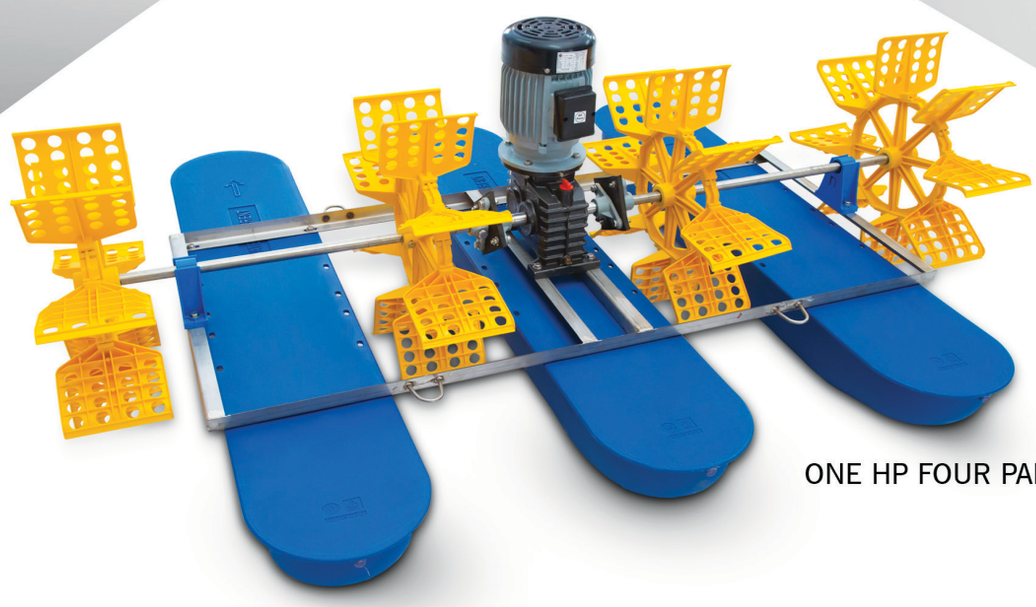
1 HP Gear Box

Paddle Wheel

Long Arm Gland

2 HP Gear Box

2 HP Out Put Shaft



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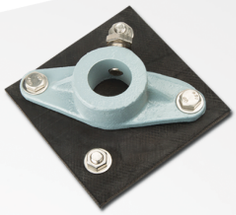
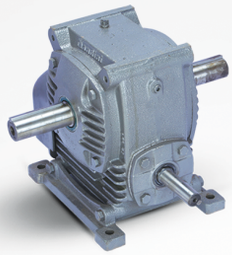


Spiral Gear Box Movable Joint

Bearing Stand For Spiral



Long Arm Gear Box

Movable Joint

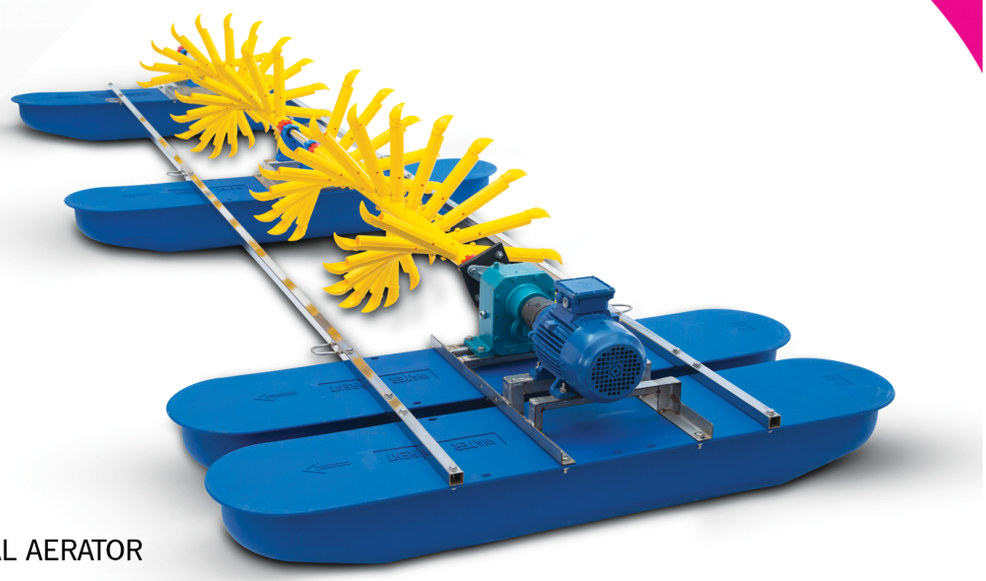
Paddle

Float

1 HP Motor

2 HP Motor

HDPE Cover



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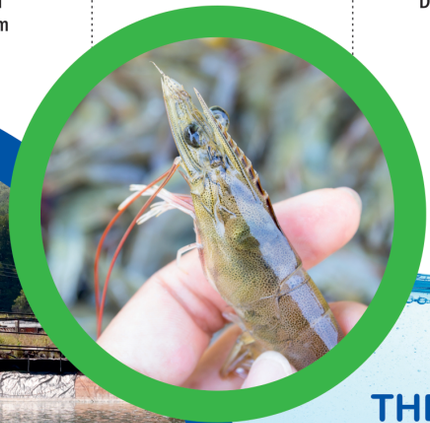

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Editorial & Business Office
AQUA INTERNATIONAL
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BG-4, Venkataramana Apartments,
11-4-634, A.C.Guards, Near IT Towers
Hyderabad - 500 004, India.
Tel: 040 - 2330 3989, 96666 89554
E-mail: info@aquainternational.in
E-mail: forum@aquainternational.in
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From the Editor...

M.A. Nazeer

Dear Readers,

The July 2018 issue of ***Aqua International*** is in your hands.

We are happy to inform to our esteemed readers and advertisers that Aqua International has completed 25 years of its publication and services to aquaculture sector, we thank the readers and advertisers for the patronage all these years.

Readers may find a Special Feature published on Guangzhou Tinder Industry Co. Ltd, China, Feed Mill machinery manufacturers in China for poultry and aquaculture.

Globally animal-agriculture is facing enormous challenges such as urbanization; reducing land available for cultivation; climate change; growing water scarcity; competition from biofuels for grains; and soil degradation. Meanwhile, developing nations and the growing overall world population are demanding more animal protein. As a proactive industry association, CLFMA is leading the agenda of sustainably increasing animal protein production in the country through focusing on the top three priorities. 1. Increase input efficiency, 2. Reducing environmental footprint of animal protein and 3. Saving precious natural resources.

Using biofloc, a new technology that obviates the need for the use of plankton in aquaculture, the feed, called Nutrifloc, and has been developed. "We balance the carbon-nitrogen ratio in the water due to which certain microbes develop. These microbes help maintain the quality of the water and reduce formation of sludge," explained Dr S. Felix, Vice-Chancellor of Tamilnadu Fisheries University, who is part of the team that has developed the technology.

Union Minister of State for Agriculture and Farmers Welfare Krishna Raj has urged the marine scientists to promote seaweed farming which, according to her, has multi-dimensional industrial prospects. The minister was interacting with the scientists of the Central Marine Fisheries Research Institute (CMFRI) recently in Kochi.

Dr S.S. Mishra, Director of ICAR-CIFA, Bhubaneswar, Odisha, as President of function emphasized for improvement of livelihood conditions of tribal farmers through adoption of scientific aquaculture practices including good quality fish seed for stocking, providing supplementary feed to fish and adopting better management practices. He assured all technical help from CIFA for benefit of fish farmers of the region. Mr R.V. Baria, Project Administrator, TSP Programme of Narmada District said that the socioeconomic development of tribal population of the region can be done through adoption of scientific methods of aquaculture. He expressed his thankfulness to ICAR-CIFA for conducting such programme in his district.

The one-day Seminar on 'Pros and Cons on Use of Antibiotics in Aquaculture' was organized by Office of the Dy. Director of Fisheries (Microbiology & Parasitology), Directorate of Fisheries, Government of West Bengal, Pailan, South 24 Parganas recently. Dr Moloy Kumar Sahu, DDF (M & P), Government of West Bengal gave an overview on antibiotic resistance, which occurs when different species of bacteria, pathogenic to human and aquaculture species, characteristically change in response to improper and uncontrolled use of antibiotics.

The Marine Products Export Development Authority (MPEDA) is poised to expand its Aquatic Quarantine Facility (AQF) for imported Pacific White Shrimp (L. vannamei) in a move expected to increase shrimp farming production in the country by up to 3 to 3.5 lakh metric tonnes per annum and generate higher revenues from seafood exports. MPEDA is going to launch State-Of-The-Art Aquaculture Complex at Kochi.

Scotland's two leading salmon farmers, Marine Harvest Scotland and Scottish Sea Farms, have reported a sustained improvement in fish health during the first five months of 2018 with a marked reduction in disease-related mortalities.

In the Articles section, article titled **"Pineal Organ Melatonin as a Potent Photo neuroendocrine Regulator of Seasonal Reproduction in Fish"** by S. Selvaraj, N. Jayakumar, R. Durairaja, B. Ahilan and S. Felix discussed Pineal organ melatonin transmits photoperiod information to the neuroendocrine system annual changes in melatonin levels drive the seasonal reproductive cycle in fish synthetic melatonin agonists and antagonists can be used to manipulate reproduction in captive fish melatonin function is conserved in finfish and shellfish.

Another Article **"Induced Breeding: A Revolutionising Step Towards the Fish Boom in India"** by Pravati Kishan, Shubham Varshne and Resmarani Mohanty discussed India is called as the "carp country" because of carps are the mainstay in Indian aquaculture. These carps do not breed in confined condition. In India, the first attempt to induce breeding was done by khan(1937) on C.Mrigala.

Article titled **"Ontogenic Changes in Feeding in Fishes"** by Debashis Jena, Ansuman Panda and Alok Kumar Jena discussed to understand the changes associated with feeding in fishes as a function of their size and age, it is existent to study their ontogeny. This article describes the changes that a fish undertakes during its lifetime to achieve growth, energy, survival and habitat utilisation efficiency in their natural environment that could be applied in aquaculture to gain high survival rate and to yield high production.

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

M. A. Nazeer
Editor, Aqua International
info@aquainternational.in
forum@ aquainternational.in

World Environment Day: CLFMA highlights top three priorities for India's dynamic Livestock industry

Globally animal-agriculture is facing enormous challenges such as urbanization; reducing land available for cultivation; climate change; growing water scarcity; competition from biofuels for grains; and soil degradation. Meanwhile, developing nations and the growing overall world population are demanding more animal protein.
As a proactive industry association, CLFMA is leading the agenda of sustainably increasing animal protein production in the country through focusing on the following top three priorities.

• **Increase input efficiency** – Contrary to the popular myth that the increasing consumption of animal protein is at odds with sustainability, livestock sector is an important contributor to sustainably meeting the world's food demand. Indian livestock industry, as it enters an exciting growth phase, needs to focus on ways they can produce more from less. Be it feed, water, energy or antibiotics, the Indian livestock industry is making all efforts to judiciously use these inputs to maximize the conversion efficiency. For example, through investing in genetic improvement of milch animals, their yields can be boosted significantly when complementing with balanced ration.

• **Reducing environmental footprint of animal protein**

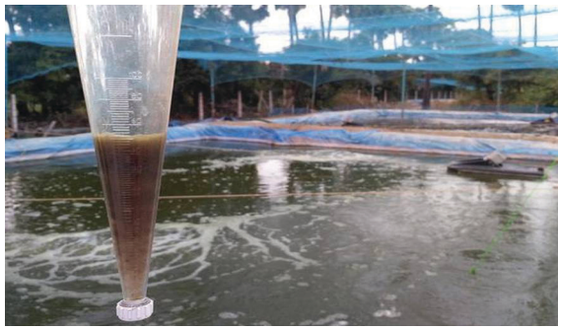
In most developing countries, crop and livestock farming complement each other. Diversifying the feed raw materials for meat production can play an important role in environmental sustainability. By-products from crops; biomass of various kinds; and slaughterhouse wastes (e.g. meat and bone meal) are being utilized by the livestock industry, which rids the ecosystem of burgeoning waste burden. Further, poultry manure or litter, for example, can be used as manure and thereby can replace chemical fertilizers to some extent in modern intensive agricultural production systems. Additionally, with serious concern globally and in India on the use of fossil fuels, it is important for India, which produces about 450-500 million tonnes of biomass per year, to effectively use them. More research is being pursued in this direction as India still needs to capture more value out of biomass particularly for animal feed. Further, new technologies are being explored to find out alternative sources of proteins (e.g. insects, algae) for feed so that our dependence on the traditional raw materials (maize and soybean) is reduced significantly.

• **Saving precious natural resources**

Recent advancements in animal nutrition are helping the industry maximise feed conversion ratio with less and less inputs. Without these technologies or innovations, far more cultivable land area is needed to produce enough feed grain to cater to the increasing demand from feed sector. So, the ultimate result of these innovations is the reduction of conversion of pristine natural landscape and forests into croplands. To achieve increased animal performance while minimising feed costs, new nutritional strategies, feed additives (e.g. enzymes), must be employed to optimise feed conversion and digestibility.

University Develops Technology for Shrimp Feed

'Bioflac' will help reduce use of water, bring down cost of food



In an effort to help aquaculture farmers, the Tamil Nadu Dr J. Jayalalithaa Fisheries University has developed a new feed that will aid in the growth of the vannamei shrimp and the tilapia fish.

Using biofloc, a new technology that obviates the need for the use of plankton in aquaculture, the feed, called Nutrifloc, has been developed. "We balance the carbon-nitrogen ratio in the water due to which certain microbes develop. These microbes help maintain the quality of the water and reduce formation of sludge," explained S. Felix, Vice-Chancellor of the University, who is part of the team that has developed the technology.

The technology reduces the use of water, which earlier had to be changed on a regular basis, brings down power consumption and cuts the cost of feed. With the adoption of the technology, aquaculture can be done indoors as well since sunlight would be required only for those using plankton.

The team has applied for a patent for the technology. "Due to an increase in shrimp production that has lead to a fall in prices, many farmers have been forced to sell at very low prices. The rising prices of lime, bleaching powder, medicines and oil and a ballooning wage bill have added to their misery," he added.

"This feed would cost at least ₹20 less per kg than the commercial fish-meal based feed and would evidently help farmers," he said.

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Union Minister Urges Marine Scientists to Promote Seaweed Cultivation

Union Minster of State for Agriculture and Farmers Welfare Krishna Raj visits CMFRI

Kochi: Union Minister of State for Agriculture and Farmers Welfare Krishna Raj has urged the marine scientists to promote seaweed farming which, according to her, has multi-dimensional industrial prospects. The minister was interacting with the scientists of the Central Marine Fisheries Research Institute (CMFRI) here on recently.

"Seaweed cultivation will greatly be beneficial to the development of various nutraceutical products, medicines and cosmetic products. Promotion of seaweed farming will also help increase the income of fishermen", she said adding that marine scientists should intensify research to boost seaweed cultivation in Indian waters. The minister appreciated CMFRI's efforts to develop nutraceutical products against diabetes, arthritis, obesity and thyroid.

Union Minister of State for Agriculture and Farmers Welfare Krishna Raj visiting the National Biodiversity Museum at CMFRI.

The minister also said that small scale entrepreneurship should be promoted in fisheries to improve the living standards of fishermen and fish farmers. "Village level campaigns are required to create awareness among the fishermen and farmers about the prospects of entrepreneurship in fisheries sector. Women empowerment could be made possible by encouraging them take up entrepreneurial initiatives", Krishna Raj said.

She called upon the scientists to implement innovative and diversified farming practices to woo more people into fish farming. The minister also stressed the need for upgrading the living status of fishermen and fish farmers into that of industrialists.

The minister visited the National Marine Biodiversity Museum and the research laboratories at the CMFRI. Dr K K Joshi, Head of the Marine Biodiversity Division, Dr T V Sathianandan, Head of the Fishery Resources Assessment Division and Dr Shyam S Salim, Principal Scientist spoke on the occasion.

Union Minister of State for Agriculture and Farmers Welfare Krishna Raj speaking at an interactive meeting with the scientists at CMFRI.

Prawns Flourish in Telangana waters

Fisheries Dept. to cultivate Hatchery-Reared Prawns in 23 Reservoirs

Prawns harvested from the reservoirs in Telangana as a part of pilot project by Fisheries Department, Govt. Of Telangana

The Fisheries Department's experiment on promoting hatchery reared prawn varieties in major reservoirs across the State has yielded successful results.

The project was launched in November on a pilot basis in 11 reservoirs across the State and the department had released 1.08 crore prawn seed into the reservoirs with an estimated ₹1.39 crore spent for the purchase of seed at ₹1.28 a piece. With the commencement of harvesting season, the department has so far reported yield of more than 184 tonne with an estimated market value of ₹4.43 crore.

"The harvest in the Lower Manair Dam alone is estimated to be above ₹2 crore, when compared with the ₹30 lakh spent on the procurement of prawn seed for the reservoir," Fisheries Commissioner C. Suvarna told *The Hindu*. The yield is expected to be higher as harvesting has not yet commenced in four of the 11 reservoirs while it was partially completed in the four other reservoirs.

The project involved obtaining brood stock from Kerala which was reared in a hatchery in Prakasam district and then transported to rearing ponds in Krishna district. Given the experimental nature of the project, the department had ensured that fresh water juveniles were released into the 11 major reservoirs rather than post larval stage seed for ensuring survival of the seed. "This is the first time hatchery reared juveniles have been released into the reservoirs and the experiment has given successful results," she said.

Enthused with the successful results of the pilot, the department had now decided to scale up the experiment and it has accordingly been decided to try the experiment by releasing 4.3 crore juveniles in 23 reservoirs across the State. "The pilot project has also taught us where we should not stock the juveniles.

The project will be scaled up after assessing the results of the second phase," she said. In view of the difficulties it had faced in obtaining the required number of juveniles, the department initiated measures in advance to ensure that required quantity of seed is available before the season begins.

ICAR-CIFA organizes Launching Workshop on "Improved Carp Polyculture in Village Ponds" in Tribal Dominated Aspirational District Narmada, Gujarat

Rajpipla, Narmada District 24 May, 2018:

The launching workshop on "Improved Carp polyculture in village ponds" was organized by Anand Regional Research Centre of ICAR-CIFA at Dr B R Ambedkar Hall of Rajpipla, Narmada District, Gujarat on 24 May, 2018 as a part of Tribal Sub Plan (presently known as STC) Programme of ICAR-CIFA, Bhubaneswar. Narmada has been identified as the tribal dominated Aspirational District by the Government of India. More than 150 participants including scientists, academicians, extension officials, development officers and progressive tribal fish farmers attended the event.

In the inaugural session Dr. C.K. Misra, Scientist In-Charge of Regional Research Centre of ICAR-CIFA in Gujarat welcomed the participants, briefed the genesis and objectives of the event, and way forward towards development of tribal communities through sustainable aquaculture operations. Dr B.C. Mohapatra, Chairman of TSP and Principal Scientist, ICAR-CIFA, Bhubaneswar said that there is a huge demand for good quality fish seed in India which could be met through wider adoption of FRP hatcheries and focused for dissemination of location specific aquaculture technologies in the tribal areas of Gujarat. He explained the economic benefit of the aquaculture and urged all the member to join their hands to take up aquaculture in all types of water bodies.

Dr S.S. Mishra, Director of ICAR-CIFA, Bhubaneswar, Odisha as President of function emphasized for improvement of livelihood conditions of tribal farmers through adoption of scientific aquaculture practices including good quality fish seed for stocking, providing supplementary feed to fish and adopting better management practices. He assured all technical help from ICAR-CIFA for benefit of fish farmers of the region. As Chief Guest Mr R.V. Baria, Project Administrator, TSP Programme of Narmada District said that the socio-economic development of tribal population of the region can be done through adoption of scientific methods of aquaculture. He expressed his thankfulness to ICAR-CIFA for conducting such programme in his district.

Mr N.F. Patel, Deputy Director of Fisheries, Govt. of Gujarat emphasized for diversification of aquaculture practices in tribal districts with the latest information from research institutes such as ICAR-CIFA and to take benefits of different schemes of Fisheries Department of Govt. of Gujarat for overall socioeconomic improvements. Dr P.R. Bhatnagar, Head of Vasad Research Centre of ICAR-IISWC explained the need of water harvesting structures in fish farming. Dr C. Anil, Head of Bharuch Centre of ICAR-CSSRI explained for taking benefit of integration of agriculture with aquaculture. Dr R. Borichangar, Nodal Officer of Navsari Fisheries College explained the need of fisheries education in fish farming. Dr Suhas Kamble, SIC of Vadodara Research Centre of ICAR-CIFRI narrated to take benefits of cage culture and pen culture technologies to improve fish production. Mr R.P. Sakhreliya, District Fisheries Officer of Narmada District explained the schemes of Govt. of Gujarat. Mr Jaimin H. Bhatt, Scientist, Anand Agricultural University explained about economic importance of various fisheries interventions of Krishi Vigyan Kendra for holistic development of tribal communities of Gujarat.

On the event one Leaflet on "Scientific Methods of Carp Polyculture in Village Ponds" in local language was released for the benefit of tribal farmers of Gujarat. Selected tribal farmers were felicitated on the occasion to encourage their enthusiasm for scientific methods of aquaculture. The event included interactive discussions with the participants. Vote of thanks was proposed by Mr Ajit Keshav Chaudhari, Scientist, RRC of ICAR-CIFA, Anand.

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Seminar on Antibiotics in Aquaculture held at Kolkata by Fisheries Dept, WB

The one-day Seminar on 'Pros and Cons on Use of Antibiotics in Aquaculture' was organized by Office of the Dy. Director of Fisheries (Microbiology & Parasitology), Directorate of Fisheries, Government of West Bengal, Pailan, South 24 Parganas on 22/2/2018. Dr Moloy Kumar Sahu, DDF (M & P), Government of West Bengal in his introductory remarks gave an overview on antibiotic resistance, which occurs when different species of bacteria, pathogenic to human and aquaculture species, characteristically change in response to improper and uncontrolled use of antibiotics. In the first invited lecture, Dr Sanjoy Das, Principal Scientist, ICAR-CIBA, Kakdwip spoke on the topic 'Use of chemotherapeutics and disinfectants in aquaculture'. According to Dr Das, disinfectants as common disease management aids in aquaculture systems should have wide antimicrobial activity and should effect minimum extent of toxicity to non-target organisms. He individually discussed the pond application characteristics of chemicals like potassium permanganate (acts both as disinfectant and oxidizing agent), bleaching powder, benzalkonium chloride, formaldehyde, copper sulphate, caustic soda, malachite green and others. These products must be judiciously used only in recommended dosage. If $KMnO_4$ application is found to lead to plankton crush, then it must be avoided and farmers must keep provision for oxygen tablets to enhance dissolved oxygen in fish ponds. We were informed about its use for pond bottom treatment, in conditions of bacterial infection in fishes, dip treatment of infected fishes. Dr Das further discussed about use of bleaching powder (with 10-20ppm available chlorine), effectiveness of malachite green against fungus and keratinolytic bacteria, features of black spot disease in shrimps, formaldehyde to combat ectoparasitic infection, application of $CuSO_4$ only in brackishwater ponds and not in freshwater ponds, dosage of dip treatment of freshwater fishes in $CuSO_4$ soln., use of $KMnO_4$ and lime in combination to kill saprophytic bacteria in pond bottom soil, maximum residue limit/level (MRL) of permitted antibiotics in fish and shellfish products (50-300 ppb or 50-300 microgram/kg). In the end, Dr Das discussed about application procedure and mode of functioning of gut probiotics (*Bacillus* sp., *Vibrio parahaemolyticus*), water probiotics (*Nitrosomonas* sp.) and soil probiotics in aquaculture system.

In the second invited lecture, Dr T. Jawahar Abraham, Professor at Department of Aquatic Animal Health Management, WBUAFS spoke on the topic 'Prudent use of antibiotics in aquaculture'. Three major causes of fish diseases are unsatisfactory aquatic environment, presence of pathogen in environment and low disease resistance power of fishes. If we prevent the entry of pathogen into farm ponds, then we can prevent occurrence of diseases and the use of chemicals and antibiotics will not be relevant at all. Preventive measures must be taken from Day-1 of culture, farm management practices must be properly recorded, prioritization on biosecurity measures both at hatchery and farm. Dr Abraham explained horizontal and vertical transmission ways of pathogenic microorganisms into aquatic system. The 'multiple stocking - multiple harvesting' method of fish farming is less advantageous, as it provides an opportunity for the microorganisms to enter into pond along with fish fingerlings (collected from more than one source) at different points of time. In fish farming sector, widespread use of antibiotics for treating bacterial diseases has led to development of antibiotic resistance in *Aeromonas hydrophila*, *A. salmonicida*, *Edwardsiella tarda*, *Vibrio anguillarum*, *V. salmonicida* and *Yersinia ruckeri*.

Dr Abraham mentioned that farming principles for carps, catfishes and other fishes are different (catfishes and major carps require 40% and 25% protein in feed for growth), and so too the fauna of pathogenic microorganisms affecting them. We were informed about scientific basis of withdrawal period of antibiotics from farmed fishes; which should be known before using the same. It is the time taken by body to break down the antibiotic until it is no longer present. Every one in 1×10^8 cells of bacteria gets mutated in natural environment, but, since recent past, this mutation rate has increased, which is now one in 1×10^6 cells. Microbes will increase in human body along with increase in antibiotic resistance in bacteria. In Norway, 887mg antibiotic was used to produce every 1kg of fish in 1987 but 0.4mg antibiotic was used to produce 1kg fish in 2014. Use of antibiotic has drastically decreased. In India, shrimp hatcheries use about 30kg chloramphenicol to produce every 30 million shrimp post-larvae. Dr Abraham emphasized on the key terms Good Hygienic Practices and Better Management Practices (BMP) to control the spread of antibiotic resistance in fish and shellfish pathogens.

In the third invited lecture, Dr Sanjib Kumar Manna, Principal Scientist, ICAR-CIFRI, Barrackpore spoke on the topic 'Present and future prospect of aqua-medicine in respect of aquaculture in West Bengal'. Dr Manna gave a thorough conception to audience about presence of 25-27 trillion cells in human body, 3-4 bacteria present over each of it (about 10 bacteria present over each body cell in weak persons), evolvement of mitochondria (in animal cell) and chloroplasts (in plant cell) from free-living bacteria small in size *via* symbiosis within a eukaryotic host cell. The bacterium smaller in size produce ATP for

the larger cell. Dr Manna spoke about importance of presence of fat and incorporation of fatty acids in supplementary feed meant for early stages of cultivable fishes, population of 10,000-1,00,000 bacteria in every 1ml water in aquatic environment, and the number increases in foul waters, bacterial load of 10^7 - 10^8 cells / gram of pond soil, significance of the activity of histone coiling of human chromosome so to repel most of the bacteria present over our cell membrane, increase of bacterial load in fish body cell by 100 times under stressful condition, application dosage of oxytetracycline (80mg/kg and 150-200mg/kg in feed for finfish and shrimp respectively, 500-1000mg requirement for every silkworm larva).

Due to increase in organic matter content in water body (*via* entry of domestic sewage, decomposition of unconsumed fish feed, huge stocking density), bacterial load in aquatic environment increases and consequently concentration of methane, ammonia and nitrite increase. We have to decrease bacterial load and enhance fish cell energetics, Dr Manna opined. ATP is produced across the inner membrane of bacteria (mitochondria absent) and they release ATP *via* flagella in order to survive under stressful condition. When organic matter is degraded by *Bacillus* group of bacteria, the end product formed is CO_2 or short carbon chains; not much NH_3 or NO_3^- is produced. *Nitrosomonas* group degrades NH_4^+ and NO_3^- ions. Dr Manna added that as a result of decrease in rate of body metabolism in fishes during winter (mucus thickness: 0.1 micronmt), mucus production-cum-secretion occurs at a low rate in comparison to summer months (mucus thickness: 1 micronmt). Glycopeptide present over fish skin mucus acts as first line of defense; this cease to exist in winter and body of fishes become less slimy. Secondary metabolites (as antibiotics) secreted by one bacteria becomes toxic to another bacteria.

Gut probiotic bacteria in fishes secrete bacteriocin, which inhibits proliferation of harmful bacteria. Pathogenic bacteria are not allowed to colonize over the inner gut/intestine wall, and are eliminated due to competition for space. Application of antibiotics *via* fish feed leads to destruction of mitochondria in fish body cells, thereby hampering fish cell energetics. In aquaculture, antibiotics are inferior to probiotics. It is necessary to use prebiotics (oligosaccharide group), which stimulate growth of beneficial bacteria. Fish farmers experience good profit margin initially, but profit/growth rate decrease in later years, disease incidences become frequent; it is due to decomposition of accumulated organic matter in pond system, pathogen load increase and bacteria infects fishes under culture year after year. About 30 essential nutrients (boron absent in fish) leach out from pond bottom and accumulate in fish body, but, in later years, due to increase in organic matter, leaching out of nutrients is restricted and thus its limitation in fish body is felt. Dr Manna explained all the concepts to audience.

In the fourth invited lecture, Dr Debasish Roy, Technical Officer, MPEDA Sub-Regional Centre, Contai, Purba Medinipur spoke on the topic 'Current and potential future hazards to public health of antibiotic usage in aquaculture'. He discussed elaborately on mandates of MPEDA, organizations working under the aegis of MPEDA, *viz*., NETFISH, RGCA and NaCSA. Dr Roy further spoke on marine products export from India highlighting authentic facts and figures, item-wise export during 2016-2017. He explained on the list of 20 *antibiotics* and pharmacologically active substances *banned* by MPEDA for use in aquaculture, spoke on issues of rejection of consignments of shrimp from importing countries on account of quality concerns in past years. He elaborated on shrimp consignment *rejections* on quality grounds due to *antibiotic* contaminants, heavy metals, microbial and *bacterial* residues since 2009-2010 till date. In 2016-'17, out of 80 consignments rejected from India, 24 were specified for antibiotic contamination; again out of these, 3 consignments were from Purba Medinipur of West Bengal.

Dr Roy explained the importance of pre-harvest test (PHT) of farmed shrimp, which was introduced to ensure the absence of banned antibiotic residues (that of nitrofuran metabolites and chloramphenicol) in aquaculture products before it is harvested. PHT is mandatory for export of all aquaculture products to EU countries. MPEDA has 19 ELISA laboratories, to test whether banned antibiotics is present in shrimp tissues in detectable limits. Chloramphenicol, furazolidone, neomycin, nalidixic acid, and sulphamethoxazole are banned, and no residues should be left in shrimp body. In the end, he opined that shrimp farmers must know what chemicals are present in the marketed aqua products, especially when those could have adverse effects on our health and environment. Ingredient composition must be listed on the product label. News communicator Subrato Ghosh participated in the entire programme attentively.

Fisheries Department to Push for Regional Boards

A high-level team of the Fisheries department will meet Commerce and Industry Minister Mr Suresh Prabhu soon to pursue the proposal for regional centres of the National Fisheries Development Board, the Central Aquaculture Authority (CAA) and the Central Institute of Brackishwater Aquaculture (CIBA), Chennai

Additional Director K. Seetaramaraju said on recently the appointment with the Ministry had been fixed for June end. "Proposals for the regional bodies have been sent and we are speeding up the exercise," he said at a press conference here. "The regional body of the CAA will help in preventing production of seed in unauthorised hatcheries while the CIBA regional body will address the woes in getting access to various fish species seed in the state itself," he said.

The department, in collaboration with the CIBA, would set up a hatchery for supply of the seed of the Asian Seabass and Sylla Serreta, at Pandurangapuram in Guntur district in July. Mr Seetaramaraju said Rs. 38 crore including Rs. 23 crore had been sanctioned for it.

Foundation Stone Laid for Phase IV of MPEDA's Aquatic Quarantine Facility

Expansion expected to boost Pacific White shrimp (L.vannamei) production by 3.5 L metric tonnes

Chennai, June 13: The Marine Products Export Development Authority (MPEDA) is poised to expand its Aquatic Quarantine Facility (AQF) for imported Pacific White Shrimp (*L. vannamei*) here in a move expected to increase shrimp farming production in the country by up to 3 to 3.5 lakh metric tonnes per annum and generate higher revenues from seafood exports.

From left to right: Dr K Gopal, IAS, Principal Secretary, Department of Animal Husbandry, Dairying and Fisheries, Government of Tamil Nadu, Mr Tarun Shridhar, Secretary, Department of Animal Husbandry, Dairying and Fisheries, Govt of India and Dr. A. Jayathilak IAS, Chairman, MPEDA, and President, RGCA, laying the foundation stone for the Phase IV of the AQF at Neelangarai in Chennai

Mr Tarun Shridhar, Secretary, Department of Animal Husbandry, Dairying and Fisheries, Govt of India laid the foundation stone for the Phase IV of the AQF at Neelangarai in Chennai today (Wednesday, June 13).

The AQF, which has been set up by the Rajiv Gandhi Centre of Aquaculture (RGCA), the Research & Development arm of the MPEDA, will have six cubicles, three receiving areas and one packing area including one fumigation room, at the extended facility. The additional capacity will help to quarantine up to 1,23,750 brooders per annum.

L. vannamei, also known as Whiteleg Shrimp or King Prawn, is an exotic species widely in demand in US, Europe and other global markets. Its broodstocks are imported mainly from the USA and the AQF at Neelankarai was set up in 2009 to facilitate a regulated mode of introduction of this non native species into India.

Shri Tarun Shridhar said that the Ministry of Agriculture has given funds to the AQF as part of the "Blue Revolution" to prioritize and promote aquaculture in India. He said it will help farming of *L.vannamei* in other potential states, like Gujarat, Odisha, Maharashtra and Kerala.

He also assured that all necessary assistance will be given to MPEDA and RGCA to achieve substantial growth in the production and export of seafoods from India.

Dr. A. Jayathilak IAS, Chairman, MPEDA, and President, RGCA, said the AQF has successfully quarantined more than 11 Lakh *L.vannamei* broodstocks so far, and the additional capacity will significantly strengthen the industry and shrimp exports.

He noted that marine exports from India are expected to touch an all time high of more than 6 billion US dollars, with volumes reaching a record 1.27 million tonnes. Newer initiatives in aquaculture, such as the AQF expansion, will be key to achieving the target of 10 billion US dollars from marine exports by 2022, he added.

Dr K Gopal, IAS, Principal Secretary, Department of Animal Husbandry, Dairying and Fisheries, Government of Tamil Nadu, assured full state support to the AQF.

MPEDA_Chennai 2: Mr Tarun Shridhar, Secretary, Department of Animal Husbandry, Dairying and Fisheries, Govt of India, Dr. A. Jayathilak IAS, Chairman, MPEDA, and President, RGCA, Dr K Gopal, IAS, Principal Secretary, Department of Animal Husbandry, Dairying and Fisheries, Government of Tamil Nadu, with senior officials at the foundation stone laying for the Phase IV of the AQF at Neelangarai in Chennai

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ICAR-DCFR, Bhimtal and Gaumco Society organized Farmers-Officers Scientists Interactive Meet at Ziro for Enhancing Fish Farmers Income

A Farmers-Officers-Scientist Interactive Meet was held at Hari village, Ziro valley of Lower Subansiri district of Arunachal Pradesh on 22nd March 2018 on "Fish farming and seed production in cold regions of Arunachal Pradesh". The programme was jointly organized by ICAR-Directorate of Coldwater Fisheries Research, Bhimtal, Uttarakhand and Gaumco Multipurpose Cooperative Society Pvt. Ltd, Lower Subansiri district, Arunachal Pradesh in association with Department of Fisheries, Govt. of Arunachal Pradesh. The objective of the meeting was to promote aquaculture and fisheries in hilly regions disseminating technical knowhow to achieve better productivity augmenting livelihood security. Altogether, 200 participants including farmers, officers, scientists and guests attended the programme. Welcoming the participants and delegates, Dr. Debajit Sarma, Director, ICARDCFR, Bhimtal briefed on the mandates of the institute and the objective of the programme to create awareness in making the state self sufficiency in fish seed production and expansion of diversified aquaculture practices in cold regions while incorporating new variety of fish into the farming system. He also emphasized that establishing a seed production unit is need of the hour since there is a scarcity of the quality seed in the region and the proposed seed production unit will help to fulfill the demand of the farmers. The programme was chaired by the Hon'ble Parliamentary Secretary Food and Civil Supplies Mr Er. Tage Taki as Chief Guest. He mentioned on the importance of adopting scientific farming practices for enhanced production of fish and crops in the region. The programme also witnessed the gracious presence of Mr Kemo Lollen, Deputy Commissioner, Lower Subansiri district, Govt. of Arunachal Pradesh as Guest of Honour. He emphasized on the need of a fish seed production unit in the region for achieving better results in the fish based activities by stakeholders. Mr Hage Kobin, Zilla Parishad Chairperson, Lower Subansiri district also took keen interest on the issues of the programme. He spoke on the introduction of profitable fish species in the region for doubling the income of fish farmers . Mr Er. Gyati Atto, Chaiman of Gaumco Multipurpose Cooperative Society Pvt. Ltd talked on the purpose and objectives of the society for creating opportunities and benefits for the rural farming community and stressed on taking the fish seed production as a true means for producing quality seeds for the farmers of the district and nearby areas. Scientists from ICAR-DCFR, Bhimtal Dr. Deepjyoti Baruah and Mr Parvaiz Ahmad Ganie explained and demonstrated the scientific methods of breeding different groups of fishes for seed production. Farmers representatives Mr Tilling Tadi, Mrs. Tylang Shanti and Mrs. Gyati Rinyo of the region also expressed their gratitude for the meet and expressed their satisfaction that such kind of programmes will benefit the farmers by learning knowledge and skills on fish culture and seed production. Mr James Nabam DFDO, Lower Subansiri district; Scientists from KVK Lower Subansiri Dr. A.N. Tripathi, Mr Girish Nainwal, Fishery Officers Mr Kago Tamang, Ms. Chigging Yadii Voda also participated in the programme and interacted with the farmers on the fish based schemes and plans for the district. Furthermore and most importantly, a Portable FRP Fish Hatchery was installed and inaugurated on the occasion by the Hon'ble Parliamentary Secretary Food and Civil Supplies Mr Er. Tage Taki in presence of other dignitaries at the premises of Mrs. Gyati Rinyo, an active member of Gaumco Society. The fish hatchery is of first kind to be established in the region with assistance from ICAR-DCFR, Bhimtal. In order to encourage the fish farmers, critical input in the form of quality fish seeds were distributed free of cost to the farmers for stocking in their rice-fish plots and culture tanks under the aegis of ICAR-DCFR, Bhimtal. The programme had a successful session of interaction among the participants where many questions raised by farmers were solved and feedback was received. Certificates were distributed to the farmers for their participation. Vote of thanks was offered by Mr Gyati Mali, Treasurer, Gaumco Society and Dr. Deepjyoti Baruah, ICAR-DCFR and Coordinator of the programme.

MPEDA to Launch State-Of-The-Art Aquaculture Complex at Kochi

The Marine Products Export Development Authority (MPEDA), which is headquartered here, is all set to launch its multi-species Aquaculture Complex here with an aim to revolutionize fish production in the country, an official said.

Spread over 8.5 acres, the facility will produce seeds/ fingerlings of about seven commercially important species, which have a high export demand, including tiger shrimp, Asian seabass, pompano, cobia, genetically improved farmed Tilapia (GIFT) and mud crab.

MPEDA Chairman A. Jayathilak said that the unique feature of the facility will be its tiger shrimp hatchery with a production capacity of 20 million disease-free high health seeds per annum.

This effort will revive the Black Tiger shrimp farming after a gap of two decades and will certainly bring about huge returns, as demand and price for good quality tiger shrimp is very high in the international markets, especially Japan and European Union," he said, noting that one of the major impediments while undertaking its farming is the lack of healthy, disease free seeds.

Serving as a model, the new facility at Kochi will pave way to establish similar facilities in other parts of the country.

The hatchery is designed in such a manner that depending on demand, the facility can be utilized for the seed production of other freshwater/marine fin fishes or shell fishes.

The entire bio-secured hatchery has all essential facilities such as reservoirs, water filtration unit, microalgae labs, artemia section, maturation section, larval rearing and post-larvae rearing units, and effluent treatment system. A quarantine unit to collect the disease-free wild brood stock will be established soon.

Natural Products from Seaweeds: CMFRI Scientist Wins Rafi Ahmed Kidwai Award

Kochi: Dr Kajal Chakraborty, Senior Scientist at the Central Marine Fisheries Research Institute (CMFRI) and Fellow of National Academy of Agricultural Sciences has won the most prestigious Rafi Ahmed Kidwai award for outstanding research in agricultural science instituted by the Indian Council of Agricultural Research (ICAR), New Delhi for the year 2017.

The award is in recognition of Dr Kajal'sresearch in the area of marine bioprospecting, especially in developing various nutraceutical products from seaweeds for different diseases. Basically an organic chemnist, Dr Kajal has developed nutraceuticals for arthritis, diabetesand cholesterol. All his inventions are patented by CMFRI and a few are out-licensed for commercial production.

The award includes an amount of Rs 5 lakh along with citation. Prime Minister Narendra Modi will present the award on the foundation day of ICAR on July 16.

Swachh Bharat Activities at CIFT

A programme on 'Hygienic fish vending' was conducted for the benefit of fisherwomen at Puducherry. Dr V. Geethalakshmi, Principal Scientist, explained the importance of maintaining cleanliness and personal hygiene during fish vending and the role of cleanliness in enhancing the price realized for fish. A video on hygienic fish handling was screened to a group of 58 fisherwomen who were selected by Fisheries Department, Puducherry for vending fish at Model Hygienic Market. On the occasion, Mr A. Vincent Rayar, Director, Fisheries Department, Govt. of Puducherry stressed the need for cleanliness at home and work place and advised the participants to follow the hygienic handling protocol advocated by ICAR-CIFT.

Awareness on cleanliness and personal hygiene to women fish vendors at Puducherry

Swachh Bharat Diwas at Aliyar reservoir region, Aliyar, Tamil Nadu

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In the Pink: Salmon Farmers' Investment in Fish Health Delivers real results

Investment in technology has delivered real results in improving salmon health

Scotland's two leading salmon farmers, Marine Harvest Scotland and Scottish Sea Farms, have reported a sustained improvement in fish health during the first five months of 2018 with a marked reduction in disease-related mortalities.

Figures for both salmon farmers show that the number of fish that died as a result of disease fell by over 50% between January and May compared with the previous six months.

Disease-related mortality is also lower year on year with Marine Harvest Scotland and Scottish Sea Farms reporting a reduction of 61% and 27% respectively compared with the first six months of 2017.

The sustained improvement comes as welcome news following a challenging year for some farms owing to warmer than average sea surface temperatures; a trend witnessed across most parts of the world's oceans and seas.

These warmer temperatures can encourage marine organisms to thrive where ordinarily they might not occur in abundance, posing threats to fish health in the form of harmful algal or jellyfish blooms, as experienced in 2017.

In response, both producers have invested in new technologies including environmental data monitoring equipment enabling real-time analysis of key markers such as salinity and oxygen concentration, helping farmers make swift and informed decisions, underwater camera systems enabling farmers to observe salmon within the pens and respond quickly to any changes in innate behaviour, and innovative new netting which, in initial pilots, has helped eliminate gill disease.

Changes have also been made to farm management strategies.

"Each individual farm effectively has its own micro-environment and therefore faces its own challenges. However, by taking a tailored approach to farm management that is based on the local marine ecosystem and has prevention at its core, we have been able to increase the protection offered to the salmon in our care," said veterinarian and Head of Fish Health at Marine Harvest Scotland, Meritxell Diez Padrisa.

Both producers are also investing in multi-million pound state-of-the-art hatcheries which will enable smolts – young salmon – to be grown to a larger, more robust size, thereby shortening their time at sea and lessening the chance of infection from other marine creatures.

Meanwhile, adding to the improvement in overall fish health, Marine Harvest Scotland and Scottish Sea Farms have seen significantly lower lice levels from January to May 2018.

In the case of Marine Harvest Scotland, sea lice levels were 49% lower compared with the previous six months, while Scottish Sea Farms were 34% lower.

"Colder temperatures witnessed over winter 2017 have some part to play in this reduction, helping slow the growth of sea lice," commented Ralph Bickerdike, head of Fish Health at Scottish Sea Farms.

"However, we're also seeing the cumulative impact of investment in integrated sea lice management including sea lice shields which reduce the number of lice entering salmon pens in the first place, use of cleaner fish which eat sea lice, and hydro and thermolicer technology which washes off and collects sea lice. The result of these efforts is that we're seeing some of our healthiest, strongest fish yet."

The results are equally encouraging across the sector as a whole, with Scottish Salmon Producers' Organisation figures showing that sea lice levels are at their lowest since July 2013.

Helping to ensure these positive trends in fish health are maintained will be the recently announced Scotland's 10 Year Farmed Fish Health Framework; a joint initiative between Scotland's salmon and trout farmers, the Scottish Government and several of its agencies which sets out a number of key measures for the sustainable growth of the sector – improving gill health and greater control of sea lice included.

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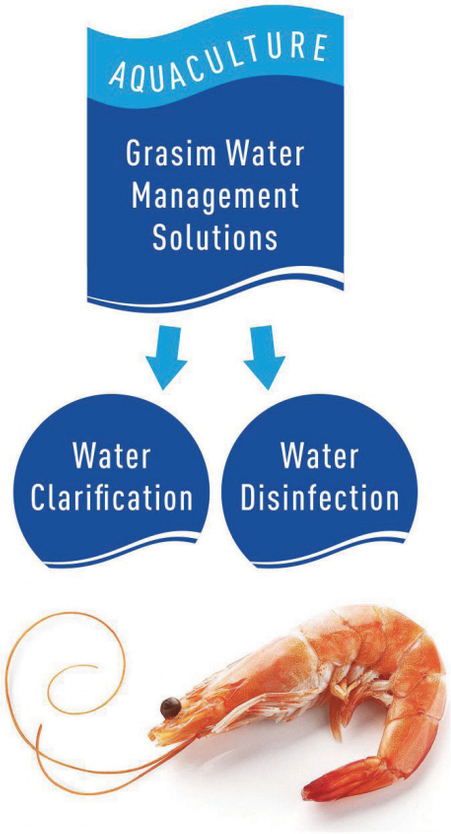

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Tinder launching its Feed Mill Machinery in India

"Tinder, one among China's Top 3 Feed Mill Machinery Manufacturers for Poultry, Aquaculture and Livestock Sector looking at Indian Market." We are top 3 among domestic feed mill machinery brands

Wang Guorong, Chairman of Tinder

Guangzhou Tinder Industry Co. Ltd, one of the top 5 Feed Mill machinery manufacturers for Aquaculture and Poultry in China are entering into Indian market. Aqua International Editor, Mr M. A. Nazeer visited Tinder Headquarters in Guangzhou in China recently and seen their various operations. The Editor had an exclusive interview with Mr Wang Guorong, Chairman of Tinder. Excerpts:

Aqua International: Please tell us something about your profile.

Wang Guorong: I am Mr Wang Guorong, the Chairman of Tinder. I was born in November 1963 in Ningxia, China and graduated from Lanzhou University of Technology. Now I live with my family in Guangzhou, Guangdong.

AI: When and how did you start your career?

Wang Guorong: My major (specialization) subject is Mechanical Design and Manufacturing and I was distributed to work in Lingnan Machinery factory that is a military enterprise after graduated in 1987. I started to learn feed mill machinery in that factory. In 1990, I resigned and worked in a deceleration machine factory in Guangzhou for three years. In 1993, I resigned and established my own company named CP Mechatronics Co. Ltd focusing on equipment installation. At that time, our company completed contract projects of 12 factories for CP.

AI: When did you start Tinder Industry? How is the acceptance of your products in poultry and aquaculture sectors?

Wang: In December 1995, Guangzhou Tinder Industry Co. Ltd was founded. We have 23 years of development history. In the beginning, Tinder started by manufacturing one single machine and today Tinder can provide whole turnkey project. In 2017, Tinder has sold 32 lines of poultry feed equipment and 17 lines of aqua extruded equipment, 6 lines of shrimp feed equipment.

"Tinder can provide whole turnkey project. In 2017, Tinder has sold 32 lines of poultry feed equipment and 17 lines of aqua extruded equipment, 6 lines of shrimp feed equipment."

AI: What is the size of your factory? Where do you have machineries manufacturing units?

Wang: Tinder Industry Co. Ltd located at Beixing Industrial Park, Huadu District, Guangzhou City, China with an area of 30,000 m^2. Tinder produces 80 to 100 lines of poultry and aqua feed equipment every year.

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Aqua International Editor M.A. Nazeer with Wang Guorong, Chairman of Tinder during the editor's visit to Tinder HQ in China recently.

AI: Where are you selling your machinery products in China and abroad?

Wang: The sales network of Tinder spreads throughout the country – China, and also reaches to Indonesia, Thailand, Vietnam, Bangladesh, Kazakstan and Cambodia.

AI: What are the products you manufacture for poultry, aquaculture, pig, dairy and other sectors?

Wang: The main aquatic feed machines are Pulverizer, Extruder, Dryer and Oil Coating machine. The main poultry feed machines are Hammer Mill, Mixer, Pellet Mill, Cooler and Grading sieve. Electric-controlled equipment is also our core product.

AI: Which are your most popular products among the machinery products you manufacture?

Wang: For poultry feed machines, a complete range of Hammer Mills are the best selling products with consistent quality and 5% more capacity than similar products of top domestic brands. For aquatic feed machines, Pulverizer, Extruder and Dryer are the top selling products. Pulverizer is of 30% more capacity than the same kind of famous domestic brand and wearing parts can be used longer time with good performance. Extruder has advanced technology and consistent quality with gearbox and screw bushing, which is of 20% more capacity than that of our competitor. Dryer is uniquely designed to ensure that steam consumption is 180 to 250 kilograms per ton feed and water uniformity ±0.75%. Therefore, these machines are our most popular products.

AI: What is the specialty of your products when you compare with other competitor companies?

Wang: It can be summarized into three aspects. Firstly, Tinder has a complete range of feed mill machinery to support factory construction. Secondly, Tinder has a strong R&D team with more than 60 machine patents and 5 computer-controlled software patents. Thirdly, Tinder produces machines in its factory that can decrease the cost to improve price performance. Tinder guarantees product quality and project quality with advanced equipment processing technology, integrated project contracting service and high-tech CNC system.

AI: How many feed mill machinery have you sold since inception of Tinder to poultry, shrimp, fish etc. sectors in China and other countries?

> *"For poultry feed machines, a complete range of Hammer Mills are the best selling products with consistent quality and 5% more capacity than similar products of top domestic brands. For aquatic feed machines, Pulverizer, Extruder and Dryer are the top selling products. Pulverizer is of 30% more capacity than the same kind of famous domestic brand and wearing parts can be used longer time with good performance."*

Wang Guorong, Chairman of Tinder talking cheerfully and humorously with visitors

Wang: Tinder has built up 620 factories and has provided more than 2000 lines of equipment sofar. In 2017, our sales turnover was RMB 400 million that is 63 million in US dollars.

AI: To maintain quality of feed mill machinery and projects, what are the measures you are taking under various stages at your factory?

Wang: There are four development stages of Tinder. In the first stage, Tinder contracted factory equipment installation and installed equipment of 12 feed mill factories for CP Group. Tinder adopted the standards of European and American enterprises and set up an installation system. In the second stage, Tinder researched international advanced technology and developed a series of machines for a complete processing line independently to meet the demand of domestic customers for domestic products. In the third stage, Tinder imported plasma cutting machines and adopted storey structure to satisfy biding requirement of CP Group and New Hope Group. In the fourth stage, Tinder imported laser cutting machines and CNC machine tool. Moreover, Tinder updated and standardized its technology that reached to Chinese top level

An outside view of Guangzhou Tinder Industry Co. Ltd in Guangzhou, China

and advanced world level with more than 60 product patents and electrical controlled technology patents.

AI: Technology and performance wise, how are your products?

Wang: Tinder produces advanced products. Pulverizer is of world-leading technology. Extruder, Dryer, Oil Coating Machine and Pellet Mill are also our core products. These products are of good quality, superior performance, high energy efficiency and long service life. Tinder adopted self-developed intelligent-controlled system TEC 3.1. It can support head office to formulate a recipes for all factories. Meanwhile, all factories submit reports to give feedback to head office. Thus the management of feed mill factories becomes normative, clear and dynamic.

AI: What are your plans for Indian market?

Wang: Indian market has great potential and Tinder attaches importance to it. There are three phases in our plans for Indian market. One is to find a good agent and make promotion. Tinder aims to improve brand popularity and the recognition of its machinery and technology through regularly participating in exhibitions, forums as well as giving interviews to magazines and making advertisement. Moreover, Tinder provides an integrated solution for feed mill project with sufficient knowledge of the requirements of Indian customers. Tinder serves to improve Indian feed industry development of poultry and aquaculture. Lastly, Tinder strives to improve marketing and service system and boost our sales with annual growth rate of 30% in India.

> *"Tinder has built up 620 factories and has provided more than 2000 lines of equipment. In 2017, our sales turnover was RMB 400 million that is 60 million in US dollars."*

AI: How do you see potentiality to your machinery products in India?

Wang: With the development of Indian economy, the demand for animal protein is greater than before and Indian market has huge market potential. Tinder can provide you a complete feed production line and its products are competitive for good overall performance and cost effective. Tinder will be a favourable feed mill machinery brand in Indian market.

AI: After sales service is the vital aspect particularly to capture Indian market. What are your plans in this aspect?

Wang: Tinder provides comprehensive sales service. For presale service, Tinder provides concrete and integrated solution as a guidance for customers to make decision wisely. For sales service, Tinder salesmen contact the customers not less than three times every month and solve the complaints by reporting feedback, making internal consultation and following up all the way. For after sale service, Tinder offers wearing parts solution every year and

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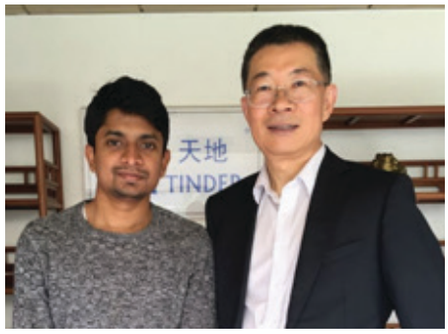
Wang Rongkai,
Chief Engineer, Tinder

Mr Wang Rongkai is the Chief Engineer of Tinder and Member of National Technical Committee on Feed Machinery of Standardization Administration of China.
He was committed to feed machinery design for 40 years and participated in setting national industry standards. Mr Wang got more than 20 patents for utility mode and won the third prize for machinery industry design.

local agent is responsible for daily maintenance service after signing a project. After sales equipment specialists go to feed mill factory to examine and repair machines every three months so as to guarantee the normal operation of equipment. In the event of severe malfunction, Tinder arranges service engineers in 24 hours after receipt of customer complaints and service engineers reach to feed mill factory within one week in principle depending on time for visa.

For any queries, please contact:

Guangzhou Tinder Industry Co. Ltd
Address: BeiXing Industrial Park, HuaDu District, GuangZhou, Guangdong, China
Tel : 086-20-86795688
Fax : 086-20-86795680
E-mail : tinder@tinderchina.com
Website: www.tinderchina.com



M.A. Nadeem, Country Manager - India for Tinder with the Chairman Wang Guorong.

Channing Ke,
General Manager, I.B.D, Tinder

Mr Channing Ke is the General Manager of I.B.D of Tinder. He graduated from Food Engineering School of Wuhan Polytechnic University. He once worked in one large feed machinery enterprise responsible for International marketing and management with rich experience of feed processing technology and international marketing. Mr Channing hopes to bring Tinder feed machinery to Indian customers and make contribution to Indian feed industry.

"Firstly, Tinder has a complete range of feed mill machinery to support factory construction. Secondly, Tinder has a strong R&D team with more than 60 machine patents and 5 computer-controlled software patents. Thirdly, Tinder produces machines in its factory that can decrease the cost to improve price performance."

Tinder Chairman to visit India on August 9

We, TINDER, are sponsoring and participating in Poultry CEOs Forum India & PF Awards 2018 to be held at Hyderabad, India on August 9, 2018. We are also going to make a power-point presentation about our company and our products in the Forum. We invite interested feed millers for a meeting and discussion with us during our stay in Hyderabad, India on August 9.

– Wang Guorong, Chairman of Tinder

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Pineal Organ Melatonin as a Potent Photo Neuroendocrine Regulator of Seasonal Reproduction in Fish

S. Selvaraj*, N. Jayakumar, R. Durairaja, B. Ahilan and S. Felix
Fisheries College and Research Institute, Tamil Nadu Dr. J. Jayalalithaa Fisheries University
Ponneri, Thiruvallur, Tamil Nadu

Introduction

Seasonal reproduction in fish is controlled by an endogenous rhythm or clock whose periodicity is circannual and the periodicity of this circadian clock is entrained by the seasonal changes in daylength. Circadian clock is reset on a daily basis by environmental changes, primarily an input light, to ensure synchronization of endogenous rhythms with the 24-hour solar day (Wayne, 2001; Falcón et al., 2010; Strauss and Dircksen, 2010). One major output of the circadian clock is the rhythmic synthesis and secretion of the pineal organ melatonin, which constitutes an essential component of the circadian timing system (Ben-Moshe et al., 2014). Melatonin is involved in diverse functions, including seasonal reproductive cycle, gonadal physiology, neuroprotective, anti-inflammatory, pain-modulating, blood pressure reducing, retinal, vascular, osteoblast differentiation, anti-tumor and antioxidant effects (Emet et al., 2016). The pineal organ of fish is differentially sensitive to environmental light intensity, and photoneuroendocrine cells secrete melatonin in response to light. Pineal organ melatonin influences different elements of reproductive axis to regulate pubertal onset and seasonal gonadal growth and maturation events. In mammals, the photic information is perceived through the eyes and conveyed, through a retino-hypothalalamic tract, to the suprachiasmatic nuclei of the hypothalamus, where the master clocks reside; from there, a multisynaptic pathway connects the suprachiasmatic nuclei to the pineal organ, the melatonin producing unit (Boutin et al., 2005; Falcon et al., 2009, 2010). In contrast, the circadian system in fish is organized as a network of more or less tightly interconnected circadian units and the pineal organ occupy a major central position in this circadian organization (Falcón et al., 2007, 2009, 2010). Moreover, lunar, semilunar, and tidal cycles of moon-related periodicities also play an important role in fish reproduction (Takemura et al., 2010; Ikegami et al., 2015).

Morphology of pineal organ

Pineal organ appears as an end vesicle attached to the roof of diencephalon by a slender stalk (Falcon et al., 2007, 2009). In adult fish, the end vesicle appears below the skull and covers the whole cerebral hemispheres and olfactory bulbs. The pineal epithelium lacks a blood-brain barrier and exposed to the haemal environment in its basal part (Ekström and Meissl, 1997; Falcón et al., 2007, 2010). Lumen of the pineal organ communicates with the third ventricle of the brain. The three main cell types that make the pineal epithelium are pinealocytes or photoreceptors, glial or interstial or supporting, and ganglion type cells. Photoreceptor cells are photosensitive, containing photopigments and secretory producing chemical substances, which undergo morphological changes in response changes in light (Falcón et al., 2010). Fish pineal gland record gradual light intensity changes rather than the rapid changes and morphologically, photoreceptor cells have similarities with cone photoreceptors of the retina. Glial cells create diffusion barriers between the extracellular fluid and the cerebrospinal fluid in the lumen. Ganglion cells are intrapineal and most of them send axonal projections to the brain regions. This is the major neuronal information way to the brain (Ekström and Meissl, 1997; Falcon et al., 2007, 2009). Photoreceptors release excitatory neurotransmitter at the synaptic junctions with the ganglion cells. Ganglion cells in turn, immediately transmit the information to different brain centers. Melatonin is produced at night by the photoreceptors and released into the cerebrospinal fluid and blood (Falcon et al., 2007, 2010). Melatonin represents a key hormone of the pineal circadian clock that synchronizes functions and behaviors to external cue variations such as photoperiod and temperature. The pineal gland has also been shown to be involved in the regulation of vertebrate temperature (Ralph et al., 1979a,b; Kavaliers, 1982).

Melatonin biosynthesis by pineal photoreceptor cells

The melatonin biosynthesis in pineal photoreceptor cells involves four enzymatic stages: tryptophan hydroxylase catalyzes the conversion of tryptophan into 5-hydroxytryptophan; 5-hydroxytryptophan is decarboxylated by the aromatic aminoacid decarboxylase to produce serotonin; the arylalkylamine *N*-acetyltransferase converts serotonin to *N*-acetylserotonin; *N*-acetylserotonin is *O*-methylated by the action

Highlight Points

- Pineal organ melatonin transmits photoperiod information to the neuroendocrine system
- Annual changes in melatonin levels drive the seasonal reproductive cycle in fish
- Synthetic melatonin agonists and antagonists can be used to manipulate reproduction in captive fish
- Melatonin function is conserved in finfish and shellfish

of the hydroxyindole-*O*-methyltransferase to produce melatonin (Klein *et al.*, 1997; Falcón *et al.*, 2007). Melatonin is highly lipophylic, and crosses the cell membrane easily. In the teleost fish, pineal melatonin is released into the blood stream and cerebrospinal fluid in the third ventricle region of the brain, as soon as it is synthesized (Falcón *et al.*, 2009). In the pineal organ of vertebrates including fish, melatonin levels and the arylalkylamine *N*-acetyltransferase activity serve as an index of melatonin synthesis, show clear daily patterns peaking at night (Reiter, 1993). Melatonin acts through G-protein coupled receptors. Melatonin shows its affects through four pathways: binding to melatonin receptors in plasma membrane; binding to intracellular proteins such as calmoduline, calreticulin and tubulin; binding to orphan nuclear hormone receptors and an antioxidant effect (Emet et al., 2016). Besides the pineal photoreceptor cells, melatonin synthesis has also been found in other tissues like the retina, brain regions, and peripheral organs such as gut, gonads, lung, spleen, etc., which do not contribute significantly to blood melatonin levels but shown to be of local importance (Huether, 1999; Falcón et al., 2007, 2010). In most finfish species, melatonin circadian rhythms were outlined with peaks during the dark period and the rhythm synchronizes to the 24 h light-dark cycle (Klein, 2007). However, in shellfish, different pattern has been demonstrated (Abran et al., 1994).

Role of melatonin in seasonal reproduction in finfish and shellfish

Several experimental studies demonstrated that the pineal gland and/or melatonin control seasonal reproduction in finfish (Bromage et al., 2001; Bayarri et al., 2004; Francis et al., 2004; Maitra et al., 2005). The effects of pinealectomy on gonadal activity shown to vary with photoperiod and/or season and pinealectomy promoted a daily cycle in serum gonadotropin levels in the goldfish, kept under short photoperiod (De Vlamming and Jo Vodicnik, 1978; Hontela and Peter, 1980). In an Indian catfish, pinealectomy accelerated ovarian recrudescence and vitellogenin synthesis, under short photoperiod (Garg, 1988). Pinealectomy in Asian catfish increased the glandular level of the thyroid hormones and stimulated vitellogenesis during preparatory and prespawning periods with no significant effect during spawning and post-spawning periods (Nayak and Singh, 1987; Ghosh and Nath, 2005). In Atlantic salmon, pinealectomy abolished the natural nocturnal rise in melatonin and did not influence the incidence or timing of early sexual maturation in the male parr (Mayer, 2000). Several other functional studies in other fish clearly indicate that pineal gland entrains photoperiodic information and regulate seasonal reproduction in finfish (Cowan et al., 2017).

Effects of melatonin on seasonal reproduction in fish depend on the photoperiod, duration of exposure to melatonin, and the site of melatonin synthesis. In carps, it is well demonstrated that melatonin plays a major role in the seasonal gonadal development and maturation. Chattoraj et al. (2005) for the first time demonstrated that prior incubation of rohu oocytes with melatonin accelerates the action of maturation inducing hormone on final oocyte maturation. Subsequently, Chattoraj et al. (2008) reported that serotonin is involved in modulating the action of melatonin on the final oocyte maturation in carp. Spotted snakehead exposed to melatonin water daily for 24 h had more vitellogenic follicles and fewer atretic follicles, in comparison to untreated control (Renuka and Joshi, 2010). Exogenous melatonin suppressed specific growth rate, gonadosomatic index, ovarian cellular activity, protein and lipid biosynthesis, in Nile tilapia (Singh et al., 2012). A daily and seasonal rhythm feature of hepatic melatonin was demonstrated in carp, suggesting their temporal relationship with the functions of ovary in Catla (Hasan et al., 2016). In catla, exogenous melatonin treatment accelerated oocyte growth in the preparatory phase but retarded in the prespawning and spawning phases of annual reproductive cycle, suggesting ovarian stage dependent response to melatonin (Mondal et al., 2017). In the grass puffer that exhibit lunar synchronized spawning activity, seasonal and daily oscillation of reproductive genes kisspeptin, gonadotropin-inhibiting hormone and their receptors in the diencephalon shown to be regulated by melatonin, circadian clock and water temperature (Ando et al., 2018). Serotonin, catecholamines, glucocorticoids, mineralocorticoids, and steroid hormones have been shown to modulate melatonin production in fish pineal gland (Pavlidis et al., 1999; Yanthan and Gupta, 2007; Nikaio et al., 2010; Emet et al., 2016).

Shellfish are also known to use the photoperiod as a temporal cue to initiate reproduction. Reproductive cycles of adult crustaceans are significantly influenced by moulting process (Adiyodi and Adiyodi, 1970; Nagaraju, 2011). Evidence for the presence of melatonin in crustaceans is demonstrated in several species (Sainath et al., 2013). Melatonin has been observed in the hemolymph, eyestalks, optic lobe and nervous system of crustaceans like black tiger shrimp, freshwater prawn, fiddler crab and the lobster (Withyachumnarnkul et al., 1992, 1995; Tilden et al., 1997; Aguzzi et al., 2009). Functional studies on the distribution of melatonin receptors in crustaceans indicate conservation in the function of melatonin as that of finfish, including circadian rhythms and reproduction (Sainath and Reddy, 2010; Strauss and Dircksen, 2010; Sainath et al., 2013). Like finfish, melatonin contents also exhibit diurnal variations in some crustaceans, with levels high during daytime and low during nighttime (Withyachumnarnkul et al., 1992, 1995; Tilden et al., 1997; Aguzzi et al., 2009). Recently, it was demonstrated that the melatonin in haemolymph and optic lobes of of Chinese mitten crab and Chinese grass shrimp exhibit circadian rhythms (Han et al., 2018). A diverse function for melatonin, including cheliped regeneration, digestive enzyme function, and immunity following autotomy in the Chinese mitten crab have been demonstrated (Zhang et al., 2018). Limited studies indicate that the melatonin also influences reproductive axis of crustaceans, regulating seasonal reproduction. Administration of melatonin found to induce precocious vitellogenesis in the fresh water edible crab (Sainath and Reddy, 2010). Likewise, in the giant mud crab, melatonin induced ecdysteroidogenesis, methyl farnesoate synthesis and expression of ecdysteroid receptor and retinoid X receptor in the hepatopancreas and ovary (Girish et al., 2015).

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In molluscs, eyes act as both a photoreceptor and source of a melatonin that provide the link between photoperiod and the reproductive axis, regulating seasonal reproduction (Wayne, 2001). Hecht (1927) found that the photoreceptors in a marine bivalve mollusc (common piddock) are located in the siphon and exposed parts of the mantle and these structures are sensitive to light. Melatonin precursors are localized in the nervous system and peripheral organs, including gonads and indicated to regulate seasonal reproduction in bivalve mollusks (Alavi et al., 2017). In a gastropod mollusk (sea slug), melatonin is secreted in a rhythmic pattern with levels elevated during the day, and low during the night (Abran et al., 1994). In a garden snail, melatonin concentration peaked at the end of the night in cerebroid ganglion (Blanc et al., 2003). Recent transcriptome survey of phototransduction and clock genes in marine bivalve molluscs indicated conservation of the timekeeping mechanism like finfish and crustaceans, reported previously (Sun et al., 2016). Few studied reported melatonin in cephalopod molluscs and levels found to peak during the dark period (Munoz et al., 2011). Melatonin has been detected in relatively high concentration in the retina of cuttlefish (Vivien-Roe¨ls and Pe´vet, 1986). In an octopod, marked daily rhythms have been observed and found to affect gonadal maturation and spawning (Sousa Reis, 1989; Brown et al., 2006). Munoz et al. (2011) suggested that melatonin might play an important role in the transduction of the light–dark cycle information for adjustment of rhythmic physiological events in cephalopods through altering the levels of melatonin precursors.

Melatonin agonists and antagonists

Two melatonin receptor subtypes have been demonstrated in mammals, and an additional subtype has been found in birds, amphibians, and fish (Reppert et al., 1995; Vanecek, 1998). Melatonin, acting through melatonin receptors inhibits dopamine release, and this bioassay is widely used to analyze the potency of different agonists and antagonists. Several studies reported that melatonin has high affinity for receptor subtypes types. Behrens et al. (2000) evaluated the effect of melatonin agonist (N-acetyl-4-aminomethyl-6-methoxy-9-methyl-1,2,3,4-tetrahydrocarbazole) and antagonist (N-pentanoyl 2-benzyltryptamine) on horizontal cell spinule formation and dopamine release in a goldfish fish retina and found that the dopamine agonist induced a twofold increase in dopamine release and the antagonist prevented light-induced spinule formation, and reduced dopamine release to below dark-adaptive baseline levels. Melatonin agonists, N-acetyl-4-aminomethyl-6-methoxy-9-methyl-1,2,3,4 tetrahydrocarbazole and N-butanoyl-2-(2-methoxy-6H-isoindolo[2,1-a]indole-11-yl)ethanamine accelerated zebrafish development; however, melatonin antagonists, luzindole and N-butanoyl-2-(5,6,7-trihydro-11-methoxybenzo[3,4]cyclohept[2,1-a]indol-13-yl)ethanamine, blocked the effect of melatonin on zebrafish development (Danilova et al., 2004). Melatonin analogue, 2-iodomelatonin is more potent, with affinities of 40 pM and 180 pM for melatonin receptor subtype 1 and melatonin receptor subtype 2, respectively. In addition, several chemicals with affinity for the melatonin receptors with differing potencies have been reported by Boutin et al. (2005). Pharmacological evaluation of different synthetic agonist and antagonists is reviewed in Dubocovich et al. (2010). The use of melatonin agonists such as ramelteon, agomelatine, circadin, N-[(2R)-2-(6-chloro-5-methoxy-1h-indol-3yl)propyl]acetamide and tasimelteon and their application for in-vitro and in-vivo studies have been detailed by Emet et al. (2016). Several of the melatonin agonists and antagonists listed above are commercially available in the market and can be manipulated with major hormones administered for induced breeding depending on the type of reproductive dysfunction exhibited by cultured fish.

Conclusion

Recent studies in fish indicate a possible link between kisspeptin, gonadotropin-inhibiting hormone and other neuropeptides, acting as central mediator of photoperiod regulation in seasonal reproduction in fish. In the male European seabass, melatonin elicited seasonal changes in key reproductive hormones that affected testicular maturity; however, there was no clear effect of pinealectomy on the expression of genes encoding kisspeptin and GnRH systems (Alvarado et al., 2015; Cowan et al., 2017). Melatonin inhibited gonadotropin-inhibiting hormone expression in the reproductive axis of zebrafish, in response to photic environment (Yumnamcha et al., 2017). Interestingly, photoperiod shown to regulate gonad development in Atlantic salmon via kisspeptin systems in hypothalamus and saccus vasculosus (Chi et al., 2017). Recently, species-specific melatonin rhythms have been found in the crustaceans and molluscs (Han et al., 2018). Emerging studies in teleosts indicate the production of neurosteroids in the pineal organ through the activation of steroidogenic enzyme pathway locally, suggesting complexity in the regulation of seasonal reproduction in fish (Tsutsui et al., 2017). Further research in fish is required to confirm the possible link between melatonin and newly emerging players like neurosteroids and neuropeptides in controlling seasonal reproduction. Overall, melatonin and related drugs are a new and promising era for fish medicine.

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

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Induced Breeding: A Revolutionising Step Towards the Fish Boom in India

Pravati Kishan[1], Shubham Varshney[1]*, Resmarani Mohanty[2]
[1]Central Institute of Fisheries Education, Mumbai
College of Fisheries OUAT, Rangeilunda Berhampur-7, Odisha

Introduction

Carps and other cyprinids contribute the largest share in the total world aquaculture production. India is the second largest producer in the world aquaculture, behind to China. Since 1980s inland fish production in India has increased at a higher rate. Various species of freshwater fish belongs to the family Cyprinidae is commonly known as carp, native to Europe and Asia. Due to their consumer preference and suitable climate for its growth, these fishes are extensively cultivated in most of the Asian countries. Cyprinids include a wide variety of carp species, represent a cheap source of protein. Catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*cirrhinus mrigala*) are referred to as Indian major carps(IMCS) because they are native to the Indo-Gangetic riverine system of India. Major carps whose are native to the riverine system of China are called Chinese carps and which include the species such as silvercarp (*Hypopthamichthysmolitrix*), grasscarp (*ctenopharyngodonidella*), Common carp (*Cyprinus carpio*) etc. India is called as the "carp country" because of carps are the mainstay in Indian aquaculture. All the major carps mentioned above are seasonal, riverine spawner except common carp, which are biannual spawners and also breed in confined waters.

Induced Breeding

In general, many economically important fishes don't breed in confined or captive condition so there is a technique called induced breeding through which fishes are bred by artificial stimulation. Induced breeding is a technique to breed ripe fish breeders in captive condition inducing by administration of pituitary hormone or any other synthetic hormone. This stimulation techniquepromotes the ripe gonads to release ripe egg and sperm timely. The active factors like LH and FSH are present in fish pituitary which plays important role in final maturation and release of egg and sperm to water for fertilization.

History of Indued Breeding

The technique of inducing breeding was first developed by B.A Houssay of Argentina in 1930 who injected the fresh pituitary gland extract collected from a fish to a viviparous fish that resulted in the premature birth of young ones. Following this Brazil was the first country to develop Hypophysation technique (stimulation of breeding by administration of pituitary gland extract) on a commercial scale. In India, the first attempt to induce breeding of *C.mrigala* by the injection of the mammalian pituitary extract was done by Khan(1937). Later Chaudhuri(1955)succeeded in inducing breeding of *Esomus dandricus* and Pseudotropius with pituitary gland of catla and *C.reba* respectively. Chaudhuri and Alikunhi (1957) successfully induced *Labeo rohita, C.mrigala,C. reba,L.bata* and *Puntius sarana* to spawn with carp pituitary. Parameswaran & Alikuni successfully bred the exotic Chinese carps – *Hypophthalmichthysmolitrix*&*Ctenopharyngodonidella* in 1963.

Why Fishes do not Breed in Captivity?

Due to lack of environmental stimuli and consequently hormonalmany farm fishes(IMCS) don't breed in confined or captive condition. The environmental stimuli are changes in photoperiod, temperature, rainfall, and food availability triggers the ovulation and spawning process in fish. Different types of sensory receptors present are in the fish body which detects the environmental stimuli, including the eye, pineal gland, olfactory organs, taste buds, and thermoreceptors. Without environmental cues, endocrine control can't continue. The hypothalamus, located at the base of the brain, is sensitive to signals from sensory receptors and releases hormones in response to environmental cues. Environmental stimuli translated by the brain into neuronal signals which result in the release of GnRH and inhibition of release of gonadotropin release inhibiting factor (GnRIF) causing the pituitary to secrete gonadotropins (GTHs). These two hormones are required for breeding in fish. So, in the captive condition lack of appropriate environmental stimuli causes the disturbance inbreeding process. In captive condition, the IMC secrets the dopamine hormone which has the inhibitory effect on secretion of gonadotropin-releasing hormone (GnRH). Other factors also affect the maturation of ovary are poor nutritional food and insufficient natural food, exposure to pollutants etc.

Fish Pituitary Gland

The pituitary gland is an endocrine gland situated on the ventral side of the brain. It is small, soft, whitish body whose size and shape vary with species. It is more or less round in carps, oval shaped in catla and rohu and pear-shaped in mrigal. The pituitary is located in a concave cavity

Highlight Points:

India is called as the "carp country" because of carps are the mainstay in Indian aquaculture. These carps do not breed in confined condition. In India, the first attempt to induce breeding was done by khan(1937) on C.mrigala.

known as Sella turica and enclosed by a thin membrane called durameter.It may be attached to the brain by a short stalk called infundibular stalk. The carps pituitary is attached to the brain by infundibular stalk so it is a leptobasic type. The fish pituitary gland secretes a number of hormones which control the physiological mechanism in the fish body. Gonad stimulating hormones (FSH and LH) are the most important hormone which takes part in stimulation and maturation of the gonads and induces spawning in fishes.

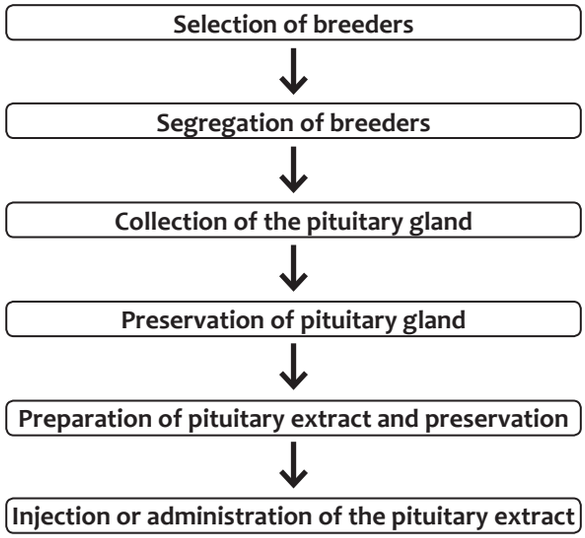
Hypophysation Technique

The technique of induction of spawning by administration of pituitary gland extract is called hypophysation technique. First success in the induced breeding of Indian major carps by injections of fish pituitary hormones in the year 1957 by Alikunhi, for commercial production of carp seed and improve breeding systematic trails were done and standardized the technique.

Mechanism of Induced Breeding

In induced breeding hormone administration is the common method, in which the pituitary gland extract is injected into the ripe spawners both male and female to force them to release sperm and eggs respectively. Induced spawning depends upon the dosage of injection, the stage of maturation of fish gonad and environmental factors like temperature, water currents and rain etc.

Steps of the induced breeding mechanism



1. Selectionof breeders

It is a very important aspect of induced breeding. The breeding fishes should be healthy, fully ripe and of medium size. These are collected from natural grounds or farm reared stock from different hatcheries. This prevents inbreeding depression. The age group of breeders should be ranging from 2-4 years and have a weight averaging 1-5kg are preferable for breeding. Overaged fishes (over 5 years) are not advisable to recruit. For breeding work, professional breeders have been proved better (Gupta, S.D.*et al*,1995). The stocking density is maintained at 1000kg per hectare area (e.g. carps) in a stocking pond. From stocking pond, the suitably aged breeders are selected and transferred to fertilization pond. The fully ripe male is easily distinguishable by roughness on pectoral fin and milt freely oozes out when its belly is pressed. Similarly, the ripe female is distinguished by relatively soft, round and bulging belly and its vent is swollen, protruding and pinkish in colour.

2. Segregation of breeders

To get a higher percentage of fertilization during induced spawning, it is necessary to synchronize between shedding of gonads i.e., the release of sperm and egg takes place at the same time.Suitable male and female fishes are stocked, reared and raised in two separated ponds to avoid undesirable breeding. Feeding can be done with equal quantities of rice bran and oil cakes at the rate of 1% of the body weight once daily.Disease preventive measures taken were Injured fishes are treated with 20% $KMNO_4$ solution, to avoid the bacterial growth, protozoan parasites and the fungi, the breeders are treated with 10 ppm of $KMNO_4$ solution for an hour and 1 ppm acriflavine for another 5-12 hours, in separate pools. Regularly monitored thephysio-chemical and biological conditions of water. Breeders are weighed and calculated the dose of pituitary gland extract is to be given later, prior to spawning.

3. Collection of the pituitary gland-

The pituitary gland is usually collected from freshly killed or ice preserved fully mature and healthy donor fish. The pituitary can be from same fish species or from a phylogenetically related species. Pituitary collected from either male or female fish can be used and equally effective. Among carps common carp(C.carpio) is most preferred donor fish due to the availability of mature fish round the year.May to July months, most suitable time in India for the collection of pituitary glands of major carps.

The pituitary gland can be collected from a donor by any one of the following two methods.

a) Open brain cavity through the foramen magnum.

b) By dissecting and cutting through the dorsal side of the skull.

4. Preservation of pituitary gland-

Pituitary gland can be used immediately after collection in fresh condition or it is preserved and stored for future use.

a) Preservation in absolute alcohol-

The freshly collected pituitary from donor fish is preserved in absolute alcohol in the marked amber coloured phial. After 24 hours, the alcohol is changed and the phials are kept at room temperature with a shelf life up to 1 year or in the refrigerator with an increased shelf life up to 2-3 years. The absolute alcohol should be changed occasionally because it helps in DE fattening and dehydrates the glands preserved in better condition for a long time.

b) Preservation in acetone-

The fresh gland is put in fresh acetone or in a dry ice chilled acetone and kept in a refrigerator for 36-48 hours in which acetone is changed after every 12 hrs. It can be preserved for 6-12 months.

5. Preparation of pituitary gland extract-

The Extract of the pituitary gland is usually prepared just before injection. A known amount of gland is taken by

estimating the total quantity of to be breed then gland is air dried using blotting paper and weighed. The gland is taken in tissue homogenizer with a little amount of distilled water or 0.3% saline solution. Dilution rate is 0.2ml/kg of body weight of the fish. The pituitary extract is then centrifuged and only the supernatant solution is used for injection.

6.Preservation of pituitary gland extract-

Preservation is done in Glycerine and kept in the refrigerator for 24 hours or in propylene glycol and kept in the refrigerator for 30 days.

7. Injection or administration of pituitary extract-

The injection of pituitary gland extract is done either intramuscularly or interperitoneally.

a) Intramuscular injection is given through either on the dorsal part of caudal peduncle or in the dorsal muscle above lateral line and below the anterior part of dorsal fin. It is commonly practised in India and it is less risky compared to other methods.

b) Interperitoneally injection is given through the ventral part of fish behind either the base of the pelvic or pectoral fin. It may cause damage to internal organs in fully mature fish.

Types of injection

Homoplastic injection: In this type of injection the pituitary gland is collected from same species or closely related species to receiver species. E.g. carp pituitary gland extract to carps.

Heteroplastic injection: In this type of injection both donor and receiver fishes are distantly related to each other. E.g. catfish pituitary gland extract to carp and vice versa.

The dose of injections-

A. Female-

- 2 doses of pituitary gland injection
- First dose (initial or preparatory or priming dose) =2-3mg/kg Bodyweight
- After 4-6 hours interval, a second dose (final or resolving dose) is given=5-8mg/kg body weight

B. Male-

- An only single dose is given 2-3mg/kg body weight at the time of the second dose of a female.

8. Spawning-

Spawning is usually carried out in traditional breeding hapas. To attain successful induced breeding, 1 female to 2 males put together in breeding hapas is advisable for breeding. Breeding hapas is a rectangular box-shaped structure stitched out of fine-meshed mosquito net cloth or nylon cloth. The sizeof hapa varies from 3.5x1.5x1m to 1.8x0.9x0.9m for 3-5kg weighing breeders. Hatching hapas have average measurements of 2 x1 x 1 m(mesh size-0.5mm) for the outer hapa and 1.75 x 0.75 x 0.5 m (mesh size-2-2.5mm) for the inner one in figure 2. Four bamboo poles are fixed in the water column at both upper and bottom corners. The height of the hapa should be 10-20cm of the upper surface above water and the upper surface of hapa is opening at one end which can be closed by a flap of the net. The spawning process is taking place after 3-6hour of hypophysation technique. If the injection is given in evening time then spawning occurred in the midnight. The fertilized eggs are transparent pearl like which are collected during morning hours whereas unfertilized eggs are opaque or whitish.

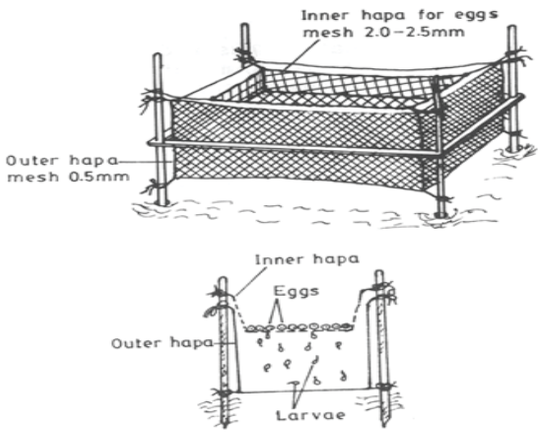


Fig. 2. Breeding hapa and hatching hapa used in India (After Woynarovich and Horvath, 1980)

Factors affecting Spawning in Induced Breeding

I. Temperature varies-24 C-37C, optimum temperature-27C Chaudhary, (1968)

II. Water – Flowing water is preferred.

III. Turbidity – 100ppm 1000ppm.

IV. The rain-in absence of rain artificial water showers is provided.

V. Dissolved oxygen (DO_2)- 5 to 6 ppm

VI. Climate- cool and cloudy weather attracts fishes.

Use of Synthetic Hormones in Induced Breeding of Fishes

After the introduction of hypophysation technique other several synthetic inducing agents are used to achieve 100% perfection in spawning. Some of the inducing agents described below which are used presently in aquaculture-

1.Human Chorionic Gonadotropin (HCG)

HCG is a glycoprotein hormone produced from the placenta during the pregnancy. When this hormone is injected to mature fish, this caused the maturation and release of gametes. Generally, HCG is injected alone doesn't give good results, but when it combines with pituitary gland extract is effective. For human chorionic gonadotropin, doses vary from 45 IU/ kg to 12500 IU/kg again depending on the species. HCG is cheap compared to pituitary extract and has a long shelf life. The product is ground in distilled water (2mg in 0.2ml) and centrifuged. The supernatant is used as an injection.

2.Synahorin

Synahorin,(a mixture of HCG and mammalian anterior pituitary extract) has been found to be successful in the induced spawning of Labeo rohita at the rate of 25 rabbit units/ kg after priming with 2-4 mg /kg of carp pituitary extract.

3 Ovaprim

Dr Lin of China and Dr Peter of Canada developed a technology (inducing agent) for inducing the breeding of fish, it is an analogue of LHRH combined with a dopamine antagonist called ovaprim. The ovaprim ismanufactured inM/s

Syndel Laboratories Limited, Canada and in India marketed by Glaxo India Ltd., Bombay. Ovaprim consists of GnRH-a anddomperidone which is a dopamineantagonist. Ovaprim contains 20µg of salmon GnRH and 10mg of domperidone per millilitre. Rates of fertilization and hatching are higher and size of eggs after water hardening always considerably bigger in Ovaprim treated fish with hatchlings obtained healthier as compared to pituitary gland extract. However, a major disadvantage in the use of Ovaprim is its high viscosity, which causes difficulty in injection and also high cost.

4.Ovatide

Hemmo Pharma, Mumbai (India's only manufacturing company which has indigenously developed Ovatide® (sGnRH) for Fish Spawning. Its Composition is sGnRH analogue with dopamine antagonist pimozide. Application of Ovatide is the most modern and advanced technology for spawning of fish at low cost. Fishes injected with Ovatide achieved complete spawning with high fertilization and high hatching percentage. The viscosity of Ovatide is low, so it easily injectable. Administrated in a signal dose is also effective on broodfish without showing any side effects after injection.

Name	Pituitary Extract (ml/kg)		Ovatide (ml/kg)		Ovaprim (ml/kg)	
	Male	Female	Male	Female	Male	Female
Catla (*Catlacatla*)	0.30-0.60	0.20-0.40(I) 0.40-0.80(II)	0.20-0.30	0.40-0.50	0.10-0.20	0.40-0.50
Rohu (*Labeorohita*)	0.30-0.60	0.20-0.40(I) 0.40-0.80(II)	0.10-0.20	0.20-0.40	0.10-0.20	0.30-0.40
Mrigal (*Cirrhinusmrigala*)	0.30-0.60	0.20-0.40(I) 0.40-0.80(II)	0.10-0.20	0.20-0.40	0.10-0.20	0.25-0.30

5. WOVA-FHTM

Wockhardt, one of the largest pharmaceutical companies in India developed the drug WOVA-FHTM. Its composition is Gonadotropin-releasing hormone analogue (SGnRH). For induced breeding in carp and catfish WOVA-FHTM synthetic agent can be used.

6. Ovapel -

Ovapel is developed by University of Godollo in Hungary. It is composed of mammalian GnRH analogue and dopamine receptor antagonist and Lactosum Carriers. The recommended dose is 1-2 pellet/kg of fish in catla and Rohu.

7. Pimozide

It is a dopamine antagonist having the ovulatory role of LH-RH- A. It is quite effective in IMC. These are cheap hormones but short lived.

Advantages of induced breeding-

- Production of high-quality seed of a particular species is possible.
- By application of several genetic techniques like gynogenesis, androgenesis, sex reversal or by hybridization between the species can produce higher growth rate in fish.
- At a single time, several breeders can be bred at a location with different species.
- During spawn collection from the natural water, some unwanted eggs of wild species came with the desired species eggs. It is very difficult to segregate at that stage. in later stage the segregation is possible but it is a time-consuming process. So, the inducing breeding is the technique to get pure seed of fish species under cultivation process.
- It also decreases the stocking of potential spawners over long periods. Sometimes many carps achieve fully mature in confined water but do not breed.
- The technique is very simple and does not need too much technical knowledge.
- Year-round availability of seeds.

Ontogenic Changes in Feeding in Fishes

Debashis Jena[1]*, Ansuman Panda[1], Alok Kumar Jena[2]

[1]Department of Fisheries Resource Management [2]Department of Aquaculture

College of Fisheries, Central Agricultural University (I), Tripura, India*Corresponding author mail:jdebashis@gmail.com

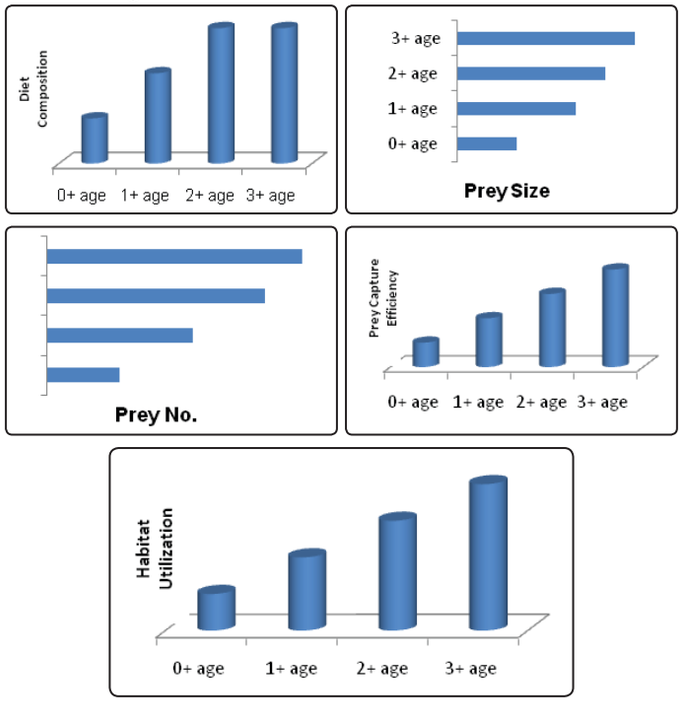
Introduction

From an ecological and evolutionary point of view body size is one of the most important attributes of an organism. Body size of an organism determines its energetic requirements, its capability for resource exploitation and its behaviour towards to the natural enemies. Difference in body size are a major means by which species avoid direct overlap in resource use (Schoener ,1974) and size selective predation can be a primary organizing force in some communities (Brook and Dodson, 1965 and Hall et al., 1976). Thus body size imposes important constrains on the manner in which an organism interacts with its environment and influences the strength, type and symmetry of interactions with other species (Schoener, 1969 and Wilson, 1975).

Ontogenic changes in feeding refer to the change in organism's resource use pattern as it increases in size from birth or hatchling to its maximum. Besides the body size, many other important factors like predation risk and susceptibility to physical factors also affect the feeding behaviour of the organism. So many species undergo extensive ontogenic shifts in food and habitat use based on their resource utilizing abilities and predation risk. As most fish species continue to grow in their life (Wootton, 1998), the substantial increase in body size that a fish achieves during ontogeny has an implication for species interaction (Werner & Gilliam, 1984). The diets of most fishes change with growth, but the timing of these changes varies from species to species and is often associated with changes in lifestyles or habitats (Blaber, 2000). The ultimate objective of ontogenetic change is to maximize energy intake, enhance growth rate and minimize the risk of predation. The rapid growth of fish is obvious in the first year, and as it grows it is capable of handling larger-sized food. This is also the period when their diets change rapidly.

General scenario for ontological changes

A number of researches have been conducted on the ontological changes in feeding in fishes. In general it is found that diet composition, mean prey size, prey number, prey capturing efficiency and habitat utilisation (Resource Utilisation) increases with increase in body size and age of the fish. In the early stages of life, these changes occur rapidly while in the adult stage those changes decreases or remain constant.



A brief review for Ontogenic Changes in feeding in fishes

Ontogenic shifts are not only for the species that metamorphose, but also approximated in many groups where morphology simply changes allometrically with growth. Among fish, ontogenetic changes in resource use are nearly universal (Werner and Gilliam, 1984). Yellow perch (*Perca flavescens*), smallmouth bass (*Micropterus dolomieui*) and largemouth bass (*M. salmoides*) shifts their diet from small entomostracans to Insects and fish in later stage (clady, 1974). Larval vertebrates eat prey as they are encountered while adult vertebrates feed on energy maximizers (Griffiths, 1975). The leopard searobin, *prionotus scitulus* (pisces: triglidae) shifts their prey preference from planktonic and epifaunal prey in small fish to infaunal prey in larger fish (Ross, 1978). Mean prey size and the amount of prey items increases with increase in size of fish in bay gobies (*Lepidogobius lepidus*) (Grossman, 1980). Ontogenetic and interspecific variation in the diets of the fishes is correlated with

Highlight Points

To understand the changes associated with feeding in fishes as a function of their size and age, it is existent to study their ontogeny. This article describes the changes that a fish undertakes during its lifetime to achieve growth, energy, survival and habitat utilisation efficiency in their natural environment that could be applied in aquaculture to gain high survival rate and to yield high production.

differences in external morphology related to locomotion, mouth dimensions and ontogeny of dentition in the sparids *Lagodon rhomboides* and *Diplodus holbrooki* (Stoner, 1984). It is also found that young Atlantic salmon (*Salmo salar*) tend to capture prey more quickly and with greater accuracy with increase in their body size (Coughlin, 1991). Rohu (*Labeo rohita*) and singhi (*Heteropneustes fossilis*) ingest larger prey as they grow due to age related increase in gape. However a nearly constant prey size and mouth size ration was maintained for a period of 4 wk after hatching (Mookerji and Rao, 1994). Ontogenic changes are also found in the Common carp (*Cyprinus carpio*) species. In the early developmental stage, fish prefers to eat only one type food but food preferences increases with age and size of the fish (Vilizzi, 1998). Nijru (2004) found that the major diet of Nile tilapia (*Oreochromis niloticus*) <5 cm total length is zooplankton whereas bigger fish includes a wider range of food items in their diet. It has been found that crustaceans form a greater proportion of the diet in sand bar shark (*Carcharhinus plumbeus*) when they are young. But as the size increases, cephalopods and elasmobranchs constituent the main prey item. Prey diversity also increased with size, with large, mobile, and reef prey species found more commonly in the diet of larger sharks (McElroy *et al*., 2006). Zooplankton is the dominant food for Rohu up to 20.6 cm total length (TL) and then gradually decrease in importance as fish grows. Phytoplankton which is the minor component of rohu diet increase in importance as fish as the fish grows and becomes the dominant food for rohu at 24.2 cm TL. There is also a positive correlation between phytoplankton biovolume and Fish size. In the initial stage of fish growth in case common carp, zooplankton is the major food item but it is shifted to Macroinvertebrates as it grows in size means there is a positive correlation between Macroinvertebrates biovolume and fish size (Rahman, 2009). Fish prey composition, feeding intensity and fish prey predator length ratios increase with increase in size and age of Coho salmon (*Oncorhynchus kisutch*). In the young stage they use to prefer juvenile rock fishes, larvae of crabs and euphausiids which are shifted to juvenile forage fish in adult stage. While in case of Chinook salmon (*Oncorhynchus tshawytscha*), the proportional contribution (by weight) of fish prey in their diets—from 55% in the smallest length-class examined (80–100 mm) to 95% in the largest one (375 mm) (Daly, 2009).

Some of the major Factors Affecting Ontogenic Changes in Feeding in fishes

Conclusion

Drastic changes in the food base may be considered as a strong selective force native predator population and this phenomenon requires more study in both basic and applied ecology. Invasions by exotic species are agrowing threat to biodiversity, ecosystem function, and local economies (Mack et al. 2000), but there are still many gaps in our understanding about why many species do not establish, why well established exotic species suddenly crash or even go extinct (Simberloff and Gibbons 2004), and why some exotic species become hyper-abundant. It is likely that native predators are one important but overlooked factor in controlling the long-term population dynamics of invasive species and mitigating their impacts on ecosystems.

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Bon Ammonia and obnoxious Gasses

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

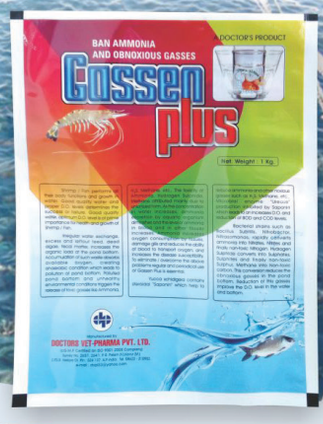
Irregular water exchange, excess and leftout feed, dead algae, fecal matter, increases the organic load at the pond bottom. Accumulation of such waste absorbs available oxygen, creating anaerobic condition which leads to pollution of pond bottom. Polluted pond bottom and unhealthy environmental conditions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

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

COMPOSITION:
YUCCA SCHIDIGERA
ALOEVERA
BACILLUS SUBTILIS
BACILLUS POLYMIXA
BACILLUS LICHENIFORMIS
NITRASOMONAS
NITROBACTOR
STABILIZERS

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

PRESENTATION: 500 gms &1 kg



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Tel: 0261 - 2465884, 2479196
M: 98795 23961, 89801 26699, 98793 39786
E: shkhan6677@yahoo.com
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ISF Trading
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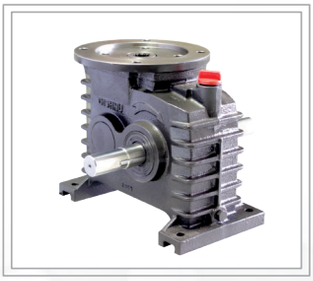
O/p RPM: 105, 120, 140, 160
Pedals: 4, 6 & 8



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Range: 1Hp to 3 Hp
O/p RPM: 105, 120, 140, 160
Pedals: 4, 6 & 8

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- 60% Power saving
- Highly Corrosion Resistance
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- Weighs 50% lesser for ease of floating
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- High Strength cast iron housing
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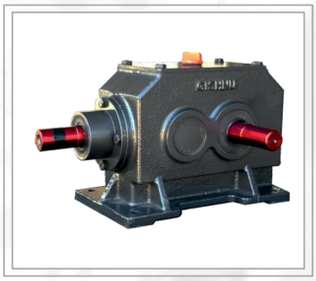
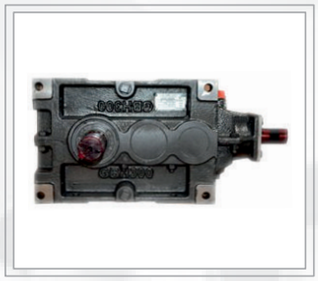
- Paddle Output shaft SS 304 for Corrosion free
- Heat Treated Steel Pinion Gears

BEVEL HELICAL GEAR BOX



Type : GBH 200 Long Arm
Range: 3 Hp
O/p RPM: 105, 120, 140, 160
Pedals: 8+8



Type : GBH 300 Long Arm
Range: 5 Hp
O/p RPM: 105, 120, 140, 160
Pedals: 16+16

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