

Aqua International

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and my team
have a shared
vision to drive
our company



The motto makes
Dr Aman Sayed
even more
ambitious and
hopes to serve...



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- ★ విబ్రియో ద్వారా సంక్రమించే **white faeces** ని అరికడుతుంది.
- ★ **RMS** నుంచి రక్షణ కల్పిస్తుంది
- ★ బయోఫేజ్ V వాడకం వలన ప్రోబయోటిక్ కి ఎటువంటి హాని జరగదు. మరియు **probiotic** పనితీరు పెరుగుతుంది.
- ★ బయోఫేజ్ V వాడకం వలన **biofloc** పెరుగును. దానివలన గ్రోత్ పెరిగి **F.C.R.** తగ్గును.



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6-20 రోజుల D.O.C లో :
ఒక ఎకరాకు 100 ml బయోఫేజ్ - V ని 10 లీటర్ల చెరువు నీటిలో కలిపాలి. ఆ కలిపిన ద్రావణం ని చెరువులో సమానం గా చల్లవలెను.
అవసరాన్ని బట్టి మరలా 40 నుంచి 50 రోజుల D.O.C లో రెండవసారి వాడవలెను.

FEED APPLICATION

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అవసరాన్ని బట్టి మరలా 40 నుంచి 50 రోజుల D.O.C లో రెండవసారి వాడవలెను.

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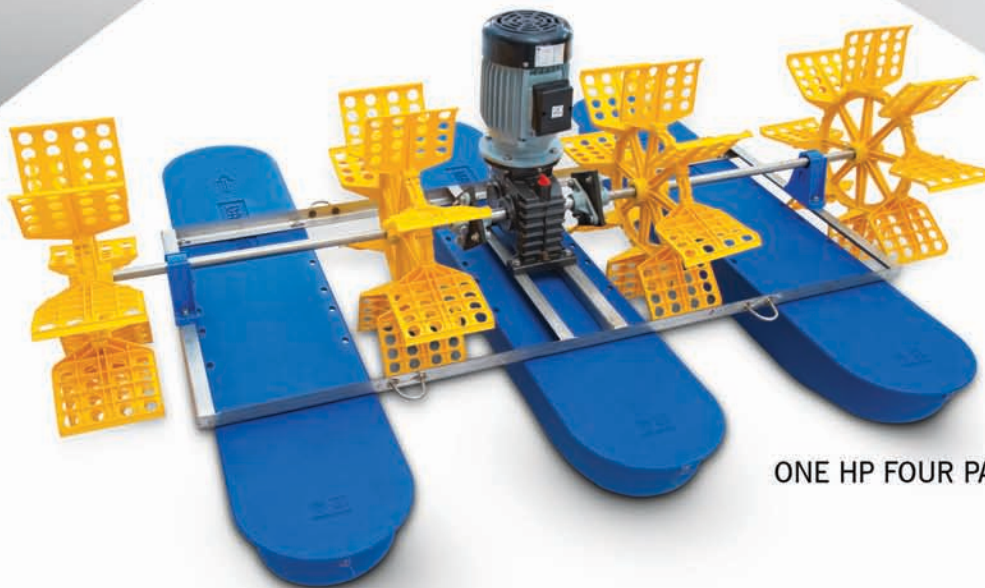
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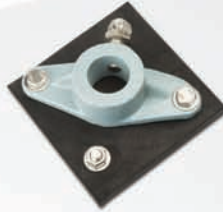
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- Editor



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Special Feature

- At SRIBS, me and my team have a shared vision to drive our company to be counted amongst the best in Aqua Healthcare both for product quality and customer support.
- The motto makes Dr Aman Sayed even more ambitious and hopes to serve in large geographic areas in future.

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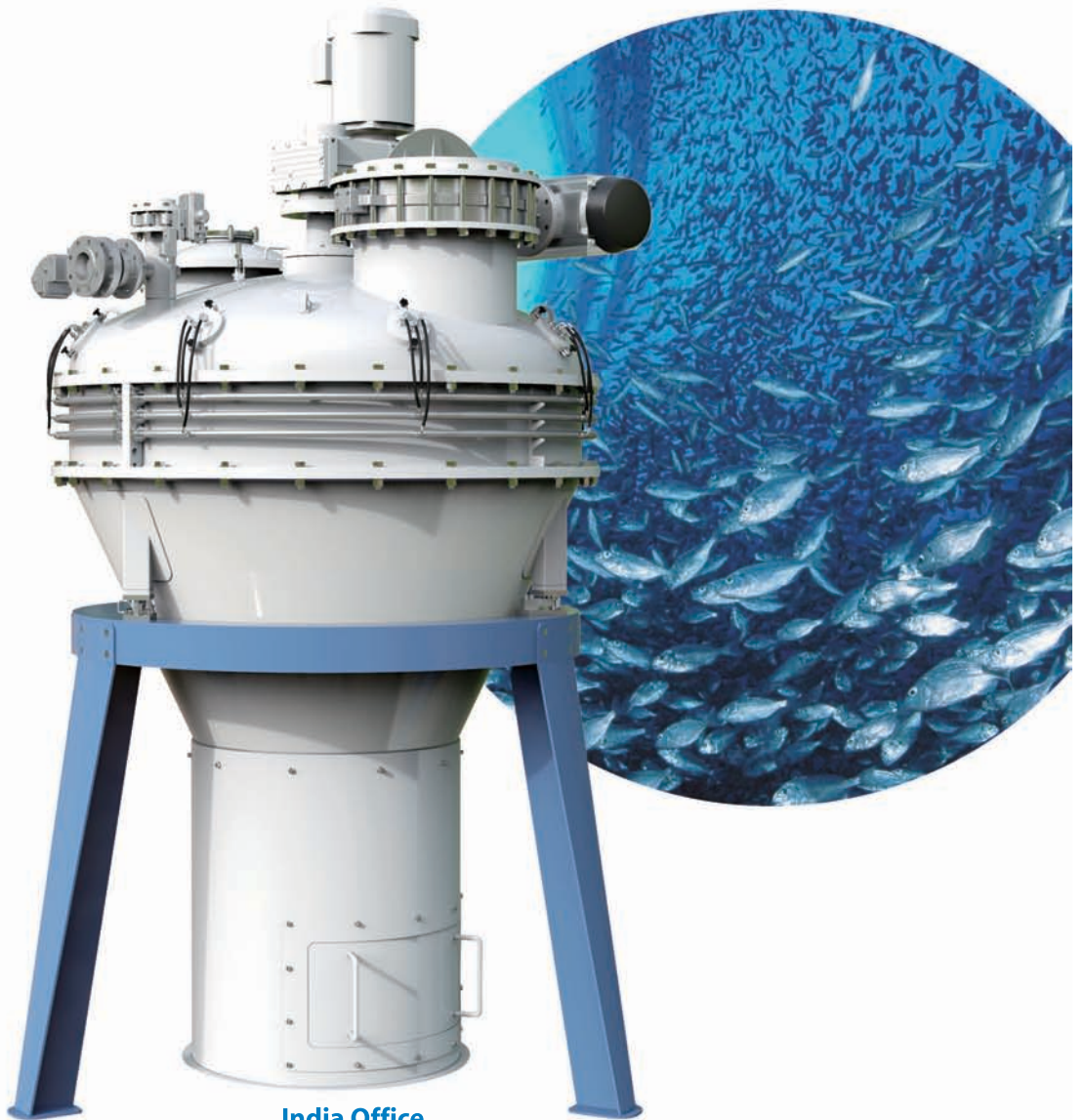
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CAA (Amendment) Bill 2023 for promoting ease of doing business and fine-tuning its operational procedures

With emergence of highly virulent pathogens in animal health and aquaculture, there is a need for highly effective therapeutic product which can reduce usage of sanitisers and antimicrobials. Continuous use of sanitisers and antimicrobials lead to damage of microbiome in aquaculture pond ecosystem and shrimp gut



Dear Readers,

The May 2023 issue of Aqua International is in your hands. In the news section, you may find news about ...

The Union Government on April 5 introduced Coastal Aquaculture

Authority (Amendment) Bill 2023, through its Union Minister of Fisheries, Animal Husbandry and Dairying, Parshottam Rupala. The Bill, dated March 29 seeks to amend certain provisions of the Coastal Aquaculture Authority Act, 2005 and decriminalise offences under it for “promoting ease of doing business” and fine-tuning the “operational procedures of Coastal Aquaculture Authority”.

ICAR-Central Inland Fisheries Research Institute, Barrackpore organized three awareness programs on “Demonstration of Drone Technology in Inland Open Water Fisheries” in three wetlands of West Bengal viz. Chamta wetland, North 24 Parganas; Khalsi wetland, Nadia and Sindrani wetland, North 24 Parganas on 11 to 13 April 2023 respectively under the ICAR Agri-Drone project coordinated by ICAR-ATARI, Kolkata.

For quality fisheries production, water health management is one of the crucial aspects which helps fishes to disease free survival, good growth and quality habitat. Inland fisheries are mainly suffering from poor water quality due to fish pathogens, fish disease, macrophyte infestation, pollutants from different sources.

The International Biodiversity Day is celebrated every year on May 22. As we understand, genes and further proteins control different morphological characteristics by which species

are identified; some letters in mRNA code change in organisms due to exposure to environment and minute mutation gives variations in different individuals of one species.

China’s Ministry of Agriculture and Rural Affairs published guidelines that recommended lowering the amount of Corn and Soybean Meal in pig and poultry feed. According to a report from Reuters, the guidelines include recommendations for alternative ingredients ‘with the goal of improving the usage of available raw materials and creating a formula that better suits China’s conditions’.

SRIBS Biotechniqs has been awarded as one of the Top 10 Leaders and Achievers from Aquaculture sector by Industry Outlook Magazine. Dr Babu Sudhakar believes that to be a successful industry leader, one has to relentlessly innovate, update and upgrade his or her products and services based on changing customer needs to maintain your competitive edge. Improvise - adapt - overcome is the adage he follows to ensure that the organisation remains on growth track.

Dr Aman Sayed, managing director for India and regional director of South Asia, Alltech Biotechnology, shared his 23 years career journey in poultry and aquaculture sectors. He feels that his motto makes him even more ambitious and hopes to serve in large geographic areas in future.

In the Articles section – Bacteriophages as a Therapy for Shrimp Diseases, authored by **D. Vijayanand**, discussed about with emergence of highly virulent pathogens in animal health and aquaculture, there is a need for highly effective therapeutic product which can reduce usage of sanitisers and antimicrobials. Continuous use of sanitisers and antimicrobials lead to damage of microbiome in aquaculture pond ecosystem and shrimp gut.

Contd on next page



Aqua International

Our Mission

Aqua International will strive to be the reliable source of information to aquaculture industry in India.

AI will give its opinion and suggest the industry what is needed in the interest of the stakeholders of the industry.

AI will strive to be The Forum to the Stakeholders of the industry for development and self-regulation.

AI will recognize the efforts and contribution of individuals, institutions and organizations for the development of aquaculture industry in the country through annual Awards presentation.

AI will strive to maintain quality and standards at all times.

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Bacteriophages are Viruses of bacteria which enter the bacteria, use the bacterial source of energy, hijack the bacteria, multiply inside the bacteria and kill them by lysis. When they kill the bacteria, each virus which enter the bacteria multiplies and releases 10 to 100 mature ready-to-attack bacteriophages which are capable of infecting and destroying next set of target pathogenic bacteria.

Another article titled – **Transgenic Fish Production and its Application in Fisheries**, authored by **Bala Ganesan and Deepak Agarwal**, said that transgenic fish have been generated for a variety of uses, including the development of human treatments, experimental models for biological study, environmental monitoring, ornamental fish and aquaculture. Transgenic fish contain heterologous DNA introduced and integrated into their genome through gene transfer technologies such as microinjection, electroporation, etc. Several factors contribute to the success of aquaculture through transgenesis. Important steps to produce transgenic fish. Transgenic fishes with increased growth efficiency have higher feed conversion efficiency resulting in economic and environmental benefits such as reduced feed waste and effluent from fish farms.

Introducing Chinook salmon GH cDNA driven by the promoter of the ocean pout antifreeze protein gene into Atlantic salmon eggs resulted in a more significant growth boost in transgenic fish. Some of the transgenic animals grew at a far faster rate than their non-transgenic counterparts. Lu et al. found that both P and F transgenic medaka carrying a chicken 0-actin gene promoter/human GH gene construct or tilapia carrying carp-0-actin promoter rtGHlcDNA demonstrated considerable growth augmentation when compared to non-transgenic siblings in a series of recent experiments. The P, transgenic tilapia grew at a rate that was several times faster than the controls. Recently, the effect of the ICF-I transgene on somatic growth in medaka and tilapia was investigated. The ICF-I transgenic medaka and tilapia not only developed quicker during embryonic development, but they also grew significantly faster.

Article titled – **Adverse Consequences of Intensive Aquaculture System**, authored by **Iffat Jahan**, discussed about Aquaculture expansion and development is so fast and progress but beside its causing several problems to environment. Use of high valued feed, various machine and so on cause impacts on greenhouse gas emission. It affects the productivity, genetic diversity, survival, growth, reproduction, distribution and so on changes of cultured stocks in aquaculture system.

The emission of GHGs directly or indirectly effects on climatic condition and further contributes to global warming. However, climate change and global warming causes an increase in physiological stress on the cultured stock and increases the disease incidence, rising sea level, low groundwater, eventually leading to financial losses to the farmers in aquaculture system. Therefore, finally it affects the productivity, genetic diversity, survival, growth, reproduction, distribution and so on changes of cultured stocks in aquaculture system. Hence, these GHGs will reduces the productive and sustainable development of aquaculture system.

Another article titled – **Metabolomic Studies of Carbohydrate Metabolism in Fish**, authored by **Atshaya Sundar**, said that fish nutrition is the complex and meticulous branch of science where newer inventions taking place now and then, so it is evident that for an appropriate, effective feed formulation, one

should have a thorough idea of the nutrition and feeding habits of the cultured animal. There comes the omics techniques to enhance our understanding of several nutrients, metabolites, genetic approaches on the target animal.

Almost more than a decade lot of research had been carried out to replace marine ingredients with plant - based when using them in diets apart from ANF and digestibility level of CHO in ingredients is also high, hence by applying the metabolomics approach, it is easy and accurate to determine the different types of metabolites which are the end product of metabolism and it is influenced by the type of diet given we can compare the test diet with the control diet having the marine ingredients and draw a conclusion regarding the influence of high or low CHO diet on metabolites produced, it has been observed that glycolysis and gluconeogenesis pathway is influenced by plant-based diet.

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

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

M.A.Nazeer
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Government introduces Aquaculture Bill

The Bill seeks to amend certain provisions of the Coastal Aquaculture Authority Act, 2005 and decriminalise offences under it for 'promoting ease of doing business'

What are its provisions

The Government on 5 April introduced the Coastal Aquaculture Authority (Amendment) Bill 2023, through its Union Minister of Fisheries, Animal Husbandry, and Dairying, Parshottam Rupala.

The Bill, dated March 29, seeks to amend certain provisions of the Coastal Aquaculture Authority Act, 2005 and decriminalise offences under it for “promoting ease of doing business” and fine-tuning the “operational procedures of Coastal Aquaculture Authority”.

What is this Bill?

Besides amending the Coastal Aquaculture Authority Act, 2005, the Bill seeks to clarify that “coastal aquaculture and activities connected therewith” shall continue to be regulated by “the Coastal Aquaculture Authority Act and no other Acts.”

Under Section 2 (1)(c) of the 2005 Act, “coastal aquaculture” means culturing or cultivating, under controlled conditions in ponds, pens, enclosures, or otherwise, in coastal areas, of shrimp, prawn, fish, or any other aquatic life in saline or brackish water; but does not include freshwater aquaculture.

Also in Explained Punjab's shrimp farming push: Why, and what are the farmers' demands?



Opposition members display placards in front of Speaker's chair as MP Rama Devi, an MP nominated to the panel of Chairpersons, Lok Sabha, conducts proceedings during the Budget Session of Parliament in New Delhi on April 5, 2023.

The 2023 Bill seeks to broaden the definition of “coastal aquaculture” or “coastal aquaculture activity” to mean “rearing and cultivation of any life stages of fish, including crustacean, mollusc, finfish, seaweed or any other aquatic life under controlled conditions, either indoor or outdoor, in cement cisterns, ponds, pens, cages, rafts, enclosures or otherwise in saline or brackish water in coastal areas, including activities such as production of brood stock, seed, grow out, but does not include fresh water aquaculture.”

Additionally, it aims to promote newer forms of environment-friendly coastal aquaculture such as “cage culture, seaweed culture, bi-valve culture, marine ornamental fish culture and pearl oyster culture”, which, it adds, has the potential for creating employment opportunities

on a large scale for coastal fisher communities and especially fisherwomen.

It also aims to encourage the establishment of facilities in areas having direct access to seawater to produce genetically improved and disease-free broodstocks and seeds for use in coastal aquaculture. Moreover, the Bill seeks to prevent the use of antibiotics and “pharmacologically active substances”, which are harmful to human health in coastal aquaculture.

Provisions for “biosecurity”

The Bill also includes new provisions for “biosecurity”, which refers to measures and strategies for analysing, managing, and preventing the risk of introducing or spreading harmful organisms like viruses and bacteria within the coastal aquaculture unit, which could lead to infectious diseases.

It provides for the introduction of a “Brood Stock Multiplication Centre” which receives “post-larvae or juvenile which are specific pathogen free” or tolerant or resistant to such pathogens or other post-larvae or juveniles from a “Nucleus Breeding Centre”, to be reared under strict biosecurity and disease surveillance.

Many of these biosecurity measures also find a mention in the 2015 “Guidelines for Regulating Establishment and Operation of SPF Shrimp Broodstock Multiplication Centres”, published by the National Fisheries Development Board, which is part of the Department of Animal Husbandry, Dairying, and Fisheries, which used to be a part of the Ministry of Agriculture and Farmers Welfare.

Formed in 1991, the Department of Animal Husbandry, Dairying, and Fisheries (DAHDF) was earlier responsible for overseeing matters related to animal husbandry, dairy, and fisheries. It advised states and UTs on the formulation of policies and programmes. However, in 2019, under the Modi government, the Department of Animal Husbandry and Dairying was subsumed under the newly created Ministry of Fisheries, Animal Husbandry & Dairying.



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



2. HIGH ACTIVITY OF SPORES

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3. ESTABLISH BALANCED POND BACTERIA SYSTEM

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6. INCREASE AQUACULTURE PRODUCTION

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

* COMPOSITION:

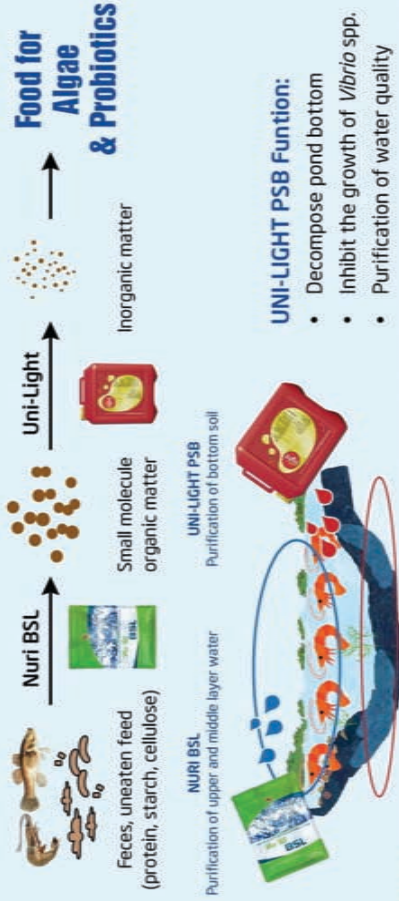
Bacillus spp. > 1 x 10¹¹ cfu/kg
(*Bacillus subtilis*, *Bacillus amyloliquefaciens*, *Bacillus licheniformis*)
Carrier (rice bran, corn gluten) 15%
Moisture 75%
10%

* STORAGE:

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

* DIRECTION OF USE:

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BSL Dosage:

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

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

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What is the Coastal Aquaculture Authority Act 2005?

The Coastal Aquaculture Authority Act was enacted by Parliament on June 23, 2005, and it came into force on December 22, 2005. The Act was introduced for the establishment of a “Coastal Aquaculture Authority” for regulating activities connected with coastal aquaculture in the coastal areas.

Under Section 2 (1) (d) of the Act, “coastal area” meant the area declared as the Coastal Regulation Zone, for the time being, in the government notification dated February 19, 1991, “to regulate activities in the coastal area under section 3 of India’s Environment Protection Act, 1986.”

For the last three decades, this 1991 notification or “subordinate legislation” was the only source of managing coastal zones of India and was intended to balance developmental needs with the protection of natural resources.

Section 4 of the 2005 Act allowed the Centre to establish an authority called the Coastal Aquaculture Authority for regulating coastal aquaculture activities in coastal areas, which would consist of a chairperson who is a current or former HC judge, a coastal aquaculture expert and members nominated by the Central Department of Ocean Development, Ministry of Environment and Forests, Ministry of Agriculture, Ministry of Commerce along with four members representing coastal States on a rotation basis and one member secretary.

What are the penalties and punishment under the Act?

Section 13 of the 2005 Act relates to the registration for coastal aquaculture. It states that except for the manner provided under it, “no person shall carry on, or cause to be carried on, coastal aquaculture in coastal area or traditional coastal aquaculture in the traditional coastal aquaculture farm which lies within the Coastal Regulation Zone”.

Section 14 was the only penal provision under the 2005 Act, which punished coastal aquaculture or traditional coastal aquaculture in contravention of Section 13, with imprisonment of up to 3 years or a maximum fine of Rs 1 lakh or both.

However, no court could take cognizance of an offence under section 14 without a “written complaint filed by an officer of the Authority authorized in this behalf by it.”

The 2023 Bill seeks to change this by inserting Section 13A, which allows the CAA to “authorise any officer of the Authority or the State Government or the Central Government, not below the rank of Assistant Director of Fisheries in a District, to function as authorised officer to exercise such powers, to discharge such duties and perform such functions, as may be specified in that order.”

The new Section 13A also allows the Centre to authorise an officer not below the rank of government Under Secretary to function as an adjudicating officer imposing penalties under the Act. Besides this, the

Centre can authorise any officer of the Authority or the State Government or the Central Government, not below the rank of Deputy Secretary, to function as the Appellate Authority.

Moreover, the adjudicating officer or the Appellate Authority shall have the same powers as are vested in a civil court under the CPC, 1908 while trying a suit, which includes summoning and enforcing the attendance of witnesses; requiring the discovery and production of documents; requisitioning any public record or document or copy of such record or document from any office receiving evidence on affidavits; and issuing commissions for the examination of witnesses or documents.

Under Section 14, the Bill also seeks to bring about a systematic method for punishments and penalties under the Act. It says that where any person carries on coastal aquaculture in contravention of any of the provisions of this Act, an officer authorised under section 13A can suspend or stop the activity for a prescribed time or impose penalties as per the Table given in the Bill. The officer can even order the removal or demolition of any structure or the destruction of any standing crop. The officer may also suspend or cancel the registration of the offender.

If the offence pertains to “Hatchery, Brood Stock Multiplication Centre, Nucleus Breeding Centre or such other coastal aquaculture unit”, the penalties range for non-

registered people varies from Rs 50,000 to Rs 1 lakh for a first-time offence and third time & its subsequent offences respectively. For those who have registered and obtained a certificate, the penalty varies from Rs 25,000 to Rs 1 lakh for the same offence.

However, this is not the first time that the Centre is proposing an amendment to the 2005 Act. Last year, in October, the government sought to introduce the Coastal Aquaculture Authority (Amendment) Bill, 2022, in the Winter Session of the Parliament along with 15 other new bills.

What did the Coastal Aquaculture Authority Act Bill 2022 propose?

The Coastal Aquaculture Authority (Amendment) Bill, 2022, which the government proposed to bring last year, sought to revise the provisions of the principal 2005 Act to reduce the regulatory compliance burden on stakeholders without diluting the core principles of environment protection in coastal areas. It also proposed to decriminalise offences under the Act and to expand the scope of the law to bring all coastal aquaculture activities under its ambit.

It also proposed to exempt shrimp hatcheries from the application of the 1991 Coastal Regulation Zone notification by amending Section 13(8) of the 2005 Act, which prohibited coastal aquaculture within no-development zones, and Section 27 to exempt the entire coastal aquaculture from the purview of the 1991 notification.

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International Year of Artisanal Fisheries and Aquaculture Closes with many Concrete Results

Rome: The Food and Agriculture Organization of the United Nations (FAO) today marked the close of a global year-long campaign focused on small-scale artisanal fishers, fishfarmers and fishworkers, underlining the need to keep the momentum going.

With over 260 events held in 68 countries, the International Year of Artisanal Fisheries and Aquaculture 2022 (IYAFA), “celebrated the millions of people working in small-scale artisanal fisheries and aquaculture – including some 45 million women small-scale fishers – who produce 40% of all the fish we eat,” FAO Director-General QU Dongyu said at the closing ceremony, adding: “They are stewards of valuable ecosystems, and of longstanding traditions and cultures.”

Small in scale, big in value
Mostly carried out by families, sometimes with a handful of workers, small-scale artisanal fisheries and aquaculture (or fish and seafood farming) add up to a massive subsector. Small-scale fisheries provide livelihoods for nearly half a billion people globally – 95 percent of them operating in the global south.

Yet the workforce includes some of the communities most vulnerable to environmental

degradation, biodiversity loss, climate impacts and economic shocks, as they contribute to the management of aquatic resources in the world’s oceans, rivers and lakes.

To raise awareness of their role, the FAO-led campaign, supported by a wide array of partners, helped forge and strengthen partnerships among small-scale artisanal fisheries and aquaculture workers and other stakeholders. Examples of this are the Ibero-American Network for Small-Scale Artisanal Fishing (RIPAPE) and the Maghreb and North African Platform for Artisanal Fishery.

An important body of new research carried out during IYAFA 2022 has added to our knowledge about sustainable small-scale fisheries, including the recently launched Illuminating Hidden Harvests report, by FAO, Duke University and World Fish, which investigates the contributions of small-scale fisheries to sustainable development.

The IYAFA 2022 Final Report highlights the significant number of declarations, calls to action and statements made by partners, at national, regional and global level, as well as providing recommendations to further support the

subsector. These include the areas of environmental, social and economic sustainability, governance, gender equality and equity, food security and nutrition, resilience and the participation of youth

Aligned with Blue Transformation

All these recommendations are aligned with the Sustainable Development Goals and FAO’s aspiration of the 4 Betters – Better Production, Better Nutrition, a Better Environment, and a Better Life, leaving no one behind. This is supported by FAO’s Blue Transformation vision to change the way the world manages, uses and conserves its aquatic resources to end hunger and poverty.

Although IYAFA 2022 is ending, “it should not be the end, but a new beginning where we continue to amplify the voices of small-scale artisanal fishers and continue to support the development of inclusive small-scale artisanal fisheries and aquaculture national plans and strategies,” the FAO Director-General said.

Keeping the momentum

Taking forward the momentum and support generated by IYAFA 2022, we must build on established instruments, including the Voluntary

Guidelines for Securing Sustainable Small-Scale Fisheries, Qu added.

Among those also participating in the event were Abdallah H. Ulega, Minister of Fisheries and Livestock, Tanzania; Bärbel Kofler, Parliamentary State Secretary to the Federal Ministry for Economic Cooperation and Development, Germany (via video message); Nedwa Moctar Nech, Maghreb and North Africa Platform of Artisanal Fishery and Aquaculture; Munir Md Mujibul Haque, member of the International Planning Committee Working Group on Fisheries; Elisa Morgera, Director, One Ocean Hub; Alberto Miti, Associate Director, The Lexicon.

FAO Deputy Director-General Maria Helena Semedo closed the event, acknowledging the engagement and commitment of the many partners and supporters who made IYAFA 2022 a resounding success. The IYAFA Steering Committee was chaired by Peru, while the European Union, the Swedish International Development Agency (SIDA) and the Norwegian Agency for Development Cooperation (Norad) provided funding support to FAO for the celebration of the year.

A video screened at the ceremony highlighted IYAFA celebrations over the year and around the world, .

KEY FACTS

- Small scale fishers produce at least 40 percent of the global fisheries catch

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- Around 45 million women participate in small scale fisheries, or four in ten fishers
- Marine catch amounts to 68 percent of small-scale fisheries while 32 percent comes from inland waters.
- 492 million people depend at least partially on small-scale fisheries for their livelihoods
- Small-scale fishers and fish workers account for 90 percent of those working worldwide in global capture fisheries value chains
- The fish provided by small-scale fisheries is essential for healthy diets, providing protein and fatty acids and micronutrients like omega-3 fatty acids, calcium, selenium and zinc
- A survey of 400 small-scale fishery producers' organizations found 90 percent committed to greater sustainability and 60 percent to greater human well-being

FAO's work in fisheries and aquaculture promotes the effective management of aquatic living resources and the development of capacities to ensure equitable outcomes for all. It is geared towards bringing about a Blue Transformation, a vision committed to building sustainability and resilience. Read more about FAO's Fisheries and Aquaculture work here.

Experts deliberate on scope of GM crops in Aquaculture

Fisheries and biotechnology experts emphasised the need to bust the myths associated with the use of genetically modified (GM) crops as feed ingredients in India's aquaculture sector.

Fisheries and biotechnology experts emphasised the need to bust the myths associated with the use of genetically modified (GM) crops as feed ingredients in India's aquaculture sector.

They were of the view that GM crop-based products (mainly non-living genetically modified organisms) have huge scope in enhancing the supply of feed ingredients in aquaculture, thereby promoting growth, disease resistance and reduction of input costs in aquaculture production.

The experts were speaking at an awareness workshop on the use of GM crops and their derivatives for the aqua-feed sector organised by the Biotech Consortium India Limited (BCIL) in association with ICAR-Central Marine Fisheries Research Institute (CMFRI).

The workshop highlighted that the introduction of GM crops in the aqua-feed sector would also help reduce the mounting pressure on fishmeal and fish oil and maintain a sustainable aquaculture industry.

Dr Vibha Ahuja, Chief General Manager of BCIL said that GM crops come with several desirable traits such as insect resistance, disease resistance and herbicide tolerance, and hence using these would be beneficial to boost the yield.



"Cost analysis showed that the use of dried distillers grains with soluble (DDGS), a co-product from cereals in the distillery industry, can help reduce shrimp feed prices. Most of the DDGS produced in the world are however of GM-corn origin and Indian feed producers can capitalize on the economic benefits, if they are open to use them as feed ingredients," said Ahuja.

Allaying various concerns over GM crops, Ahuja pointed out that in the last 25 years, no confirmed report of adverse effects was reported from approved GM crops.

"Systemic regulations are in place to ensure the safe use of GM crops which are monitored by internationally accepted safety assessment methodologies. Hence, an approved GM crop is as safe as that of its non-GM counterpart", added Ahuja.

In India, Bt Cotton, a GM crop, is being cultivated from 2002 onwards with significant increase

in production and commensurate economic benefits for the farmers.

The Government of India in October 2022 approved the environmental release of GM Mustard for its seed production and testing as per the existing ICAR guidelines.

Globally, 71 countries use GM crops and their products for food, feed and processing.

Dr A. Gopalakrishnan, director of CMFRI said one of the primary benefits of GM crops in the aqua sector is their ability to increase the nutritional value of the feed.

"GM soybeans can be engineered to produce omega-3 fatty acids, which are important for the growth and health of farmed fish. That feed constitutes 50-55 percent of total input cost in aquaculture. It is essential to develop streamlined regulatory efforts with careful considerations for the ethics and risks associated with using GM plant ingredients in aqua feeds," said Gopalakrishnan.

The deliberations of experts decided to have an interface among scientists working on fish nutrition, genetics, microbiology and molecular biology and identified potential multi-disciplinary researchable issues.



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Centre plans revamp of livestock insurance scheme to raise coverage



Poor coverage: The Parliamentary Standing Committee's report reveals that not even a single animal was insured during 2022-23, whereas during 2021-22, 1,74,061 animals were insured.

Pulled up recently by a Parliamentary Standing Committee (PSC) for zero insurance coverage of livestock in 2022-23, the Centre is considering a comprehensive livestock insurance scheme modelling the Prime Minister's Fasal Bima Yojana. The Union Animal Husbandry Ministry's move is to roll out the scheme ahead of the 2024 Lok Sabha elections. There are initial proposals to waive off premium for cattle rearers from Scheduled Caste (SC)-Scheduled Tribe (ST) communities. At present, less than 1% of the country's cattle population is insured and the average yearly premium is 4.5% of the insured amount.

The Animal Husbandry Ministry recently held a meeting with various insurance companies and other stakeholders on the matter. "Our effort is to reduce the premium

so that more farmers enroll in the scheme," an official said, adding that a comprehensive livestock insurance will replace the present Livestock Insurance Scheme. The scheme is functional in 100 districts of the country. The Centrally-sponsored scheme is being managed by the respective State Livestock Development Boards.

Recently, the Animal Husbandry Ministry had told the Parliamentary Standing Committee on Agriculture and Animal Husbandry that farmers are often caught in the fight between state government officials and insurance companies. A report submitted to Parliament by the panel on Demands for Grants of the Ministry quoted an official and said the Ministry prefers direct transfer of benefits to farmers' accounts.

The panel said in the report that not even a single livestock was insured during 2022-23, whereas during 2021-22, 1,74,061 animals were insured. "The Committee were informed of the hardships faced by the livestock owners in getting their livestock insured and also about the measures being taken to ease the process of livestock insurance. Expressing concern over no Insurance during 2022-23, the Committee recommended the Ministry to take effective steps so that the process of insurance of livestock is made easy for the beneficiaries. "The Committee would also like the Department to explore the possibility of developing an App-based Livestock Insurance facility for livestock owners. The Committee would like to

be apprised of the total progress made by the Department in this regard," the report added.

The official said high policy premium rate and general economic conditions of farmers are reasons for lower enrollment in such schemes. "The government considers subsidy on the premium paid by socially marginalised farmers from SC-ST communities," the official added.

In the meeting with insurance companies, the Centre stressed on the importance of expanding the ambit of the scheme and decreasing the premium paid by the farmers.

During the Lumpy Skin Disease pandemic, about two lakh cattle died in the country. Farmers had demanded compensation from the government for the loss. The Centre's attempt is to keep the premium low and ensure maximum coverage of livestock. Hence, the centre's attempt is to keep the premium low and ensure maximum coverage of livestock.

"The coverage at present is very poor as most of the farmers are not in a position to pay premium. Some exquisite cattle breeds are insured by the breeders, but the government wants to insure more animals," the official added.

Several farmers' organisations had also demanded comprehensive livestock and crop insurance in the background of pandemics such as lumpy skin disease.

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China issues plan to reduce soymeal use in animal feed

New plan aims to reduce soybean meal inclusion in animal feed to less than 13% by 2025.



China's agriculture ministry has issued a three-year action plan to reduce the inclusion rates of soybean meal in animal feed in an effort to reduce its reliance on soybean imports.

The new plan says soymeal inclusion in animal feed should be reduced to less than 13% by 2025, down from 14.5% in 2022, according to a Reuters report. It would "guide the feed industry to reduce the amount of soybean meal, promote the saving and consumption reduction of feed grains, and contribute to ensuring the stable and safe supply of grain and important agricultural products," said the document, published by the Ministry of Agriculture and Rural Affairs.

In April 2021, China's Ministry of Agriculture and Rural Affairs published guidelines that recommended lowering the amount of corn and soybean meal in pig and poultry feed. The

guidelines include recommendations for alternative ingredients, "with the goal of improving the usage of available raw materials and creating a formula that better suits China's conditions,"

Reuters reported at the time.

The guidance recommends rice, cassava rice bran, barley and sorghum as alternatives to corn. Acceptable alternatives to soybean meal include rapeseed meal, cottonseed meal, peanut meal, sunflower meal, distillers dried grains, palm meal, flax meal, sesame meal and corn processing by products. It also suggests feed formulations based on the region of the country, such as reducing corn by at least 15% in pig rations in the Northeast by using rice and rice bran. In the southern region, it recommends using sorghum, cassava flour, rice bran meal and barley to replace corn in pig feed.

In March, China's soybean imports rose 7.9% from the same month a year earlier as buyers in China stocked up ahead of expected strong demand. >>

Fishing ban pushes up prices of fish in Tiruchi market

Tiruchi: Consequent to the annual moratorium on fishing on the east coast that began on April 15, fish prices have skyrocketed in Tiruchi market.

In order to create an environment for the breeding of fish and their uninterrupted growth in the sea, the governments implements a fishing ban on the entire east coast of the country for two months annually. The ban that began on Saturday will be in force up to June 14. No mechanised trawlers will be allowed to venture into the sea for fishing during the period. However, it will not apply to the fishermen operating with non-motorised boats. They can go for fishing within a short range from the seashore.

As a result of the ban, the arrival of fish in Tiruchi has come down, thereby causing an increase in the prices. Tiruchi mainly gets fish from Rameswaram, Mandapam and Nagapattinam. The fish traders from the coastal towns supply about 1,000 kg of fish such as Vanjiram, Sankara, Vila and Parai. In

addition, the Tiruchi market receives about 2,500 kg of fish, mainly from Andhra Pradesh, bred in inland waters.

While there is no drop in the arrival of catch from inland water bodies, the market has registered a dip in arrival of sea fish from coastal towns. The Kasivilangi market, which is considered as a wholesale market for fish in Tiruchi, records the arrival of 600 kg to 700 kg. One kg of Vanjiram, which was sold for ₹600 last week, has gone up to ₹900 to ₹1,000. Popular varieties such as Vila and Sankara, which were sold for ₹300 and ₹250 a kg a week ago, were quoted ₹350 and ₹300 respectively on Tuesday.

"The rates will generally go up by 25% during the ban period than the normal period. Due to Panguni and Chithirai festivals in Tiruchi and several villages, consumers avoid non-vegetarian food. Once the festivals are over, the rates will go up," said T.K. Raffique, a wholesale trader at Kasivilangi market in Tiruchi.

>> According to reports, the General Administration of Customs noted total imports for the month came to 6.85 million tonnes, down 2% from February's 7.04 million tonnes.

Arrivals for the first three months of the year came to

23 million tonnes, up 13.5% from a year earlier, the data showed.

Much larger volumes are expected in coming months, said traders and analysts, but demand has proven weaker than expected.

Awareness program on “Demonstration of Drone technology in Inland Open Water Fisheries” in wetlands of West Bengal



Barrackpore: Inland open waters usually cover rivers, reservoirs and wetlands, which are facing big challenges for maintaining suitable water quality for fisheries. For quality fisheries production, water health management is one of the crucial aspects which help fishes to disease free survival, good growth and quality habitat. Inland fisheries are mainly suffering from poor water quality due

to fish pathogens, fish disease, macrophyte infestation, pollutants from different sources etc. Fishermen usually treat the waterbodies by manual spraying of disinfects, pesticides, herbicides with hours of labours and high input cost. In this scenario, the new technology sprayer drone may act as an efficient tool to do the things with less time, input and cost due to smart automated technology.

To aware the fishermen about the technology, ICAR-Central Inland Fisheries Research Institute (CIFRI), Barrackpore has organized three awareness program on “Demonstration of Drone Technology in Inland Open Water Fisheries” in three wetlands of West Bengal viz. Chamta wetland, North 24 Parganas; Khalsi wetland, Nadia and Sindrani wetland, North 24 Parganas on 11.4.2023,

12.4.2023 and 13.4.2023 respectively under the ICAR Agri-Drone project coordinated by ICAR-ATARI, Kolkata. These awareness programs were planned under the supervision and guidance of Dr. B. K. Das, Director, ICAR-CIFRI aiming to educate the farmers about the scope of the technology in their fish farming. In the program, Mr Kausik Mondal, Technical officer and drone pilot of ICAR-CIFRI has briefed about the drone system and its applications in the field.

After that Agri-drone system was operated to fly over the waterbodies and sprayed disinfects in the water area. Ms. Chayna Jana, Scientist and Coordinator of the project interacted with the farmers and discussed about the benefits of the technology. Fishermen also took active part to know about the technology and showed their interest to use the system in their fish farming specially for macrophyte controls, pesticide and disinfect spraying. A total of 120 fishermen were present in these three awareness programs.



Some thoughts on a new exotic freshwater aquarium fish and biodiversity conservation – a prelude to IBD 22/5/2023

The International Biodiversity Day (IBD) is celebrated every year on 22nd May. As we understand, genes and further proteins control different morphological characteristics by which species are identified; some letters in mRNA code change in organisms due to exposure to environment and minute mutation gives variations in different individuals of one species. Total 0.1 million land race variety of rice *Oryza sativa* developed in last 5000 years in world and domesticated from wild grass *O. rufipogon*. Biodiversity can't be explained without food chain and nutrient cycle and each species functions in ecosystem as pollinator, decomposer, mega-herbivore, predator, etc. In last five-hundred years, 77 mammalian, 140 avian, 21 reptilian, 34 amphibian and 66 finfish species have got extinct.

The M: F ratio for the deer *Cervus hanglu* is 15.5: 100 and it may get extinct. Only two females of Northern White Rhinoceros are now left in world and is extinct in wild. Now 111 mammalian, 163 avian, 37 reptilian, 148 amphibian and 158 finfish species are facing risk of extinction and are 'Conservative'. Background Extinction Rate is 1.5% and 2.5% for mammals and amphibians



Five 'multi-coloured' colour widow tetra

respectively. Animals in 'least concern' category are moving towards extinction as humans have occupied their habitat. Fragmentation of animal habitats occurred due to agriculture expansion. Corals and amphibians facing high risk of extinction due to global warming (GW); symbiotic relation of corals with dinoflagellates ends and corals turn white as water heats up. Amphibian loss (Golden toad) occurred in Costa Rica Cloud Forest due to temperature rise and virulent Chytrid fungus attack; population of Halloween frog may increase in future. Subsequent to Green Revolution and Selective Breeding programmes, genetic erosion and loss of crop biodiversity have taken place as we rely upon high-yielding economically-important

plant varieties only. Global warming eliminated 75% of crop varieties and mostly pollinators (butterfly, beetles, honey bees, humming birds) are affected in addition to effect of pesticide contamination. Many economically-important fruits are highly dependent on pollinators. With deforestation, pollinators don't find flowers to pollinate. Endemic species like Dragon tree, Lemur, Brown-antlered deer, Lion-tailed macaque, etc are most vulnerable to threats of extinction; loss of habitat occurred for Black Rhino and Indian tiger in last one-hundred years.

Humans are consuming natural resource like tropical forests and space of animals, birds. About 35% of amphibian species are critically endangered. May be 70% of species going to be extinct within

short time and 6th mass extinction may happen. Ecosystem function, a critical factor for mammals, may be jeopardized with diminishing number of mammalian species and loss in their diversity. We find specialist endemic species getting vanished and replaced by opportunistic generalist species. Even though species are disappearing at an alarming rate, it is not always detected at local levels. Change in ecosystem function of animals is evident; also expansion in warm-loving species and loss of cold-adapted species due to global warming. People should be made more aware about ill-effects of indiscriminate exploitation of plant and animal resource and only then biodiversity saving movement will be into effect. All these thought-provoking facts and issues were comprehensively explained by Dr A. Kaviraj, Retd. Professor of Zoology, Kalyani University, West Bengal (WB) in a Webinar organized by Dept of Zoology, Sabang Sajanikanta Mahavidyalaya, Paschim Medinipur, West Bengal on 3/10/2021. We know that quinine is effective against all Plasmodium parasites (malarial parasites in human) and derived from the highly valuable Cinchona tree for treatment of malaria, similar to drug chloroquine in its mechanism. We must preserve Cinchona resource, an element of plant biodiversity. We have to save biological resources as each and every thing required for our survival comes from nature; otherwise we will be wiped up.

In another Webinar on IBD organized by EIS, Resource Partner on Biological Invasion, Amrita Vishwa Vidyapeetham, Coimbatore, Tamil Nadu on 22/5/2021, Dr G. Christopher, Scientist and Research Coordinator, Mahatma Gandhi University, Kottayam spoke about Western Ghats (WG) and Southern Western Ghats (SWG) which is among the world's eight hottest hotspots (out of total 34 hotspots) in biodiversity with a maximum 2695mt height at Anaimudi, Kerala. WG is home to 9000 nos plant species, above 650 nos tree species of which 352 are endemic; also found 180 amphibian, 260 reptilian and 219 fish species. Above 325 globally threatened species occur in WG, that includes 229 plant, 31 mammalian, 15 avian (bird), 43 amphibian, 5 reptilian and 1 fish species. Country's single largest population of Asian elephant, Gaur and tiger, globally threatened landscape species, are found here. In the scrub forests of SWG in Mysuru-Nagercoil stretch, we find 84 species of butterflies (out of 334 in WG), slender loris, flowers *Capparis* sp and *Gmelina asiatica* among others. Dry deciduous forests in SWG in pre-monsoon (summer) period support deer, elephant; migratory birds come in post-monsoon in moist deciduous forest. Other notable rare animals of this forest are Malabar giant squirrel (seed dispersers in forests), effective hunter Indian wild dog, omnivorous sloth bear, common leopard on trees, melanic form black panther,



Four colour widow tetra on hand

herd of Gaurs, painted grasshoppers, orange-black coloured lizard, reed brakes as frog habitats, nests of King Cobra, nocturnal Travancore spiny dormouse, grizzled giant squirrel, grey-headed Canary flycatcher bird, Malabar gray hornbill.

In the evergreen formation, i.e., Grasslands and pristine evergreen forests in Silent Valley of SWG, along with coffee and cardamom plantations, we find riparian river-side habitat, pristine landscapes and slopes. Interesting flora and fauna of these regions include Evergreen langur, epiphytic orchid flower, bamboo orchid flower, *Crotolaria* sp, stream-side flower *Impatiens phoenicea*, brown/Jerdon's palm civet, Dusky striped squirrel, Layard's squirrel, wild red palm trees in steep valleys of evergreen cliffs. Endemic and threatened species lion-tailed macaque remains associated with *Cullenia* trees here. Hill-top evergreen Malabar daffodil orchid is endemic to SWG, also found the edible 'magic' fungi and Lady's slipper orchid. In high altitude grasslands and peatbogs and Montane

Shola Canopy grasslands of SWG, we find epiphytic *Impatiens* sp flower, carnivorous plant sun dew, endemic flower *Soneriella* sp, rusty spotted cat; endemic wild cliff goat Nilgiri Tahr is landmark/flagship species here. Out of 139 mammalian species found in SWG, ten are endemic. Total 22 bird species are endemic, of which Malabar whistling thrush, Nilgiri Laughing thrush, black-and-orange flycatcher are fascinating.

Endemic fishes include *Puntius fasciatus*, *Sahyadria denisonii*, frogs *Nasikabatrachus sahyadrensis*, burrowing frog. Gray slender loris and four squirrels (Travancore flying, Layard's, Dusky striped and grizzled giant) are endemic here. Invasive ornamental flowers, habitat conversion, fragmentation of animal habitats due to hydroelectric power projects and other developmental activities are causing threat to many species in SWG; these threatened and endemic plants, birds and mammals need conservation. Fifty major dams built on 44 rivers of Kerala in SWG.

Clearance of forests for settlements, agriculture and commercial oil-palm, coffee, cardamom, Eucalyptus and rubber cultivation may lead to loss of biodiversity in SWG.

In addition to listening carefully to discussions in both Webinars, News communicator Subrato Ghosh feels that presently the genetically-modified fish *Gymnocorymbus ternetzi*, known by the names 'Glow widow tetra' and 'Colour widow tetra', is an addition to freshwater aquarium fish biodiversity (indigenous and exotic) of WB - the most highlighted and 'talked-about' aquarium fish in WB. Stunning and sparkling red, blue, yellow, green, pink, orange, purple bodied - several colourations of the colour widow tetra created following principles of gene transfer technology. Non-aggressive behaviour, food and feeding habit, body shape, size and distinguishable features are same as like original black widow tetra *G. ternetzi*; only change brought in its body (skin) colour remarkably. It was developed from black tetra for aquari-culture industry and ornamental fish pet trade. Recently from professional aquarium fish growers Sri Monotosh Malick at Baksara-Betor in Howrah and Sri Swapan Mistry at Udayrampur in South 24 Parganas, author came to know that for the first time, in mid-2020, colour widow tetra was imported from Thailand and Singapore in oxygen-packed condition into Kolkata city. It was sold @ Rs 150-200/piece in very beginning. Sometimes

Contd on Page 29

West Bengal Fisheries Dept takes initiative in imparting training to fish and shrimp farmers on scientific aquaculture

Good scope to increase production of fish and shrimp in West Bengal itself and to export fishes

Kolkata: Mr B. Roy Chowdhury, Minister of State, Department of Fisheries, Govt of West Bengal said that the amount of ice-preserved table-sized fishes (Indian major carps) loaded onto big trucks and imported into West Bengal from Andhra Pradesh via National Highway has considerably diminished now in comparison to that done 40 years ago in terms of much lesser numbers of fish-loaded trucks now entering into West Bengal. We have almost achieved self-sufficiency in table-sized fish production. More numbers of unutilized and lesser-utilized village ponds must be brought under and be utilized for modern and scientific fish culture. There is good scope to increase production *via* aquaculture in our state itself and to export fishes. We have enthusiastic youth and aqua-entrepreneurs to give efforts, have outcomes of research, technologies, research facilities in addition to ponds fit for pisciculture. We must have continued perseverance and efforts.

Rural youth community and trainees must be taught the techniques of pond water and soil analysis, fish feed production, planktonic fish food

production in ponds - must be inspired and stimulated to work hard and adopt improved technologies. Fish poaching from culture ponds must be stopped; fish farmers in any village must not be envious. Export of brackishwater shrimps is landmark achievement in West Bengal. Shrimp farmers have to be very cautious in application of medicines in ponds. West Bengal Fisheries Department has taken initiative in imparting training to fish and shrimp farmers on scientific aquaculture, proper application of supplementary fish feed. Roy Chowdhury is hopeful that a community of self-dependent progressive, dignified and honest fish farmers will come up in different villages, will gain respect of others. Extent of fish and shrimp export will increase in days to come along with increase in production; rural West Bengal will advance socio-economically. Private companies involved in aquaculture sector must also think about all-round development of fish and shrimp farmers and others concerned in addition to making profits, they will be recognized as 'Deshopriyo' (nation-loving) companies. We must work together, fish culture in

water bodies must be done with care. It was such an influential speech of Roy Chowdhury, enlightening all the participating farmers present in expo. Other persons who spoke in inaugural session were Sabhapati, Chandipur Panchayat Samity; Ex-MLA, Chandipur Legislative Assembly; Dr U. K. Laha, Officer-in-Charge, Tamluk Project of Comprehensive Area Development Corporation, Purba Medinipur and expert in induced breeding of desi Magur *Clarias batrachus*, and other invited persons.

Subsidy can be given in fish feed and electricity to building confidence within farmers: Dr Jana highlighted the ongoing projects of West Bengal Fisheries Department in this district (New Fish Production Group and PFCS Formation; Fishermen Registration; components of Banga Matsya Yojona in Purba Medinipur as Entrepreneurship Development Schemes; Fish/Shrimp Disease Diagnostic Lab is coming up at Junput, Purba Medinipur; infrastructural development in marine fish landing centres; hatchery accreditation programme for improvement and maintaining good quality of fish seeds). West Bengal

Fisheries Department is emphasizing more on addressing the problems of fish and shrimp farmers and their development, means to bring down production cost, if subsidy can be given in fish feed and electricity to farmers, building confidence within them. Antibiotic residues in export consignments of farmed shrimps from this district is not detected in very recent years, rejection of the same hasn't occurred.

Technical persons of different companies in private sector must also address the problems and needs of farmers:

N. Kayal, Assistant Director of Fisheries (Brackishwater), Purba Medinipur also rightly spoke about the need to address the lacking, needs and complaints in general raised by fish and shrimp farmers in different forum/ meetings. Brackishwater shrimp seeds (*Penaeus monodon*, *Litopenaeus vannamei*) are stocked in farm ponds in this time of the year and culture season begins; harvest done in end-June. Technical persons of different companies in private sector must also address the problems and needs of farmers. Presently *L. vannamei* seeds are not produced in West Bengal, are brought from Tamil Nadu and Odisha which are not always PCR-tested for important shrimp pathogens. Shrimp farmers in this district are not getting the right quality of seeds. Hence, it has been planned to supply PCR-tested seeds from Nachinda and Nandigram to farmers in this district.

Both Government and non-Government sectors must take initiative.

Shrimp feed, medicines and pond inputs required in shrimp farming have become high-priced; which must be sold to farmers at a reasonable rate. At the time of harvest and sale, many farmers (in their own words) are not getting the right price for the pond-grown marketable-sized shrimps which they deserve, and have been deceived. It has to be looked into. If shrimp farmers continue to survive and keep up their economic condition, then every other sector will remain active; farmers must be made aware about the opportunities and be provided necessary facilities of aquaculture. Kayal explained all the aspects comprehensively.

Swami Sarvabhutananda, Principal (*Adhyaksha*), Chandipur Ramkrishna Math and Mission,

Chandipur lauded the improvements in aquaculture technology made in recent past in West Bengal, and that the modern technologies helping fish and shrimp farmers in and around Chandipur to achieve more production.

It has been thought to initiate fish culture in a tank (pond) at this Math and collaboration will be made with Tamluk Project of Comprehensive Area Development Corporation (CADC), Purba Medinipur, Swamiji said. Dr S. N. Jana, Assistant Director of Fisheries, Purba Medinipur mentioned that the technical persons associated with R&D units of different companies participating in this Expo have contributed to all-round development of freshwater and brackishwater aquaculture in West Bengal. Presently the target of annual fish production in West Bengal is 19.0 lakh tonnes and

we are now at a deficit of only 0.5 lakh tonnes, have nearly achieved the target. Now annual freshwater fish production in Purba Medinipur is almost 2.0 lakh tonnes, and the total yearly production from freshwater, brackishwater and marine sectors is 3.5 lakh tonnes.

In the post-lunch session, farmer-oriented technical presentations were made by Dr Partha P. Biswas, Retd. Professor of Zoology, RKM Vivekananda Centenary College, North 24 Parganas, West Bengal on 'Shrimp immunity and immunostimulants - key to sustainable farming', and by News communicator Subrato Ghosh on 'Maintenance of proper water and soil conditions in freshwater fish culture ponds'. Later on, a meeting was organized for all aqua-technicians in the expo that was headed by P. K. Senthilkumar, representing Society of Aquaculture Professionals. Technical

presentations continued on the next day 13 February also. Besides numerous fish and shrimp farmers, BSc and MSc students of Zoology and Fishery and Aquaculture of Mahishadal Raj College, Midnapore City College, Contai P. K. College participated in the event.

The Bengal Aquaculture Expo 2023 was organized by Contai Aqua-Technicians Welfare Association based at Contai town at Chandipur Vivekananda ground, known by the name 'Binay Smriti Maidan', Math-Chandipur, Dist. Purba Medinipur, West Bengal during 12 and 13 February 2023. It was the 10 years celebration of this association. Fish and shrimp farmers from different blocks of Purba Medinipur attended the expo by the regional managers, distributors, senior employees, technicians and technical persons of the companies.

Contn from Page 27

Some thoughts on a new exotic freshwater aquarium fish and biodiversity conservation – a prelude to IBD 22/5/2023

later, those were bought by shopkeepers at Rs 80-82/piece and sold to hobbyists @ Rs 90-100/piece. Since March-April 2021 onwards, its seed production and farming are being done in Howrah and South 24 Parganas districts in private aquarium fish farms. It is now highly preferred by hobbyists and aquarium fish keepers in Kolkata and other parts of West Bengal.

Price of this fish is very much affordable for fish lovers. From a wholeseller and exporter shop at renowned CTI, Dasnagar in Howrah, fish sold at

wholesale rate; standard size @ Rs 6.50/piece and big/breeding size @ Rs 25-30/piece. Mainly five colour fishes available and sold - red, yellow, purple, green and blue. Blue is only seldom available, INR 15/piece standard size, same size purple widow Rs 12/piece. At another big wholesale aquarium shop at CTI Dasnagar, Rs 6.50/piece is price for colour widow tetra (small-medium size); bigger-sized red Rs 18/piece, medium-size green Rs 8/piece, big-size orange Rs 20, medium-size yellow Rs 12, big-size

blue Rs 25, medium-size purple Rs 9/piece. In comparison to year 2021, hobbyists (ornamental fish keepers) in West Bengal had to pay lesser price to buy this GMO fish in 2022 because of high availability in market. From a farm (aquarium fish breeding-cum-rearing unit) at Jagachha, Howrah, the 4-5 months-old adult and standard-size fish in four colourations purple yellow, green, red can be bought @ Rs 9/piece, wholesale rate, one has to buy minimum 500nos.

At the renowned Galiff Street aquarium fish market in north Kolkata, in end of 2022, colour widow tetra was sold for

Rs 10, 15 and 20 to general customers and aquarium fish keepers (one should buy minimum 12nos). In February 2023, the price of three colourations purple, yellow and red at its standard size was offered to customers @ Rs 20-40/piece for minimum 12 pieces. In March 2023 it was Rs 15-20 for big and standard size; little smaller ones costs Rs 12. According to shopkeepers, colour widow tetra, with its vibrant and brilliant colours makes aquarium tank very attractive and captured the market - has led the market down for some familiar aquarium fishes.

BACTERIOPHAGE THERAPY FOR SHRIMP HATCHERY

V PHAGES HATCHERY™

/// EFFECTIVE ON SUPERBUGS



CAA Certified Antibiotic-free Product
CAA/OCT22/PRO/04169

BENEFITS



Broodstock:

Prevents entry of opportunistic pathogens and safeguards health of this high value asset.



Artemia:

Reduces the *Vibrio sp.* load in Artemia tank.



Zoea & Mysis:

Helps in better conversion and survival.



Post Larvae:

Stagewise control of *Vibrio sp.* results in remarkable reduction of *Vibrio sp.* load in post larval tanks. This results in high health seeds.

Works as an Alternative to Antibiotics and complies with International Seafood export regulations.

BEST APPROACH TO CONTROL PATHOGENIC VIBRIOS

V PHAGES HATCHERY ✓✓

PROBIOTIC ✓

SANITISER X
DISINFECTANT XX
ANTIBIOTICS XXX

One Health unified approach for balanced welfare of people, animals and ecosystems.



BACTERIOPHAGE THERAPY TARGETS PATHOGEN

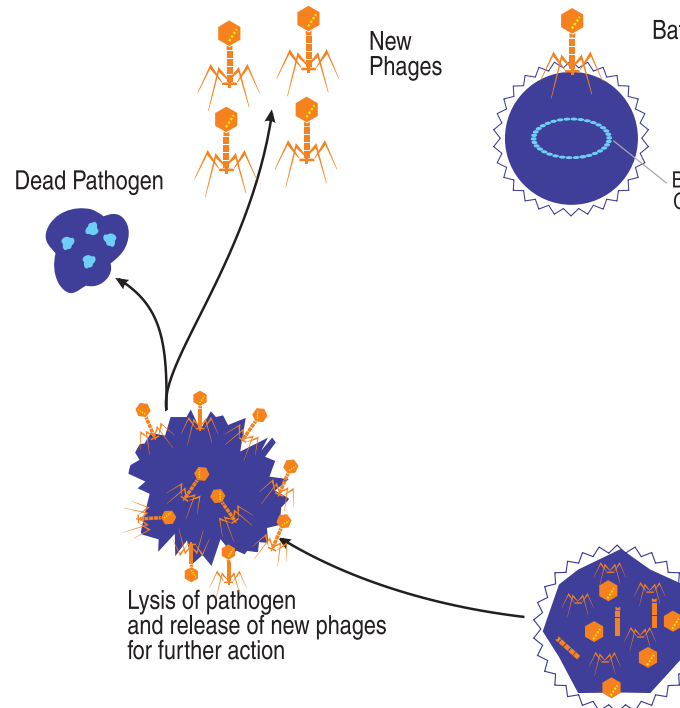
V PHAGES HATCHERY & V PHAGES GROWOUT are a cocktail of phages that are safe on aquatic animals, people and ecosystems. They are resistant to antibiotics and insecticides.

"V PHAGES" cocktail targets against most common pathogens

• *Vibrio parahaemolyticus* • *Vibrio alginolyticus* • *Vibrio cholerae*

100 % Natural | Pathogen specific approach | 100% Effective
Easy & Safe to use | Dose dependent

ILLUSTRATION OF ACTION OF PHAGES



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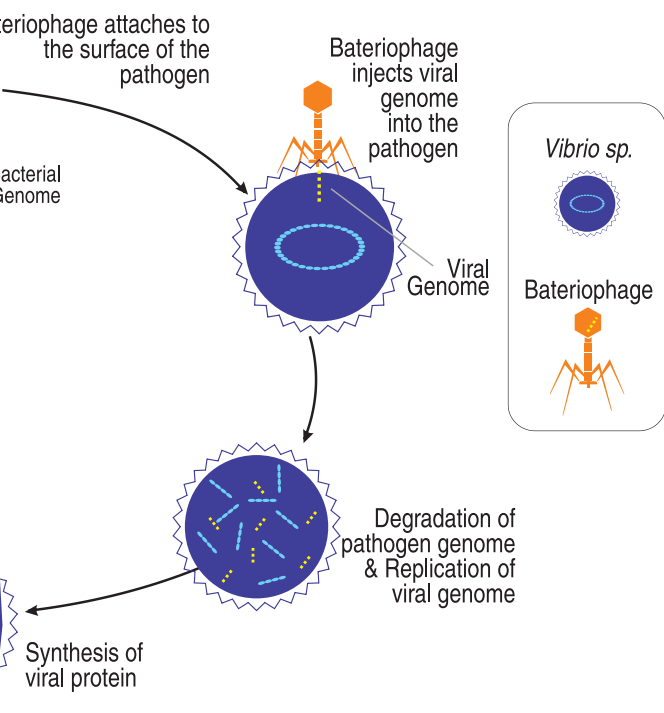
PHAGE TO DESTROY IC VIBRIOS

Cocktail of Phages isolated from Natural environment. Hence... This destroys the pathogenic bacteria which are even... eases the efficacy of probiotics.

enetic *Vibrio species* in Shrimp Hatchery & Farming
parveyi • *Vibrio campbellii* and other pathogenic *Vibrio sp.*

Very Fast action | Enhances Probiotic performance
 Does not leave any residues

ON A TARGET VIBRIO BACTERIA



BACTERIOPHAGE THERAPY FOR SHRIMP FARMS

V PHAGES GROWOUT™

EFFECTIVE ON SUPERBUGS



BENEFITS

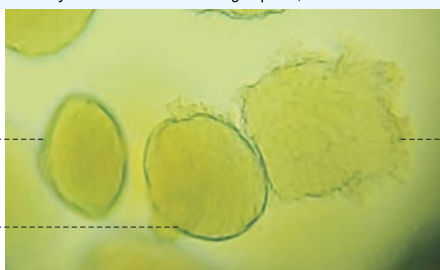
- Effective against Vibriosis, other Bacterial Infections and Running Mortality Syndrome (RMS).
- Effectively prevents Gut Infections and Improves feeding.
- Prevents sudden crop loss and extends Life of Pond during critical profit-making period.
- Enhances Probiotic performance.

Works as an Alternative to Antibiotics and complies with International Seafood export regulations.

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

Colony 1 in Stage 1:
 Intact Colony may be infected or yet to get infected.

Colony 2 in Stage 2:
 Phage infected Colony showing Partial lysis.



Colony 3 in Stage 3:
 Phage infected Colony Completely lysed, cell contents with multiplied phages spreads out in search of their host.

S PRIVATE LIMITED

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BACTERIOPHAGES AS A THERAPY FOR SHRIMP DISEASES

Email: vijay@salemicrobes.com

D. Vijayanand

Director-Business Development, Salem Microbes Pvt Ltd.

Salem Microbes Private Limited, established in 1999, is a pioneer in Probiotics for Animal Health with modern infrastructure and trained manpower, started research initiatives based on bacteriophages in 2018. With its dedicated R&D team supported by qualified field technical staffs and aqua lab, the product design, development and field demonstration is executed flawlessly.

Why Bacteriophages?

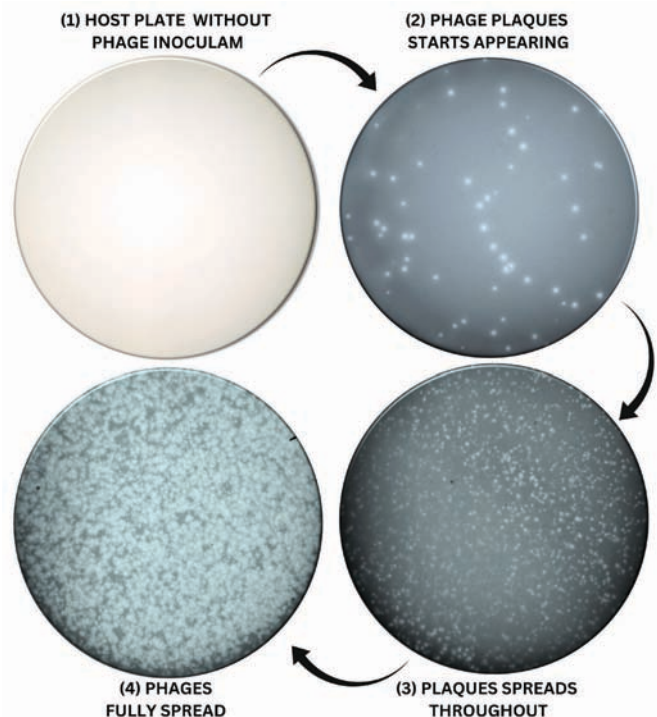
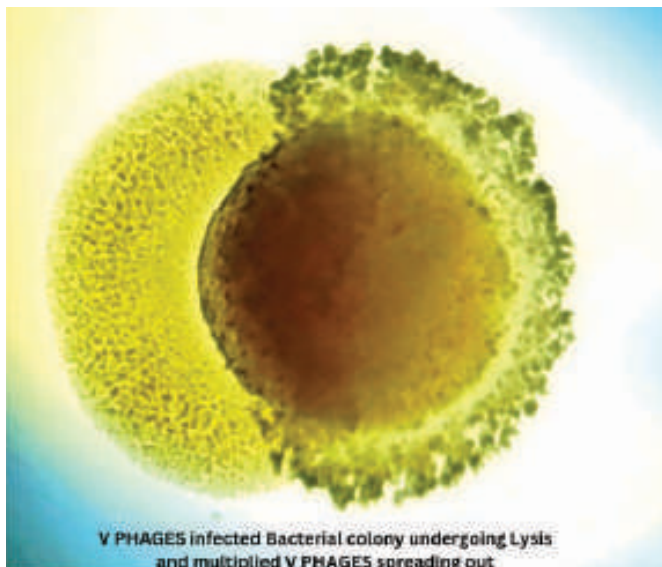
With emergence of highly virulent pathogens in animal health and aquaculture, there is need for highly effective therapeutic product which can reduce usage of sanitisers and antimicrobials. Continuous use of sanitisers and antimicrobials lead to damage of microbiome (the normal non-pathogenic beneficial bacteria) in aquaculture pond ecosystem and shrimp gut. Recent explosion of scientific research has brought to light the importance of maintaining good and unfluctuating microbiome in shrimp and fish health and aquaculture success.

Under this condition bacteriophages against virulent pathogens in aquaculture will be highly helpful in maintaining the natural ecosystem of the pond while killing the aquaculture pathogens. This strong argument inspired

Salem Microbes to initiate bacteriophage research as early as 2018 and has invested in infrastructure, technology and technical competence in bacteriophages-based solution development for aquaculture, poultry and food safety.

Salem Microbes possessing 23 years of probiotic tradition has always travelled with bacteriophages hand in hand from screening to production operations. In the current day scenario, we are 'embracing the foe as a friend' to control pathogens of aquaculture. So, we are just jumping sides and exploiting their potential.

Today, we assure that we are in the forefront of bacteriophage research, specialising in isolation, characterisation, and formulation of phage cocktail within a short turnaround time. Our research and development ensures quick screening in case of a sudden disease outbreak to make custom formulation of bacteriophages from our expansive library of bacteriophages maintained on-campus.



Phages and Probiotics, a Synergistic combination.

Probiotics have played an undeniable role in the environmental management of the shrimp pond and are going to continue to sustain the shrimp ecosystem microbiome, the only catch here is use of quality probiotic inputs which farm owners and technical experts should be aware of.

Probiotics reduce the chances of infection by competitive

exclusion, but once the critical levels of vibrio species dominate the environment, it become nearly impossible for probiotic bacteria to exclude Vibrio species. Such critical condition demands quick and sure shot treatment, which is non residual in nature and non-GMO and which does not affect the (microbiome). Here comes the concept of Phage Therapy which is highly specific and quick acting in nature specifically targeting the aquaculture pathogens.

| SALIENT FEATURES | Probiotics Application only | Bacteriophage Application only | Both Bacteriophages and Probiotics applied condition |
|--|--|---|---|
| Mode of action | Competitive exclusion of pathogens by exhausting nutrients for the pathogens. | Works on identified targeted pathogens by killing them by lysis. | Phages Eradicates Identified pathogens. There by nutrients are available for probiotic microbes. |
| How it manages pathogens ? | Dominates Pathogens but when conditions are conducive for pathogens, they cause disease Long acting | Eradicates pathogens thereby reduces frequency of disease. Self-limiting | Probiotics have a conducive environment to multiply fast and full Phages keeps check on fresh entrants |
| Residual formation | No Residues | No Residues | Phages leaves un-identified Natural Probiotic flora to thrive better |
| How they really work ? | Bacteriocin & Enzymatic action | Cell Lysis of Pathogenic bacteria. | Phages prevents horizontal transmission of toxin bearing plasmids. |
| Source | Non-GMO, Nature isolates | Non-GMO, Nature isolates | |
| Traceability and proprietary nature | | Identified and Genotyping done | |
| Is Product Upgradation possible ? | Continuous Improvement in Performance based on the new strains introduced. | Continuous update of Phages for New Identified Pathogens makes it a safe therapeutic product with broad spectrum of action. | |
| Limitations | Fights with unknown pathogens. Virulent pathogens with Toxins continue to exist, multiply and cause infections. | For Greater Benefit – It's recommended to use Probiotics after this to dominate the environment and maintain positive balance for maximum results. Virulent pathogens with toxins are destroyed, thus halting their propagation. | |

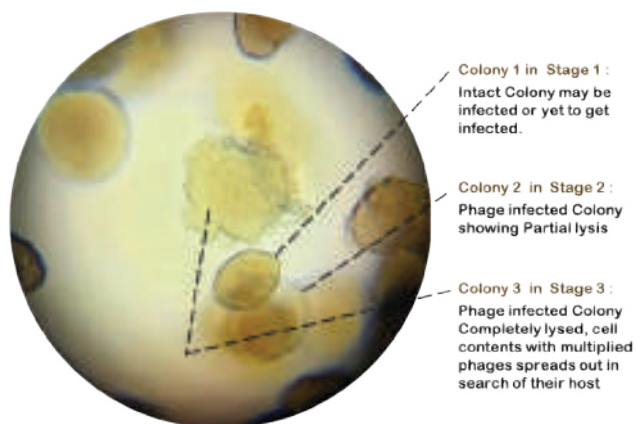
How a Bacteriophage product become relevant to a condition?

A good bacteriophage consortia should contains identified lytic phages, specific against pathogens selected from the target environment. Phage cocktails against Pathogens should be continuously upgraded to maintain the pathogen spectrum, specificity and infectivity.

How does a Phage works?

Bacteriophages are viruses of bacteria which enter the bacteria, use the bacterial source of energy, hijack the bacteria, multiply inside the bacteria and kill them by lysis. When they kill the bacteria, each virus which enter the bacteria multiplies and releases 10 to 100 mature ready-to-

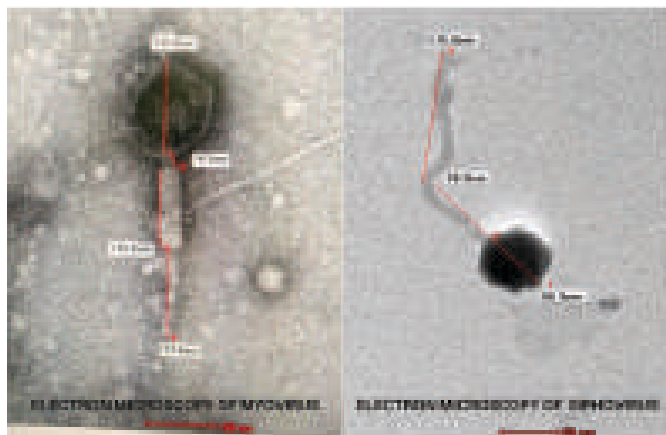
3 Different stages of *Vibrio* Colonies infected with V PHAGES and Progressive Lysis observed on an Agar Plate – Under Stereo Microscope



attack bacteriophages which are capable of infecting and destroying next set of target pathogenic bacteria.

V PHAGES Consortia.

V PHAGES Cocktails for Hatchery and Growout are quite different in their Formulation, specificity and purpose. **V PHAGES HATCHERY** satisfy the need for targeting pathogens specific and prevalent in Hatchery water source, live feeds and also its environment. **V PHAGES GROWOUT** targets the common pathogens esp *Vibriosis* which are the main cause for bringing down the productivity of a shrimp pond by causing *Vibriosis* leading to White gut, White faecal disease, off feed, Running Mortality Syndrome and crop loss.



“**V PHAGES**” cocktails target *Vibrio* species as,

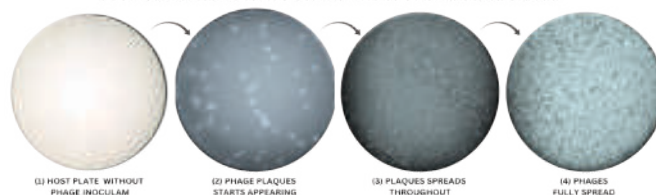
- *Vibrio parahaemolyticus*
- *Vibrio alginolyticus*
- *Vibrio harveyi*
- *Vibrio campbellii* and other pathogenic *Vibrio* sp.

When TO USE IN SHRIMP HATCHERIES?

- To reduce the load *Vibrio* sp. of the live/ wet/ frozen feed used in brood stocks.
- To reduce *Vibrio* sp. load in artemia tank.
- To reduce the *Vibrio* sp. associated problems in



V PHAGES LYTIC ACTIVITY ON A LAWN OF PATHOGENIC *VIBRIO*



Conversion and PL tanks.

- To reduce *Vibrio* sp. load in intake water thereby preventing biofilm formation in the storage. tanks and pipe line downstream of the intake tank.

When TO USE IN SHRIMP GROWOUT PONDS:

- Drop in feed intake with increase in yellow or green colonies in TCBS plates.
- White gut and white faecal matter appearance coupled with more green colonies in TCBS plates.
- Early stages of running mortality syndrome with empty gut symptom.
- During stocking to safeguard against survival loss of PL's.
- To increase the efficacy of probiotics by reducing their primary enemies, the pathogenic *Vibriosis*.

Comparing with Other Therapies.

V PHAGES are natural isolates screened and selected for their strong and fast action against their challenged targets. They do not disturb the probiotics and other non-pathogenic natural microbiome which are otherwise destroyed by other treatment approaches as sanitisers, disinfectants and any products of anti-microbial action. These phages does not leave any residues on the shrimp or environment as they are natural. All bacteriophages in V PHAGES cocktail are genotypically characterized to ensure proprietary formulation and traceability, which makes them special.

Conclusion:

Though Bacteriophage research and applications are known for many years very few products have seen the light of the day. Even these products become irrelevant when they are not supported by a strong expertise in the field and research infrastructure. Salem Microbes has established these capabilities and commits to be in the forefront of giving the best to its farmers to make their shrimps healthy, productive and profitable.

SafMannan

Predictable performance



May the force be with you!

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- Support natural defences
- Reduce pathogen pressure
- Promote gut function
- Mitigate stress impact

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For more info, please contact:

📍 Mr Suvranil Mitra ☎️ +91 8478-972160



At SRIBS, me and my team have a shared vision to drive our company to be counted amongst the best in Aqua Healthcare both for product quality and customer support

SRIBS BiotechniQs awarded as one of the Top 10 Leaders and Achievers from Aquaculture Sector by Industry Outlook Magazine - April 2023. On the occasion, Dr Babu Sudhakar wrecollects his past memories and focuses on future prospects

Commercial Aquaculture in India is of much recent origin. Major initiatives for pond culture of Shrimps started around the year 1990 when some of the big corporate houses set up commercial shrimp production farms in coastal parts of the country. Thus began the gradual progress of Aqua Health Care Industry. Wockhardt which was one of the leading pharma companies in India was the first corporate house to explore and venture into Aquaculture Health Inputs.

Dr Babu Sudhakar started his career with Wockhardt as a Research Scientist and was assigned a role of designing research based scientific products for health care in Aquaculture. He got inspired from the dynamic Chairman and Managing Director Mr Habil F. Khorakiwala through a discussion in which he shared his Vision and Agenda for Aquaculture business.

Dr Babu worked under the leadership of Mr D.K. Chopra, CEO of the company Mr Chopra played a key role in shaping up his career from a mindset of Research Scientist to a Marketing Professional. Over 12 years, he worked and gained a successful working experience at different levels of Technical, Marketing and Business Management. As Head of the unit as Business Manager, he was in charge for Domestic and International marketing operations, responsible for seeding and developing business in South-east, far-east and South American countries besides India.

As a first generation entrepreneur, Dr Babu Sudhakar established SRIBS Biotekno International company in the year 2007 for manufacturing and marketing speciality aquaculture healthcare products to cater in India and international markets. Introduced speciality, unique technological range of branded products well accepted by the farmers and earned a good brand name



Dr Babu Sudhakar, Managing Director, SRIBS BiotechniQs Pvt Ltd

for their quality and performance.

Aqua International, as a renowned Aquaculture monthly magazine is the first to recognise the company's potential in the innovation and performance of aquaculture healthcare products and awarded **Best Upcoming Aquaculture Company Award** at a CEOs Forum and AI Awards function held on 16 October 2015 at Hotel Marigold, Hyderabad, India.

Again Dr Babu Sudhakar has been felicitated by Aqua International with **Best Aquaculture Scientist Award** for his contribution in aquaculture healthcare at a function held on 14 October 2016 at the Gateway Hotel, Vijayawada, Andhra Pradesh.

In the year 2016, Mr D.K. Chopra, his mentor, Ex-boss and a renowned name in agriculture and aquaculture business, with over 4 decades of experience joined on board as Executive Director. The company has been rechristened as SRIBS BiotechniQs Private Limited.

Qualification and Prior Industry Experience

Dr Sudhakar is a microbiologist. Carried out research work for a Doctorate Degree in Microbiology from NEERI (National Environmental Engineering Research Institute), Nagpur. He did Post Graduation - M.Sc and M.Phil from School of Environmental Biology, APS University, Rewa, Madhya Pradesh, India. And further pursued Management Diplomas - DMM from Jamunlal Bajaj Institute of Management Studies (JBIMS), DBM from Narsee Monjee Institute of Management Studies (NMIMS) from Mumbai.

During his research at NEERI, Babu Sudhakar got an opportunity to present and publish more than 25 research publications at various national and international conferences and journals. His research work at National Environmental Engineering Research Institute (NEERI), Nagpur has enabled him to garner 'Institutes Foundation Day Award for conspicuous contributions to R&D Excellence' in 1994-95.

Most Important Business Challenges

Being live-stock culture, aquaculture input business will always remain a challenging segment. Starting from seeding on day one, till the harvest day every day is a challenge for farmers. Availability of quality seeds, disease outbreaks, pond and disease management, and then getting appropriate produce price are the key factors which impact business. For Dr Sudhakar, to run his business in an unorganised segment like aquaculture, where most of the business was being conducted in an unprofessional manner was a huge challenge. We created an opportunity out of this challenge to build up a niche for the company and the products as per the policies and terms controlled by the company. This surely was an achievement. Over the



Dr Babu Sudhakar receiving most admired entrepreneur award

years now the business practices are changing after introduction of GST as also few other regulations, the business is getting more organised.

Growth

Being a science student and a scientist mindset, helps me to understand the technical issues on field. In addition he keeps himself updated about the technological developments in various aspects of Aquaculture. This helps me in picking and adapting most cost effective solutions in the form of finished products or services. Core strategies for any business, more so in aquaculture have to focus on demand generation and ability to retain and expand on our customers. Thus we have built up a strong marketing team to effectively communicate and demonstrate the efficacy and the benefits of our products and technologies. Over the years now our brands have become the first choice of Aqua farmers in select market segments, said Dr Sudhakar Babu.

Guidelines for Business Development

Dr Sudhakar guess for any serious professional entrepreneur, building up a team of committed workforce is amongst the top priorities to successfully manage a growing business. Having worked as a Business Manager in a very professional HR environment for the first 12 years of his career, came very handy for me to build up his team. Thus getting right people on board, focus on training and development, leading all the way as a role model are the keys to build a performing team.

It's always important for the senior management of any progressive

organisation to stay in touch with ground realities, challenges and emerging opportunities at the grassroots level. Now with over 25 years in Aquaculture industry, he has network of his contacts with varied experiences in research, new products/ technologies and emerging trends at global level. Hence, Dr Babu and his team constantly remain updated with latest happenings in the industry.

Challenging Business Task in Career and Overcome

It has been challenging to associate with Aquaculture sector in the early stages of its commercialization where farmers are practicing traditional ways and unaware of scientific practices.

Introducing technological products to farmers who do not understand the concept was very challenging and the only way is to show them the product performance and convince them to use the products. An Aquaculture farmer has to deal with climate changes, disease outbreaks, pond bottom pollution, shortage of seeds and inputs and above all volatility of shrimp prices. Obviously this makes our job as an entrepreneur much more riskier, he stated.

Vision to Lead a Business Successful

Often vision for a business enterprise is stated in form of a philosophical statement. In my considered view having a vision implies visualisation of your dreams based on your understanding of current status, future potential, your ability to succeed backed by an action plan to realise your dreams. At SRIBS, me and my team have a shared vision to drive our company to be counted amongst the best in aqua healthcare both for product quality and customer support, said Dr Sudhakar.

Expanding Business in Aquaculture

Yes. Having a background of an Environment Scientist and being around for a long time in Healthcare Business, naturally pushed me to explore few other emerging opportunities.

In the world we live in, increasing levels of pollution, radiation coupled with stressful lifestyles trigger Oxidative stress – that is the root cause of many modern diseases. Thus the initiative to set up SERENE Envirotech Solutions Private Limited to introduce Next-gen technological products for human

healthcare and wellness segment. One emerging technology innovation is using Molecular Hydrogen as an anti-oxidant and anti-inflammatory agent. Serene has introduced these path breaking technologies for preventive human healthcare of which Hydrogen Inhaler and Hydrogen Water Bottles. UDAZH Hydrogen inhaler is India's first portable, personnel wellness tool. It is a Molecular Hydrogen (H2) generating machine for human consumption. Several scientific studies have revealed that inhaling Hydrogen or consuming Hydrogen rich water has selective anti-oxidant and anti-inflammatory properties to provide amazing health benefits to our body.



Dr Babu Sudhakar and D. K. Chopra felicitating P. V. Narsimha Raju of Ome Enterprises, Amalapuram, a prominent dealer, during an event at Bangkok. Also seen Dileep Chakarvarthy and K. V. Uma Maheswara Rao.

Within one year of its launch Serene was recognised with two awards.

National Award of 'Fastest Growing FMCG product in Healthcare and Wellness' for brand UDAZH and 'Most Admired Entrepreneur' for Dr Babu for Leadership and

excellence for pioneering work in the field of healthcare and wellness in 2022. UDAZH and Dr Babu got recognition as **Asia's greatest Brands and Leaders 2023** at Asia one's recent Award function at Bangkok.

Being a Successful Business Leader -Advice to Young Entrepreneurs

I believe that to be a successful industry leader, one has to relentlessly innovate, update and upgrade your products and services based on changing customer needs to maintain your competitive edge. Improvise - adapt - overcome is the adage I follow to ensure that the organisation remains on growth track, said Dr Sudhakar.



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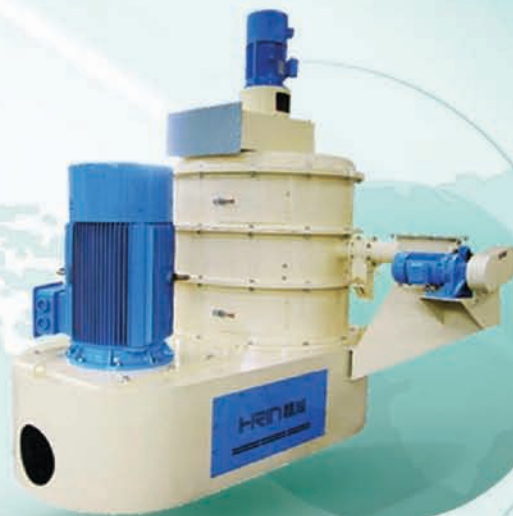
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The motto makes Dr Aman Sayed even more ambitious and hopes to serve in large geographic areas in future

Alltech's Dr Aman Sayed shares his 23 years career journey

Bangalore, India – Dr Aman Sayed is the managing director of India and regional director of South Asia at Alltech. He earned his master's degree in veterinary (Poultry) science from Bombay Veterinary College and was honoured with gold medal distinctions both at graduation and post-graduation. In the mid-2000s, through the work he completed during the last year of his master's program, he realized that there weren't enough veterinary specialists in the field and that customers were in dire need of professional assistance. This realization led him to begin pursuing roles in privately owned enterprises.

His journey began in the year 2000 with setting up an R&D farm for an Iowa-based multinational firm, where he was later elevated to a technical position serving West India. In 2003, he joined Emirates Agriculture Technologies to oversee a free-range poultry project in Sharjah. He gained job experience in Dubai during his time in the Middle East and established Kentucky Equine Research's operations there, working in the equine racing industry.

The opportunity to join Alltech knocked on his door in 2005, and Dr Sayed recalled that moment by saying, "It has been said that everything comes to you at the correct time and that you need to trust the process, and this exactly defines my career."

**“
I feel passionate and energetic about what I do at Alltech; it's what I live and breathe.”**

”



Alltech's Dr Aman Sayed

He initially had the chance to meet Alltech's creator, Dr Pearse Lyons, in 2006. Dr Sayed was profoundly impacted by his encounter with Dr Lyons on multiple levels. Dr Sayed has always been driven by and remains motivated by Dr Lyons' philosophy that problems need to be proactively addressed as soon as possible rather than waiting for them to happen and then reacting. Dr Lyons' advice inspired him to always go that extra mile and helped him land in his current position.

While working at Alltech, Dr Sayed has learnt that every day is a new day and a new beginning. He wants his team to maximize business growth and serve customers to the very best of their ability.

Over the course of more than 17 years with Alltech, Dr Sayed has held a number of positions, rising from business development manager to regional area manager for the business's poultry and dairy operations in West India. Later in his career, he took on the responsibilities

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of general manager of sales for North India and started to manage the markets in Bangladesh and Nepal. He eventually rose to the position of general manager for Poultry in India before being elevated to general manager of South Asia in 2012.

He has participated in numerous professional training programs including the Alltech Mini-MBA program in collaboration with the University College Dublin Michael Smurfit Graduate Business School in Ireland, in addition to getting experience while managing Alltech's multispecies business unit. He gained knowledge from the course about the value of preserving an entrepreneurial attitude and being prepared to take financial risks in order to turn a profit.

As someone who serves in a decision-making role, Dr Sayed has the responsibility of building a team of people who have a strong work ethic. He consistently assesses team members based on three fundamental



to make unbiased decisions guided by the core principles of business growth – but he also endeavors never to neglect the human aspects of empathy, compassion and emotion.

In 2019, Dr Sayed had a meeting with Dr Mark Lyons, Alltech president and CEO, where the Indian Poultry Journalists Association posthumously honoured Dr Pearse Lyons with a Lifetime Achievement Award. At the event, Dr Mark Lyons spoke about Alltech's purpose of Working Together for a Planet of Plenty™ and invited everyone to collaborate, across industry sectors and geographical boundaries, to create a place where animals, plants and people thrive in harmony.

"I am so delighted to be a part of this vision, which focuses on creating a world of abundance for future generations," said Dr Sayed. "This mission continues to drive me to make a positive contribution, as the only way to do exceptional work is to enjoy what you do. I feel passionate and energetic about what I do at Alltech; it's what I live and breathe."

Dr Mark Lyons has shared the proverb, "If you want to travel fast, go alone; but if you want to go far, go together" Dr Sayed is a great supporter of teamwork above individual performance, and taking that route has gotten his team to where they are today. This motto makes him even more ambitious, and he hopes to serve in larger geographic areas in the future.

"Because of their sheer dedication and contributions to society and to my life, I will always be grateful to the Lyons family," said Dr Sayed.

About Alltech:

Founded in 1980 by Irish entrepreneur and scientist Dr Pearse Lyons, Alltech delivers smarter, more sustainable solutions for agriculture. Our diverse portfolio of products and services improves the health and performance of plants and animals, resulting in better nutrition for all and a decreased environmental impact.

We are a global leader in the agriculture industry. Our team produces specialty ingredients, premix supplements, feed and biologicals, backed by science and an unparalleled platform of services.

Strengthened by more than 40 years of scientific research, we carry forward a legacy of innovation and a unique culture that views challenges through an entrepreneurial lens. As a private, family-owned company, we adapt quickly to our customers' needs and focus on advanced innovation.

**“
We are a global leader in the agriculture industry. Our team produces specialty ingredients, premix supplements, feed and biologicals, backed by science and an unparalleled platform of services
”**

**“
While working at Alltech, Dr Sayed has learnt that every day is a new day and a new beginning. He wants his team to maximize business growth and serve customers to the very best of their ability.
”**

values: honesty, openness and diligence. He thinks that everyone who works for any company should uphold these fundamental values. A person's ethics and morals, a growth-focused attitude, and a high degree of engagement, both personally and professionally, can be seen in this trio of characteristics.

Over his 23-year career journey, Dr Sayed has experienced both calm and rough waters while making challenging decisions related to driving business growth and profitability. To tackle these challenges, he has always strived

We believe agriculture has the greatest potential to shape the future of our planet. Our more than 5,000 talented team members worldwide share our purpose of Working Together for a Planet of Plenty™. Together, we can provide nutrition for all, revitalize local economies and replenish the planet's natural resources, said Dr Aman Sayed.

Headquartered just outside of Lexington, Kentucky, USA, Alltech serves customers in more than 120 countries has five bioscience centers, and operates more than 80 manufacturing facilities across the globe.

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|-----------------------|---|-----------|
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| Vitamin-D3 | - | 1000 IU |
| Vitamin-E | - | 15 mg. |
| Vitamin-B1 | - | 1.86 mg. |
| Vitamin-B2 | - | 1.25 mg. |
| Vitamin-B6 | - | 0.62 mg. |
| Niacinamide | - | 30 mg. |
| D-Panthenol | - | 1.26 mg. |
| Inositol | - | 10 mg. |
| Folic Acid | - | 10 mg. |
| Biotin | - | 15 mcg. |
| Vitamin-B12 | - | 6.25 mcg. |
| L-Lysine | - | 175 mg. |
| DL-Methionine | - | 150 mg. |
| Vitamin-C | - | 200 mg. |
| Toxin Binders | - | 200 mg. |
| Hepato | | |
| Pancreatic stimulants | - | 100 mg. |
| LDLP | - | 15mg. |
| USFA | - | 5 mg. |
| APF | - | 30 mg. |
| Calcium Gluconate | - | 20 mg. |
| Magnesium | - | 25 mg. |
| Manganese | - | 15 mg. |
| Cobalt | - | 15 mg. |
| Zinc | - | 25 mg. |
| Selenium | - | 2.5 mcg. |
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Transgenic Fish Production and its Application in Fisheries

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Email: deepakbfsc@gmail.com

Highlight Points

- ▶ Transgenic fish have been generated for a variety of uses, including the development of human treatments, experimental models for biological study, environmental monitoring, ornamental fish, and aquaculture.
- ▶ Transgenic fish contain heterologous DNA introduced and integrated into their genome through gene transfer technologies such as microinjection, electroporation, etc.
- ▶ Several factors contribute to the success of Aquaculture through Transgenesis.
- ▶ Important steps to produce transgenic fish.
- ▶ Transgenic fishes with increased growth efficiency have higher feed conversion efficiency, resulting in economic and environmental benefits such as reduced feed waste and effluent from fish farms.

Introduction

Transgenics are organisms that have had heterologous DNA (transgene) introduced and integrated into their genomes. The homologous and heterologous transgenes were microinjected and electroporated into newly fertilised and unfertilized eggs to create this transgenic fish species. (Gorodnet *al* 1989 and Jaenisch *et al.*, 1990). The following six factors contribute to the success of aquaculture (Chen T.T *et al.*, 1998).

- Complete control of the cultured fish species' reproductive cycle

- Excellent genetic background of the brood stock
- Efficient detection and effective prevention of disease infection
- Understanding of the optimal physiological, environmental, and nutritional conditions for growth and development
- Sufficient supply of high-quality water
- Application of innovative management skills
- To maintain this growth factor, molecular biology and genetic engineering technology are being used, which can aid in improving growth rates, controlling reproductive cycles, improving feed compositions, producing vaccines, enhancing disease resistance, and improving good genetic stock.

Important steps are required to produce transgenic fish (Chen T.T *et al.*, 1998).

- i) Selection of an appropriate fish species;
- ii) Preparation of a gene construct;
- iii) Introduction of the transgene into fish embryos; and
- iv) Selection and characterization of the resulting transgenic fish

Selection of Fish species

Several different fish species have been utilised as experimental animals for the development of transgenic fish, including channel catfish, common carp, goldfish, Japanese medaka, loach, northern pike, rainbow trout, salmon, tilapia, walleye, and zebrafish (Fletcher *et al.*, 1991., Hackett.P.B., 1993 and Chen.T. *et al.*, 1998) The embryos of some fish species are better suitable for gene transfer experiments than others, depending on the goal of the transgenic fish studies. Japanese medaka (*Oryzias latipes*) and zebrafish (*Barchydanio rerio*) have short life cycles (3 months from hatching to mature adults), generate hundreds of eggs on a regular basis without exhibiting a seasonal breeding cycle, and can be easily maintained in the laboratory for 2 to 3 years.

These two fish species' eggs are huge (0.7 to 1.5 mm in diameter) and have very thin, semi-transparent chorions,



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allowing for simple microinjection of DNA into fertilised eggs. As a result, these fish species are good candidates for gene transfer experiments for

- Studying developmental regulation of gene expression and gene action;
- Identifying regulatory elements that regulate gene expression;
- Measuring promoter activity; and
- Producing transgenic models for environmental toxicology.

However, one of these two fish species' significant disadvantage is their small body size, which makes them unsuitable for several endocrinological and biochemical studies. In transgenic fish experiments, big body size model fish species such as channel catfish, common carp, rainbow trout, and salmon are widely used.

These fish species are highly suited for comparative endocrinology and aquaculture investigations since their endocrinology, reproductive biology, and basic physiology have all been thoroughly studied. However, because many fish species have a long maturation period and just one spawning cycle each year, development in this sector will be limited. The third group of model fish species appropriate for gene transfer experiments is loach, killifish, goldfish, and tilapia, because their body sizes are large enough for most biochemical and endocrinological studies. Furthermore, compared to catfish, rainbow trout, or salmon, transgenic progeny can be manipulated more easily due to shorter maturation durations. Unfortunately, lack of a well-defined genetic background and asynchronous reproductive behaviour make gene transfer experiments difficult for these fish species (Chen T.T *et al.*, 1998).

Preparation of Transgene Constructs

Recombinant gene constructs that produce gene products at appropriate amounts in the intended tissue(s) at the desired time are utilised to make transgenic fish for fundamental research or application (s). As a result, the prototype of a transgenic is normally built in a plasmid with a promoter/enhancer element and a structural gene sequence.

Transgenes are grouped into three main types:

- i) Gain-of-function,
- ii) Reporter function and
- iii) Loss-of-function.

If the genes are expressed properly in the transgenic individuals, gain-of-function transgenes are meant to add additional functions to the transgenic individuals or to make it easier to identify them. Gain-of-function transgenic constructions include those that have the structural genes of mammalian and fish growth hormones (GH) genes (or their cDNAs) linked to functional promoters like chicken and fish -actin gene promoters. Increased growth hormone production and eventual growth augmentation will occur from transgenic people expressing the GH transgenes

(Zhang *et al.*, 1990; Du, S.J. *et al.*, 1992; Lu. J.K *et al.*, 1992; Chen. T. T *et al.*, 1996 and Chen T.T. *etal.*, 1993). Transgenes with reporter function include bacterial chloramphenicol acetyl transferase (CAT), -galactosidase, or luciferase genes linked to functioning promoters. These reporter function transgenes are widely employed to determine whether or not a gene transfer endeavour has been successful. A reporter gene's most important function is to detect and measure the strength of a promoter/enhancer element. The structural gene of CAT, -galactosidase, or luciferase is joined to a promoter/enhancer element in this situation. The production of reporter gene activity is utilised to determine the transcriptional regulatory sequence of a gene or the strength of a promoter following gene transfer. The "loss-of-function" transgenes are designed to interfere with host gene expression. These genes may encode an antisense RNA that interferes with endogenous mRNA translation or post-transcriptional processing. These genes could also encode a catalytic RNA (a ribozyme) that can cleave particular mRNAs and therefore prevent the usual gene product from being produced. Although these genes have not yet been tested in a fish model, they could be used to create disease-resistant transgenic brood stocks for aquaculture or transgenic model fish that are deficient in a certain gene product for basic research (Moavet *al.*, 1992 and cotton *et al.*, 1989).

Methods of Gene Transfer

Foreign DNA has been introduced into animal cells, plant cells, and mammalian germ lines using techniques such as calcium phosphate precipitation, direct microinjection, lipofection, retrovirus infection, electroporation, and biolistic bombardment. Direct microinjection and electroporation of DNA into newly fertilised eggs have been proved to be the most reliable techniques of gene transfer in fish systems among these approaches.

Microinjection Methods

In the early 1980s, microinjection of foreign DNA into newly fertilised eggs was established for the generation of transgenic mice. Transgenes have been introduced into Atlantic salmon, common carp, catfish, goldfish, loach, medaka, rainbow trout, tilapia, and zebrafish using this technology since 1985 (Chen.T.Tet *al.*, 1998).

Due of its simplicity and stability, the microinjection method has been employed successfully in the generation of transgenic fish. Microinjection gives altered fish embryos a better chance of survival than electroporation. In fish, microinjection is the most well-known method of gene transfer. The transgenic is immediately microinjected into the male pronuclei of fertilised eggs, allowing for delivery of the transgene straight into the nucleus. In the last decade, transgenic technology has advanced dramatically thanks to DNA microinjection into zebra fish embryos. DNA inserted into the cytoplasm of fertilised zebra fish eggs was found to integrate into the fish genome and be passed down through the generations. In zebra fish, the frequency of germline transmission of microinjected DNA could reach 20% (Lucy Towers., 2016.)



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Transfer of foreign DNA into fish by direct microinjection is a common practise. Separate dry containers are used to collect the eggs and sperm. Fertilization begins with the addition of water and sperm to the eggs, followed by moderate stirring to aid fertilisation. Within the first few hours of fertilisation, fertilised eggs are microinjected. A dissecting stereo microscope and two micromanipulators, one with a microglass needle for delivering transgenes and the other with a micropipette for holding fish embryos in place, make up the injection setup.

Approximately 10^6 - 10^8 molecules of a linearized transgene (with or without plasmid DNA) are injected into the egg cytoplasm in roughly 20 nl on a regular basis. The embryos are injected and then incubated in water until they hatch. The survival rate of injected fish embryos varies by fish species, but it ranges from 35 percent to 80 percent, with a rate of DNA integration of 10 percent to 70 percent in the survivors. In some fish species, such as rainbow trout and Atlantic salmon, the stiff chorions of fertilised eggs can make insertion of glass needles in microinjection difficult.

This problem can be solved using one of the following methods:

- a) Inserting injection needles through the micropyle,
- b) Microsurgery to make an opening in the egg chorions,
- c) Mechanical or enzymatic removal of the chorion,
- d) Reducing chorion hardening by initiating fertilisation in a solution containing 1 mM glutathione, or
- e) Injecting the unfertilized eggs directly.

Electroporation

Due to a high number of fertilised eggs can be treated in a short period of time, electroporation has been proven to be the most successful method of gene transfer in fish. Electroporation is a technique that uses a series of short electric pulses to pierce the cell membrane, allowing the transgene to enter the cytoplasm and then be delivered to the nucleus by the cellular machinery. Because of its efficiency, speed, and simplicity, electroporation has been used in many laboratories for gene transfer in fish systems (Lucy Towers., 2016).

Foreign DNA can be successfully transferred into bacteria, yeast, plant and animal cells in culture via electroporation. In recent years, this approach has proven popular for transferring transgenes into fish embryos. Electroporation is a technique that uses a series of short electrical pulses to permeate cell membranes, allowing DNA molecules to enter embryos. Among electroporated embryos, the rate of DNA integration is on the order of 20% or greater in the survivors. Although the overall rate of DNA integration in transgenic fish produced by electroporation may be comparable to or slightly higher than that achieved by microinjection, the time required for handling a large number of embryos by electroporation is orders of magnitude less than that required for microinjection. Several research groups have recently reported effective electroporation of sperm rather than embryos for the introduction of foreign DNA into fish.

As a result, electroporation is regarded as a highly effective and adaptable method of bulk gene transfer. A faulty pantropic retroviral vector has been produced recently as a new gene transfer vector.

The long terminal repeat (LTR) sequence of Moloney murine leukaemia virus (MoMLV) and transgenes are packed in a viral envelope containing vesicular stomatitis virus G-protein (VSV). Because VSV's entry into cells is facilitated by the VSV-G protein interacting with a phospholipid component of the cell, this pseudo typed retroviral vector has a wide host range and can transmit transgenes to a variety of cell types. Transgenes encoding neo^R or galactosidase have been delivered into zebrafish and medaka using the pantropic pseudo typed defective retrovirus as a gene transfer vector. Dwarf surf clams and crayfish (manuscript in preparation) were recently used to evaluate the viability of utilising a pantropic pseudo typed retroviral vector for delivering genes into marine invertebrates and crustaceans.

Identification of Transgenic Fish:

The identification of transgenic individuals is the most time-consuming stage in the production of transgenic fish. Dot blot or Southern blot hybridization of genomic DNA extracted has traditionally been used to determine the presence of transgene. Although this approach is costly, time-consuming, and insensitive, it provides a definitive response as to whether a transgene has been successfully integrated into the host genome. If proper restriction enzymes are used in the Southern blot analysis, it can also reveal the pattern of transgene integration. A polymerase chain reaction (PCR)-based test has been used to handle a large number of samples efficiently and economically (Lu. J. K. *et al.* 1992 and Chen.T.T.1993).

Biosynthetic Growth Hormone and Growth Enhancement:

For several fish species, growth hormone (GH) cDNAs and genomic DNAs have been extracted and described. When rainbow trout or striped bass GH cDNA is expressed in *E. coli* cells, a considerable amount of physiologically active recombinant GH polypeptide is produced (Agellonet *al*1988 and Cheng *et al.*, 1995). Agellonet *al* 1988 demonstrated that giving yearling rainbow trout the recombinant trout GH led in considerable growth increase in a series of *in vivo* tests. The weight increase in the hormone-treated group was two times larger than that of the controls after four weeks of treatment with recombinant GH at a dose of 1 g/g body weight/week in yearling rainbow trout.

The hormone-treated groups significant was two times higher than the control groups. Hormone-treated animals gained a significant amount of length. The same growth-promoting effect was observed when the same recombinant hormone was given to rainbow trout fry by submerging them in a GH-containing solution. These findings are consistent with those of Sekineet *al.*, 1985 and Gill *et al.*, 1985 and a number of other researchers. However, when more than 2pg/g body weight of the hormone were administered to the test animals, the growth enhancing impact of the biosynthetic hormone was dramatically diminished.

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Paynter and Chen. 1991, found that the “dipping approach” of administering recombinant trout GH to spats of immature oysters (*Crassostrea virginica*) resulted in considerable increases in shell height, shell weight, wet weight, and dry weight. They also discovered that oysters given recombinant trout CH, natural bovine GH, or bovine insulin utilised more oxygen per unit time than control oysters. These findings strongly show that exogenous injection of recombinant fish growth hormone can improve finfish and shellfish somatic growth.

Transgenic Fish Carrying Growth Hormone Gene

Although exogenous application of biosynthetic GH improves fish growth, it may not be cost effective due to the following factors:

- The cost of producing a large amount of purified recombinant GH is too high
- Treating individual fish with the hormone is labour intensive
- Determining the optimal hormone dosage for each fish species is difficult
- GH uptake into fish from an exogenous source is inefficient.

Despite the fact that several groups have reported efforts to transfer human or fish GH genes into several fish species over the last 15 years, only Zhang *et al.*, Du *et al.*, Lu *et al.* and Martinez *et al.* have documented conclusively that a foreign GH gene can be: (a) transferred to the target fish species; (b) integrated into the fish genome; and (c) genetically transmitted to the subsequent generation.

Introducing Chinook salmon GH cDNA driven by the promoter of the ocean pout antifreeze protein gene into Atlantic salmon eggs resulted in a more significant growth boost in transgenic fish. Some of the transgenic animals grew at a far faster rate than their non-transgenic counterparts. Lu *et al.* found that both P and F transgenic medaka carrying a chicken α -actin gene promoter/human GH gene construct or tilapia carrying carp- α -actin promoter rtGHcDNA demonstrated considerable growth augmentation when compared to non-transgenic siblings in a series of recent experiments. The P, transgenic tilapia grew at a rate that was several times faster than the controls. Recently, the effect of the ICF-I transgene on somatic growth in medaka and tilapia was investigated. The ICF-I transgenic medaka and tilapia not only developed quicker during embryonic development, but they also grew significantly faster.

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Adverse consequences of intensive aquaculture system

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Highlight Points

- ▶ Aquaculture expansion and development is so fast and progress but beside its causing several problems to environment
- ▶ Use of high valued feed, various machine and so on cause impacts on greenhouse gas emission.
- ▶ It affects the productivity, genetic diversity, survival, growth, reproduction, distribution and so on changes of cultured stocks in aquaculture system

Introduction

Aquaculture is one of the fastest developing sectors in the world and recently playing and it will be the big part for the expansion and enhancement of the global fish production. It defines as rearing of aquatic organisms in the aquatic body such as freshwater, brackish water and marine water in controlled conditions. Several inventions and approaches of advanced technology in the aquaculture field perform a major part for achieving the maximum production from any type of aquaculture system. Aquaculture production has expanded since the 1980s and it has been contended that it will be further expand in field of marine and as well as in inland aquaculture. Therefore, this sector further exaggerates and spreads, however, it should recognize the pertinent the environmental and social concerns (e.g., antimicrobial resistance, impacts arising from feed production, competition for land and water, water pollution etc.) and make aware to address them in backed with systematic suggestion and a transparent manner.

Advanced technologies cause environmental impacts

Aquaculture facing several challenges for sustainable development and its expansion. Due to its challenges and continued to growth for fulfillment of seafood global demand leads to changes in environmental conditions. Currently numerous modern technologies have been developed to maintain the optimum water quality, feed nutrient requirement, feed, disease control measures, stocking densities, modernized enclosures, etc. to fulfillment the targeted fish production. But at the same time, these modernized techniques cause release of several harmful gasses such as carbon dioxide, nitrous oxide, methane etc. that directly causes detrimental adverse effect to the environment.



Several environmental impacts of intensive aquaculture system are associated with high-input, high-output intensive systems. The drawback on commercial aquaculture includes discharge of suspended solids, nutrient and organic enrichment of receiving water, and build-up of anoxic sediments that negatively affect crop production. However, the extent and nature of these impacts vary with intensity of production, farm infrastructure and site location. Having a large number of fish kept closely together in a small area means that any diseases or parasites are likely to spread much more quickly. Thereafter, there is great chance of nutrients build up in the environment surrounding the fish because there is nothing to prevent dead fish, food that isn't eaten and feces entering the water column from the cages and other enclosures.

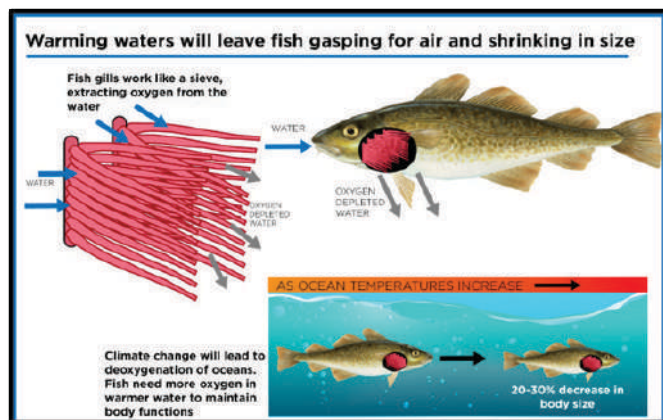


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Aquaculture contributes to greenhouse gas emissions

The continually development of aquaculture sector mainly rely on aqua feeds which causes nutrient loading in the form of carbon dioxide (CO₂) and methane (CH₄) in the water bodies. It is estimated that only 25% of nitrogen consumed by fish was converted into biomass and the rest usually released into the water bodies in the form of unionized ammonia. According to Global Feed Survey aqua feeds (39.9 Mt) alone contributes 10.9 TgC and 1.82 TgN that discharge in the aquaculture system. The manufacture and transportation of feed ingredients and preparation of pelleted feeds and their transport to farms contribute 50 to 60% of the carbon footprint.



Aquaculture contributes significant emission of greenhouse gas (GHG), during operations, production, transportation, processing, and storage of fish. Viable fish or shrimp culture ponds with both night time aeration and artificial substrates release more carbon dioxide than traditional ponds and methane released in the day and night. However, aquaculture itself accounts for a meagre 0.5 % of global carbon emissions and aeration contributes another 20 to 25% of the footprint.

Currently farming commercial species in different enclosures, is common practice. Usually enclosure such as pen, net cages, pond and tanks broadly used by farmers. There is huge amount of methane production from paddy field where plant materials regularly decaying and release into the soil but in case of aquaculture system in which large amount of uneaten feed by the cultured species from enclosures that release the more amount of methane, carbon dioxide and nitrous oxide into the water as compared to paddy fields. Recent study declared that about 28 tonnes of carbon dioxide are discharged from aquaculture ponds per acre every year as equated to 8.15 tonnes from traditional rice paddy fields. However, the global warming potentials from 8.15 ± 0.43 to $28.0 \pm 4.1 \text{ MgCO}_2 \text{ eq ha}^{-1}$, primarily increases because of high level of CH₄ emissions.

There is an information regarding greenhouse gas emission by harvesting, transportation and processing of fish there after finally reach to the market. However, during these steps a huge amount of energy used by the farmers for pumping water, powering vehicles, lightning etc. are the prospective source of greenhouse gas emissions (FAO, 2017).

Impacts of greenhouse gas emission on aquaculture system

The emission of GHGs directly or indirectly effects on climatic condition and further contributes to global warming. However, climate change and global warming causes an increase in physiological stress on the cultured stock and increases the disease incidence, rising sea level, low groundwater, eventually leading to financial losses to the farmers in aquaculture system. Therefore, finally it affects the productivity, genetic diversity, survival, growth, reproduction, distribution and so on changes of cultured stocks in aquaculture system. Hence, these GHGs will reduce the productive and sustainable development of aquaculture system (Cochrane et al., 2008).

Therefore, by adoption of comprehensive and integrated ecosystem approaches will be helps to reduce the level of GHGs emissions and subsequently helpful for sustainable aquaculture expansion with socially and economically feasible.



Methane gas and oil spills affects fish health

Resolution concepts

In every field there is a strength and weakness fragments. However, in intensive aquaculture system these are the major problems aroused. But by adoption of certain solution these problems can be reduced. Resolutions will come in a several ways. Technology must be more efficient for the production and expansion of fish and fisheries and that may lead to less waste entering into the ecosystems. There are also several general resolutions to get rid of these above problems. These might include:

- Select the right site and making sure it is assessed correctly
- Use native species to minimise impacts of escaped fish
- Keeps farms local and smaller
- Not overstocking to minimise waste
- Improvement of feed quality (i.e. feed that doesn't disintegrate as quickly)
- Certification and legislation around sustainability
- Best management practices for waste, using techniques such as settling lagoons or treatment tanks.

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Metabolomic Studies of Carbohydrate Metabolism in Fish



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Highlight Points

Fish nutrition is the complex and meticulous branch of science where newer inventions taking place now and then, so it is evident that for an appropriate, effective feed formulation, one should have a thorough idea of the nutrition and feeding habits of the cultured animal. There comes the omics techniques to enhance our understanding of several nutrients, metabolites, genetic approaches on the target animal.

Fish nutrition is the complex and meticulous branch of science, where newer inventions taking place now and then, so it is evident that for an appropriate, effective feed formulation, one should have a thorough idea of the nutrition and feeding habits of the cultured animal, with trials being made to replace fish meal by plant - based ingredients and through the usage of other sustainable sources hence advanced knowledge regarding how the nutrients interact with each other and within the cells of the body, how they are digested, absorbed across the enterocytes and how they are transported to their active sites and further whether they end up in anabolism / catabolism pathway. There comes the omics techniques to enhance our understanding of several nutrients, metabolites, genetic approaches etc.

What is meant by metabolomics ?

Metabolomics is the scientific study of substances with lower molecular weight (anything lesser than 5000 Da / <1500 Da), which means the study of metabolites / metabolome / substrate of metabolism present in the biofluids, cells etc. metabolites comprise of various compounds, including amino acids, carotenoids, flavonoids, carbohydrates, nucleotides / nucleosides etc. This approach has a wide application in the fields of health, nutrition and molecular biology. Nowadays, more

advanced research has been carried out in humans; also, it is extended to livestock and fish nutrition.

CHO metabolism in fish:

Fishes are the only vertebrates that are energy - efficient, and they require a high protein diet compared to terrestrial animals. Hence aquatic animals generally have no specific requirements towards CHO inclusion in the diet. Still, CHO plays a vital role in regulating the cost of the feed and is involved in the protein - sparing effect to some extent, whereas in the case of shrimp, they can utilize CHO even better than lipids, and certain herbivores fishes can utilize CHO efficiently, unlike carnivorous fishes like salmon, sea bass etc.

Fishes are generally considered to have a low tolerance to insulin because the time taken for glucose clearance is high. Generally, fishes are considered naturally diabetic, but fishes do produce insulin, but their affinity is not like mammals. Insulin level in unfed fish is 1 - 3ng / ml, whereas in the case of fed fish, its Slightly higher 5 - 48ng / ml (Kaushik et al.,1999). Once the CHO has been digested and absorbed, it reaches the blood stream as monosaccharides, where the other process occurs in the liver because most of the enzymes required for metabolism are present there. Specific tissues like the brain use glucose as the source of energy in the fish body. Sometimes Excess CHO can be stored as lipid in the liver and adipose tissues through lipogenesis.

Four major CHO metabolic pathways are present in fish of that glycolysis is the most significant catabolic pathway.

| | |
|--|---|
| Glycolysis (glycolytic enzymes skeletal muscles > heart > brain > kidney > gill > liver) | Breakdown of glucose for energy purposes. |
| Gluconeogenesis (the reverse process of glycolysis) – liver / kidney | Formation of glucose from non-CHO substrates (pyruvate, amino acids, lactate) |



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| Glycogenesis | Formation of glycogen from excess glucose in the body which will be stored in muscle in the case of large fish and mainly in the liver in the case of small fish of <i>Carassius</i> . (Matti Vornanen et al., 2011) |
| Glycogenolysis (mobilization of reserves) | Breakdown of stored glycogen to glucose (another major catabolic pathway in fish next to glycolysis) |

Metabolomic studies in fish Nutrition:

Two significant instruments that have a significant role in fish nutrition for metabolomic studies include MS (Mass spectroscopy) and NMR (nuclear magnetic resonance). Because these analytical methods are sensitive and provide holistic ideas about the unknown compound, among these two, MS has a higher sensitivity because of the ability to identify metabolites in biofluids present in a minor concentration of the range of the μM .

Using metabolomics in CHO metabolism:

With this approach, we can assess the effects of fish feed with different dietary composition and their effect on the metabolism in the fish body by assessing the significant tissues involved in metabolism; in the case of CHO, we can use liver, muscle etc. especially white skeletal muscle and biofluids like blood, mucus, faeces can also be assessed without sacrificing the animal.

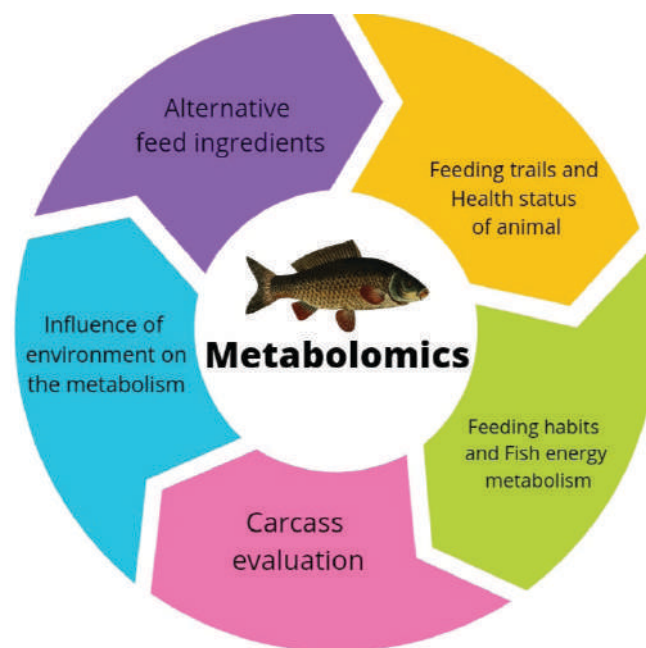
In the case of diets rich in CHO when administered to fish using the metabolomic approach, it is found that there is an increase in glycogen stores. High lactate concentration is the end product of glycolysis under anaerobic conditions that occur due to chronic stress in fish.

Almost more than a decade lot of research had been carried out to replace marine ingredients with plant-based when using them in diets apart from ANF and digestibility level of CHO in ingredients is also high, hence by applying the metabolomics approach, it is easy and accurate to determine the different types of metabolites which are the end product of metabolism and it is influenced by the type of diet given we can compare the test diet with the control diet having the marine ingredients and draw a conclusion regarding the influence of high or low CHO diet on metabolites produced, it has been observed that glycolysis and gluconeogenesis pathway is influenced by plant-based diet (Roques et al., 2019).

The post-prandial rise in glucose level may arise because of feed metabolome or may be due to catecholamines produced during stress that influence the glycogenolysis pathway (Cheng et al., 2016). When herbivores fish is fed upon a diet high in CHO, it was observed that there was a hike in the hepato-somatic index (Prathomya et al., 2017). Specific nutrient-nutrient interactions with the body of fish can also be assessed by metabolomics; one such instance

is the decrease in glucose when tyrosine and betaine are added to higher levels in the diet.

Significance of Metabolomics in Fish Nutrition:



Source: Author creation

Conclusion:

With the help of the metabolomics approach in fish nutrition, we can redefine our understanding of metabolism to an advanced level added. It helps us understand the overall nutritional status of the fish and the health of the animal. As far as CHO metabolism is concerned, there is a lot to crack, particularly with the carnivorous fishes and will definitely play a role in widening our understanding of novel-feed formulation strategies.

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*More references can be provided on request.

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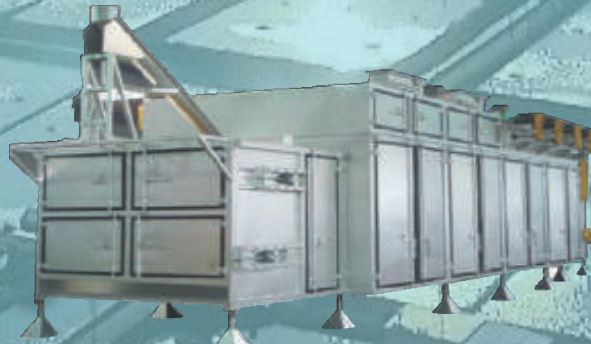
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

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