Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 7, Issue, 11, pp.22127-22130, November, 2015

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

AQUACULTURE & MARINE BIOTECHNOLOGY PROGRAMME IN INDIA

***Ninawe, A. S.**

Department of Biotechnology, New Delhi, India

ARTICLE INFO

Article History:
Received 30th August, 2015
Received in revised form
16th September, 2015
Accepted 01st October, 2015
Published online 30th November, 2015

Key words:

Aquaculture, Programme, India,
Biotechnology, Products, Marine.

ABSTRACT

Marine biotechnologyis likely to play a major role in the commercial production of bio-active molecules and pharmaceuticals. The global market for products from marine biotechnology is forecast to reach over US$ 4.8 billion by 2020 and therefore marine bio-resources offer a lot of scope for the health and well-being of aquaculture production in the country through marine bio-business. In India, the developments in the field of aquaculture have been put forth by governmental initiations like DBT programme. Hence, in this article, those developments have been dealt briefly to create awareness among the public.

***Citation*:** Ninawe, A. S. 2015. "Aquaculture & marine biotechnology programme in India", *International Journal of Current Research*, 7, (11), 22127-22130.

INTRODUCTION

Marine biotechnology has been a major focus world-wide through bio-discovery of marine microbes, invertebrates, micro-algae and macro-algae. This is likely to play a major role in the commercial production of bio-active molecules and pharmaceuticals. According to a New Report by Global Industry Analysts (2015), the global market for products from marine biotechnology is forecast to reach over US$ 4.8 billion by 2020, and therefore marine bio-resources offer a lot of scope for the health and well-being of aquaculture production in the country through marine bio-business. In this article, themes, outcomes and initiations of DBT and other governmental programme were dealt briefly to give awareness about the developments in the field of aquaculture in India.

DBT's theme paper

DBT has been supporting the programme area of Aquaculture & Marine Biotechnology, covering both R&D and applied aspects through competitive grant scheme with the operational inputs from the Task Force Committee and with impetus during Brain Storming Sessions and workshops. For the past two decades, the Department has been concentrating on developing technology for seed production and grow-out pond culture for economically important finfish and shellfish species, and also on seaweeds.

**Corresponding author: Ninawe, A. S.*
Department of Biotechnology, New Delhi, India

It has been demonstrated that the technology developed by the department can produce fresh water prawn up to 1.5 to 2.0 ton/ha. Farmers who adopted this technology have been benefited. It is also noteworthy to mention that DBT has demonstrated high production rate in shrimp culture through semi intensive shrimp culture technology by producing 10 t/ha per annum in two crops.

Research on induced breeding and maturation in commercially important fish and shrimp species has been carried out. Research has also been focused on various aspects such as Diagnostics, Vaccines, Recombinant products, Anti-microbial Peptides, Immunostimulants, High-energy and high-protein Aquaculture Feed, Fish Spawning Agents, Human Therapeutics (Omega-3 and 6), Water Quality Management, value addition and product & process development. Inventorisation and digitalization of marine and coastal bio-resources pertaining to marine mollusk are being carried out. Proposals through Public-Private Partnerships were pursued for leads in water re-circulatory system and management of metabolite load in the culture operations.

Outcomes of DBT programme

During the last plan (2007-12), the Department has given major attention to aquatic health management. The emphasis was on development of technology for screening healthy population of shrimp/fish brooders based on molecular markers. In India, the loss of shrimp due to white spot

syndrome virus (WSSV) has been estimated to be about US$ 1.50 million per year (Adams *et al*., 2008). Application of various technologies especially biotechnological tools has made an impact in reducing disease risk. In addition, recent technologies are contributing to the future enhancement of aquaculture production. For this, the efforts were directed towards the development of a number of conventional and molecular diagnostics and therapeutics. These efforts have also been strengthened through Indo-Norwegian joint collaborative projects on development of vaccines against viral and bacterial pathogens encountered in Indian aquaculture systems. As the outcome of DBT funded projects, several sensitive and specific diagnostic assays (Vaseeharan *et al*., 2003; Rajendran *et al*., 2005) have been developed to detect viral pathogens such as WSSV, fish nodavirus (VNN) and other pathogenic viruses. These successful diagnostics (Fig. 1) based on either single step or nested PCR methods are available in the names of Ampli-WSSV kit, Dr. Sahul's Kit, Genei WSSV kit, Mangalore Biotech kit, IQ2000 etc., Apart from these methods, loop mediated isothermal amplification method (LAMP) has been developed for diagnosing WSSV and white tail disease (WTD) associated *Macrobrachium rosenbergii* nodavirus (*Mr*NV) and extra small virus (XSV) (Musthaq *et al*., 2006).

Vaccine is very important to prevent diseases in aquaculture systems. The DBT has funded many R&D projects to develop vaccines (Sarath babu *et al*., 2013) against different viral and bacterial pathogens of fish and shrimp. Recombinant and DNA vaccines have been developed for *Aeromonas hydrophila*, *Vibrio anguillarum*, *Edwardsiella tarda*, fish nodavirus, WSSV and *Mr*NV. Recombinant vaccines using different genes such as OmpTS, Aha1 and OmpW have been developed and their efficacy against *A. hydrophila* was tested and found to be effective. Inactivated whole WSSV vaccine, recombinant subunit vaccine and DNA vaccine using different viral genes have been proved to be useful in small scale against WSSV in shrimp. Protection of *Fenneropenaeus indicus* from WSSV has been demonstrated using formalin-inactivated WSSV. Of all viral genes, VP28 structural gene of WSSV is found to be the most suitable candidate gene for demonstrating vaccine based protection. The protective efficiency of pVP28 against WSSV was evaluated in *Penaeus monodon* by intramuscular challenge, revealing maximum survival rate to experimental post infection of virus (Kumar *et al*., 2008). The DBT has also implemented Indo-Norwegian program to develop vaccines for viral and bacterial pathogens encountered in Indian aquaculture systems. At the end of this program, the vaccines would be available for use in the aquaculture sector.

Different types of Immunostimulants of bacterial or plant origin have been developed for cultivable organisms for their protection from viral and bacterial pathogens. Laboratory studies indicate that administration of a commercial Aquastim MBL by immersion or through feed stimulates the immune system of shrimp in hatchery, showing significant improvement in survival. Commercial herbal immunostimulant named, IMMUZONE is derived from a group of terrestrial plants through extraction process. It contains a group of compounds, which improves the defensive mechanism of shrimps and other crustaceans through their synergic effect. It does not contain Glucans and Mannans. Immuzone increases the defensive mechanism of shrimp by enhancing the hemocytic activities. Higher levels of prophenol oxidase and nitric oxide were observed after ingestion of immuzone coated feed in pond reared shrimp (Venkatesan *et al*., 2014).

Recently, a project on application of RNAi to control WSSV in shrimp has been funded by the DBT and good leads have been obtained. This project has been further extended by another three year to apply these leads to produce WSSV-free shrimp brooders and seeds. Tissue culture and the development of cell lines from fish are priorities for pathogen detection, toxicological studies, carcinogenesis, cellular physiology, and genetic regulation and expression studies. The DBT has funded projects to different research institutes to develop fish cell lines from marine and freshwater fish. Within a short period of six years, more than 50 fish cell lines (Fig. 2) have been established from economically important fish for scientific research. The DBT has also funded NBFGR to establish a National Repository to maintain these cell lines for future use (Nagpure *et al*., 2013).

The DBT has also funded a project to develop feed for aquaculture sector. An enrichment aquafeed with cellulolytic and amylolytic microbes has been developed for feeding *Lates calcarifer* (Asian seabass), *Chanos chanos* (milk fish), *Mugil cephalus* (Grey mullet) and *Etroplus suratensis* (Pearl spot) (CIBA annual report 2009-10).

Probiotics are 'bio-friendly agents', such as *Lactobacillus*, yeasts and *Bacillus sp.* They could be employed in the culture environment to suppress and fight against pathogenic bacteria and to enhance the growth of the farm cultured organisms (Ninawe and Selvin, 2009). They even play a significant role in promoting the innate immunity of the organism against the environmental stressors. Soil probiotic to breakdown the organic load at the pond bottom, antagonistic probiotic for killing bacterial pathogens, water probiotics for keeping the water clean and gut probiotics which help in digestion are being applied in Indian aquaculture systems. The DBT has funded quite a number of projects to develop probiotics for aquaculture use.

Governmental initiations in aquaculture fields

HRD support to Aquaculture & Marine Biotechnology was the major initiative during 2000-2005. The programme for fisheries personnel was successfully operated through the institutes at CIFE, CIFT, CIFA and CDFD by imparting about 3-6 months of both theoretical and hands on training. Under this programme, more than 300 scientists and researchers have been trained and many of them have started working on applied aspects and have published many papers in reputed journals, filed patents and have brought out commercial leads.
The department has taken a major initiative in strengthening the infrastructure and facility to bring about academic excellence in Aquaculture & Marine Biotechnology both in basic and applied aspects. During the 10th plan, the Department has provided support to two institutions by sanctioning a dedicated programme support on Aquaculture & Marine Biotechnology at College of Fisheries, Mangalore, and Cochin University of Science & Technology, Cochin.

The Department has been laying major emphasis on the creation of a Centre of Excellence in the area of Marine Biotechnology addressing important areas like RNAi technology, nano-technology, extremophiles, cell-line development and their application, user friendly diagnostics and vaccines for new emerging diseases, immuostimulants, brood-stock development, production of disease free seeds, low cost feed development, and post harvest technology, natural product development, bio-fuels from marine algae, novel microbialenzymes for industrial applications, novel drugs from marine organisms for medicinal value, etc.

Industry promotion schemes are being supported by the Department for product process development with the involvement of small and medium enterprises working in biotechnology. The dedicated industry promotion schemes, SBIRI and BIPP have benefitted the sector by providing funding to aquaculture based companies who are seriously engaged in products and process development of high value and export potential. The Department is also supporting international collaborations in the various sectors of biotechnology including marine biotechnology.

Fig. 1. Indigenous diagnostic kits developed for white spot syndrome virus of shrimp and fish nodavirus

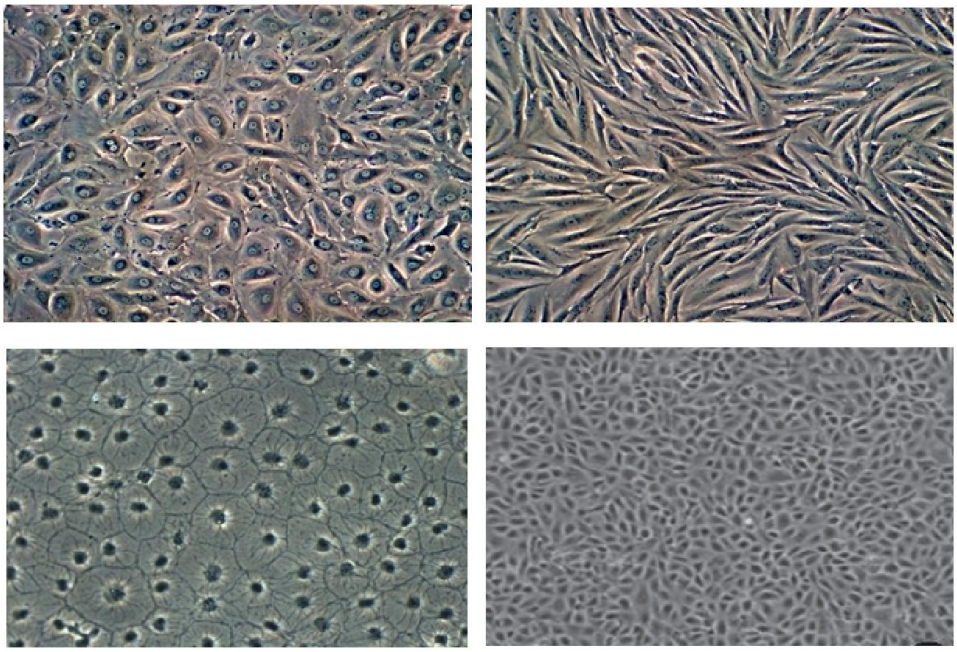

Fig. 2. Cell lines developed from Indian fish species (Source for figure 1&2: Dr. A. S. Sahul Hameed, CAH Abdul Hakeem College, Melvisharam, TN India, with his permission)

Indo-Norway collaboration on fish and shellfish vaccine development has shown good leads for vaccine development. The DBT is also working on bio-fuels programme and is supporting various R&D activities under Energy Bioscience programme. The focus has been on bio-energy and bio-fuels including biodiesel/bio-ethanol using different feed stocks. Algal Bio-fuel has an enormous potential. The priority areas identified are: Collection, screening, taxonomic identification, algal biodiversity; development of uni-algal cultures of suitable strains, and establishment of culture collection centres. The DBT has supported Biotech Parks in few states, namely Biotechnology Parks and Incubation Centres in Lucknow, UP, Biotechnology Park at Bangalore (Karnataka), and Biotechnology Parks, in the states of Kerala, Punjab and Himachal Pradesh.

These biotech parks have been established to facilitate product advancement and innovation through the development of a biotechnology industrial cluster and to produce biotechnologists and entrepreneurs having strong foundation in research and innovation. As such there is no dedicated marine biotechnology park supported by DBT. Efforts are on to consider the request from the promising states for the establishment of a biotech incubator with the active participation of the state government for setting up of biotech parks in the states. The University of Science and Technology at Cochin, Kerala, is working on projects in Marine Biotechnology covering aspects like genotypic characterization, gene-sequencing and isolation of novel enzymes and marine natural products and biomaterials, as well as establishing a database on marine biotechnology with the infrastructure and manpower support provided by the Department of Biotechnology. But still, more are to be discovered in aquaculture field in order to prove ourselves in this field world-wide.

REFERENCES

Adams A, Aoki T, Berthe FCJ, Grisez L and Karunasagar I 2008. Recent technological advancements on aquatic animal health and their contributions toward reducing disease risks–a review. Diseases in Asian Aquaculture VI. Fish Health Section, 71-88.

Kumar SR, Ahamed VI, Sarathi M, Basha AN and Hameed AS 2008. Immunological responses of Penaeus monodon to DNA vaccine and its efficacy to protect shrimp against white spot syndrome virus (WSSV). *Fish & Shellfish Immunology*, 24(4): 467-478.

Musthaq SS, Sudhakaran R, Ishaq Ahmed VP, Balasubramanian G and Sahul Hameed AS 2006. Variability in the tandem repetitive DNA sequences of white spot syndrome virus (WSSV) genome and suitability of VP28 gene to detect different isolates of WSSV from India. *Aquaculture,* 256: 34–41.

Nagpure NS, Kumar A, Dubey A, Mishra AK, Kumar R and Goswami M 2013. Establishment of National Repository of Fish Cell Lines (NRFC) at NBFGR, Lucknow. https://www.researchgate.net/publication/260436225

Ninawe AS and Selvin J 2009. Probiotics in shrimp aquaculture: avenues and challenges. *Critical Reviews in Microbiology*, 35(1): 43-66.

Rajendran KV, Vijayan KK, Santiago TC and Rajan JJS 2005. White spot syndrome virus (WSSV) infection in tiger shrimp *Penaeus monodon*: A non-lethal histopathological rapid diagnostic method using paraffin and frozen sections. Aquaculture International, 13(4): 341-349.

Sarath Babu V, Abdul Majeed S, Nambi K S N, Taju G, Madan N, Sundar Raj N, *et al*. 2013. Comparison of betanodavirus replication efficiency in ten Indian fish cell lines. *Archives of Virology*, 158 (6): 1367-75.

Vaseeharan B, Jayakumar R and Ramasamy P. 2003. PCR-based detection of white spot syndrome virus in cultured and captured crustaceans in India. *Letters in Applied Microbiology*, 37(6): 443-447.

Venkatesan C, Sahul Hameed AS, Sundarraj N, Rajkumar T and Balasubramanian, G. 2014. Analysis of Immune Genes and Heat Shock Protein Genes under Exposure to White Spot Syndrome Virus (WSSV) and Herbal Immune Stimulant in Litopenaeus vannamei. *Journal of Bacteriology & Parasitology*, 5(5): 1-12.

****