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Improved fish health: Key to succesful aquaculture

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Abstract

Intensification of aquaculture has become an important practice in recent years to optimize the returns. High density stocking, providing artificial feeds and fertilization of the pond water have become common husbandry practices in both fish and shrimp culture systems. Due to intensification of culture practices in aquaculture, diseases caused by microbes have surfaced significantly in culture systems. Use of expensive chemotherapeutants and antibiotics for controlling disease have widely been criticized for their negative impacts like residual accumulation in the tissue, development of the drug resistance and immunosuppression, thus resulting in reduced consumer preference for food fish treated with antibiotics. Hence, instead of chemotherapeutic agents, increasing attention is being paid to the use of probiotic bacteria as microbial control agents. Another alternative to pathogens, use of immunostimulants for disease control measures in aquaculture. An application of immunostimulants for the prevention of fish diseases are considered as an attractive and promising area. In the present study the beneficial effects of probiotics and immunostimulamts on the health and disease resistance of fish have been elucidated.

Keywords: probiotics, immunostimulant, aquaculture and pathogen

Introduction

Indian aquaculture is highly promising and has grown over six and half fold in the last two decades with freshwater aquaculture in India contributing over 95% of the total aquaculture production; it is based on low input technology, mainly using organic fertilisers and agro-products; and it is dominated by the culture of Indian major carps (FAO, 2014) [6]. India's aquaculture production can be classified into freshwater and brackish water production. The development support provided by the Indian Government through a network of 429 Fish Farmers Development Agencies (FFDA) and 39 Brackish Fish Farmers Development Agencies (BFDAs) have been the principal vehicles for the development and growth of freshwater and coastal aquaculture (Ayyappan, 2014) [1]

The IMCs, commonly known as carps (family - Cyprinidae), are considered to be the largest family of fresh water fishes with over 2,400 species; and they form the major aquaculture species in tropical countries, contributing about 97% of the total fresh water production (Talwar and Jhingran, 1991) [19]. The IMCs include *Catla catla* (Catla), *Labeo rohita* (Rohu) and *Cirrhinus mrigala* (mrigal); and their production have reached to over 1.8 million tonnes (Gopakumar *et al*., 1999; FAO, 2010) [3, 7]. The second important groups of carps cultured in India are exotic carps *Hypophthalmichthys molitrix* (Silver Carp), *Ctenopharyngodon idella* (Grass Carp) and *Cyprinus carpio* (Common Carp) (FAO, 2010) [3].

World Fish Production (SOFIA, 2016)

A.	Capture:	i) Inland	: 11.9 million tonnes
		ii) Marine	: 81.5 million tonnes
		Total	: 93.4 million tonnes
B.	Culture:	i) Inland	: 47.1 million tonnes
		ii) Marine	: 26.7 million tonnes
		Total	: 73.8 million tonnes
C.	Total Production		: 167.2 million tonnes

India is the Second largest country in aquaculture production in the world. In India the present fish production is about 10.79 million tonnes (3.58 million tonnes for marine and 7.21 million tonnes for Inland Fisheries). Through Intensive Culture of composite fish farming Production ranges 4320 kg/ha/year. (NABARD, 18 Dec 2013).

The growth of aquaculture industry has accelerated over the past decades; resulting in environmental damages and low productivity of various crops. The need for increased disease resistance, growth of aquatic organisms, and feed efficiency has brought about the use of probiotics in aquaculture practices. The study aims to present comprehensive notes for the use of probiotics and immunostimulants in aquaculture sector.

Constrains in aquaculture production

From a production of less than 1 million tonnes per year in the early fifties the global aquaculture production reached 73.8 million tonnes in 2014, with the Asia – Pacific region accounting 89% of the global aquaculture production (SOFIA, 2016) [5]. India has abundant fresh, brackish and marine water resources, currently either under – utilized or unutilized for aquaculture, and a rich biodiversity to harness for farming in fresh, brackish and marine water – bodies. The present scenario is that only freshwater aquaculture, notably carp culture, is witnessing considerable growth with minor contribution from catfish and freshwater prawns. In the freshwater aquaculture, 87% of India's aquaculture is on account of major carps and there is a need to bring more species and technology development for seed production for different varieties of fish (Ayyappan, 2013) [1].

However, with the intensification of efforts for producing more amounts of fish from unit volume of water, a number of associated stressors like overcrowding, frequent handling, grading, transport and deteriorating water quality tend to adversely affect the health of cultured fishes (Sinha, 1998) [17].

Constraints in aquaculture production from shrimp farming largely include

Conversion of agriculture land, salt pans, mangrove areas, salinization of aquifers, destruction of mangrove, displacements of labour, use of poor quality seed and feeds and injudicious feed managements practices, outbreak of disease, use of banned chemicals ; antibiotics and pharmaceuticals, impact of farm effluents on the vicinity of discharge points, safety of the farmed product for human consumption, water quality parameter, non-adaption of improvised improved culture system like re - circulatory culture system, raceway culture, cage culture, pen culture are the major constraints in shrimp farming (Moriarty DJW, 1999) [14]

Nutritional Deficiency in Farmed Fishes

All nutrients required for the well-being and normal growth of the fish must be supplied in formulated diets as available (digestible) nutrients. Otherwise, the fish cannot utilize the nutrients present in the feed ingredients (Lovell, 1998) [21]. The formulated diets also must be pelleted and processed in such a manner that they are durable and water stable. Proper feeding of a quality diet should be considered as a high priority in the daily routine on fish culture stations. Wasted feed depletes oxygen levels, causes gill damage, and supports fungal and bacterial growth, all of which can lead to disease problems (Moriarty D, 1997) [13]. The main factors influencing nutritional deficiency in our culture fishes are as follows:

1. Environmental Factors: Fluctuation in water temperature, DO, pH, Alkalinity,
2. The energy content of the diet
3. Lack of appetite or retarded growth because stress and disease
4. Non – adoption of improvise culture practices
5. Toxins and Anti-Metabolites present in feed
6. Vitamin and Micro – Nutrient absent in feed
7. Essential – Amino Acids are present in feed but in less quantity
8. Disease caused by excess protein present in feed
9. Size of Feed particles or forms
10. Feeding Schedule's and frequency
11. Development of diet formulations and feed management practices that promote efficient and cost-effective production while maintaining the health of the cultured species.
12. Entry of wild fishes (Vectors of Pathogens) Lall, 1998 [11]

Remedies

Intensive aquaculture practices have necessitated the development of an individual's resistance to disease rather than depending upon antibiotics and chemotherapeutics or vaccines. This has resulted in reduced fish growth and production, necessitating addition of some growth promoters, immunostimulant and aquatic probiotics (Cruz *et al*., 2012) [15]

Use of probiotics in fish feed

Contribution from aquaculture sector to the world's fish basket is increasing and maintaining its position as one of the fastest growing food production activities. However, disease outbreaks are constraint to aquaculture production thereby affects both economic development of the country and socio-economic status of the local people in many countries of Asia-Pacific region (SOFIA 2014) [4]. Disease control in aquaculture industry has been achieved by following different methods using traditional ways, synthetic chemicals and antibiotics. However, the use of such expensive chemotherapeutants for controlling diseases has been widely criticized for their negative impacts like accumulation of residues, development of drug resistance, immunosuppressants and reduced consumer preference for aqua products treated with antibiotics and traditional methods are ineffective against controlling new diseases in large aquaculture systems (Sahu *et al*., 2008) [12]. Therefore, alternative methods need to be developed to maintain a healthy microbial environment in the aquaculture systems there by to maintain the health of the cultured organisms. Use of probiotics is one of such method that is gaining importance in controlling potential pathogens. (Sahu *et al*., 2008) [12].

Microbes are very important and have critical roles in aquaculture systems, at both hatchery and grow out level because water quality and disease control are directly related and closely affected by microbial activity (Verschuere *et al*., 2000) [22]

Probiotics are basically of two types – nutritional and water/aquatic (Sahu, 2008) [12]. Aquatic probiotics principally inhibit the growth and decrease the pathogenicity of the pathogenic bacteria, improve the quality of the aquaculture water and decrease the use of antibiotics and other chemicals; thus decreasing environmental contamination. Use of aquatic probiotic is an alternate method to maintain a healthy congenial environment in aquatic systems thereby to maintain health of cultured organisms (Table 1 and 2). While nutritional probiotics are live microbial feed supplement which beneficially affects host animal by improving its intestinal microbial balance.

Commercially available probiotics are as follows

- *Lacto bacillus*
- *Streptococcus faecalis*

- *Streptococcus faecium*
- *Bacillus mesentericus*
- *Bacillus subtilis*
- *Bacillus natto*
- *Clostridium butyricum*
- *Saccharomyces cerevivisiae*
- Alkaline Protease
- Lipase

Table 1: Proven probiotic microorganisms

Lactobacillus strains	Bifidobacterium strains	Other lactic acid bacteria	Non-lactic acid bacteria
L. rhamnosus GR-1	*B. lactis* Bb 12	*Lactococcus lactis LIA*	*Escherichia coli* strain nissle
L. rhamnosus GG (LGG)	*B. infantis* 35624		*Saccharomyces boulardii* lyo
L. reuteri RC-14 *B*	*B. breve* strain Yakult		
L. casei DN114001	*B. animalis* DN 117-001		
L. acidophilus LA-1	*B. lactis* HN019		
L. reuteri SD2112	*B. longum* BB536		
L. plantarum 299v			
L. casei Shirota			
L. acidophilus LB			
L.rhamnosus HN001			
L.salivarius UCC118			
L.acidophilus NCFM			
L.fermentum VRI003			
L. johnsonii Lj-1			
L. paracasei F19			

Table 2: Details of Probiotic Company

S. No	Product Generic Name	Brand Name	Bio / Chem	Physical Properties	Level of Inclusion Suggested	Usage Recommended
01	Soil Probiotic	Prosol	BIO	Liquid	5 Lt / Ha	First application 3 days before stocking thereafter, once in 21 days
02	Soil & Water Probiotic	Prowaso	BIO	Powder	1 Kg/Ha	First application 3 days before stocking thereafter, once in 21 days
03	D O Improviser	Genoxy	CHEM	Powder	1 Kg/Ha	First application 3 days before stocking thereafter, once in 15 days
04	Ph Reducer	Reduce	CHEM	Liquid	2 Lt/Ha	Once in 10 days
05	Fungicide	Fungex	CHEM	Liquid	2 Lt/Ha	Preventive **:**once in 21 days
					4 Lt/Ha	curative **:**
06	Dyno Flagellate Controller	Dynoff	CHEM	Liquid	2 Lt/Ha	Preventive **:**once in 21 days
					4 Lt/Ha	curative**:**
07	Algicide	Algicheck	CHEM	Liquid	2 Lt/Ha	Preventive **:**once in 21 days
					4 Lt/Ha	curative **:**
08	Protozo- acide	Protoff	CHEM	Liquid	2 Lt/Ha	Preventive **:**once in 21 days
					4 Lt/Ha	curative **:**
09	Zootham- nicide	Zoothaff	CHEM	Liquid	2 Lt/Ha	Preventive **:**once in 21 days
					4 Lt/Ha	curative**:**
10	Sanitiser	Sanise	CHEM	Liquid	0.5 Lt/Ha	Preventive :once in 21 days
					1 Lt/Ha	curative**:**
11	Lake Colourant	Stay blue	CHEM	Powder	1 Kg/Ha	Preventive **:**once in 21 days
					2 Kg/Ha	curative**:**
12	Gut Probiotic	Progut	BIO	Powder	5-10 G/Kg of Feed	Regularly
13	Gill Flukes	Wormex	BIO	Powder	0.5 Kg/Ha	Once in 21 days
14	Molting Inducing Hormone	Moltin	CHEM	Powder	2-5 G/Kg of Feed	On every ashtami & navami
15	Growth Promoter	Progro	BIO & CHEM	Powder	5-10g/Kg of Feed	Alternate days
16	Zeolite Con.	Biozeo	BIO	Powder	125 Kg / Mt of Zeolite	
17	Hardness Controller	Liquizeo	CHEM	Liquid	2 Lt/Ha	Once in 21 days
18	Liver Stimulant	Stimuliv	HERBAL	Liquid	5 Ml/Kg of Feed	Alternate days
19	Vibrio Controller	Vibrichek	BIO	Powder	2 Kg/Ha	Preventive **:**once in 21 days
					4 Kg/Ha	curative**:**
20	Fungistatic	Fungistat	BIO	Powder	2 Kg/Ha	Preventive **:**once in 21 days
					4 Kg/Ha	curative**:**
21	Gas Adsorbant	Gasorb	Bio Chem Herb	Powder	0.5 Kg/Ha	Once in 15 days
22	Gel Binder	DRYGEL	Chem	Powder	1kg in 20 lt premix	premix @ 2-5 ml/ kg feed
23	Natural Antibiotics	BIOMED	Phyto	Liquid	1ml/ kg feed	once in a week
24	Shell Care	SHELLCARE	Bioherbochem	Powder	2-5 g/ kg feed	once in a week
25	DO Improver	Sodium Percarbonate	Chem	Powder	1 kg/ acre	Once in 15 days
26	DO Improver	Zinc Peroxide	Chem	Powder	1 kg/ acre	Once in 15 days
27	pH Reducer	REDUCE				

28	ACRIFLAVINE	ACRIFLAVINE	Chem	Powder	60 g / Acre/ 2 m water	when problem arises
29	PROFLAVIN	PROFLAVIN	Chem	Liquid	1 kg/ acre	when problem arises
30	Lernea and Argulus Care	IVERMIN	Chem	Powder	1 Kg/ Ton Feed	Three days
31	Sex Reversal Hormone	REVF2M	Chem	Liquid	0.5 ml/ kg feed	alternate day 7 administrations at farm level; 4-5 administrations at hatchery level
32	Columnaris Care	TRIACT	Chem	Powder	1 kg/ acre in pond water	once in 15 days as preventive.As curatice in feed @ 75g/ ton feed five days.
33	Ovulation Blocker	OVUBLOCK	Herbochem	Powder	1 kg/ ton feed	Three days

The application of probiotics in aquaculture shows promising results, but needs considerable efforts of research. It is essential to understand the mechanisms of action in order to define selection criteria for potential probiotics. Therefore, more information on the host/microbe interactions *in vivo*, and development of monitoring tools (e.g. molecular biology) are still needed for better understanding of the composition and functions of the indigenous microbiota, as well as of microbial cultures of ‘‘probiotics’’ (Balcazar *et al*., 2006) [2]. The use of probiotics is an important management tool, but its efficiency depends on understanding the nature of competition between species or strains.

Immunostimulants

Recently, many researchers have focused their interest on medicinal plants due to increasing demand for health food. Herbal medicines are known to exhibit anti microbial activity, facilitate growth and maturation of cultured species. The anti-stress characteristics of herbs will be of immense use without any environmental hazard (Citarasu, 2010) [20]. Administration of some herbal extracts or their products at various concentrations through oral (diet) or injection route has enhanced the immune response of different freshwater and marine fishes against various diseases (Ramasamy *et al*., 2011) [8].

Herbal based immunostimulants are capable of enhancing nonspecific and specific defense mechanisms and/or reducing losses from viruses, bacteria and/or parasitic infections in carp (Sakai M., 1999) [16]. In fish, the immunostimulants are known to increase certain aspects of innate immunity. Natural immnuostimulants are biocompatible, biodegradable and safe for the environment and human health. Herbal extracts and animal originated products have a potential application as an immunostimulant in fish culture, primarily because they can be easily obtained, are not expensive and act against a broad spectrum of pathogens (Aruldoss, 2014) [10].

Formulated Feed

Various formulated types of fish feeds can be used viz. herbal immunostimulant incorporated diets in combination with aquatic probiotic would help in enhancing production of fish and betterment of rural economy (Ganguly, 2013) [18]. An integrated approach by using combi ned probiotics (= microecologics) is also gaining importance. Aquatic probiotics are the ones which can proliferate in water medium and exclude the pathogenic bacteria by consuming all available nutrients (Cruz *et al*., 2012) [15]. Use of aquatic probiotic delineates the trophic interactions and defines the pattern of nutrient and energy flow, providing specific tools for environmental modifications and establishing the delicate balance between host, pathogen and environment (Cao *et al*., 2015) [9]. Similarly incorporation of nutraceutical, nutrizymes and growth promoters would help in enhancing production of fish and betterment of economy.

Conclusion

Herbal immunostimulants and probiotics have immense potential in aquaculture. The constituent of living system are more acceptable, less toxic, inexpensive and cost effective. The herbal extracts are also eco-friendly as they are biodegradable. Hence, our rich traditional knowledge about the medicinal plants could replace the expensive imported prophylactic therapeutics drugs and their undesirable side effects. Thus, probiotics and herbal products as nutraceutical can prove very effective in aquaculture operation.

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References

1. Ayyappan S. Handbook of Fisheries and Aquaculture. Indian Council of Agriculture Research publication (ICAR), India, 2013.
2. Balcazar Jl, Blas I, Ruiz-Zarzuela I, Cunningham D, Vendrell D, Muzquiz JL. The role of probiotics in aquaculture. Vet Microbiol. 2006; 114:173-186
3. FAO. The State Of World Fisheries and Aquaculture, 2010.
4. FAO. The State of World Fisheries and Aquaculture, 2014.
5. FAO, The State of World Fisheries and Aquaculture, 2016
6. FAO. National Aquaculture Sector Overview India, p. 1; Ministry of Agriculture, Department of Animal Husbandry, Dairying and Fisheries. 2014. Handbook on Fisheries Statistics. 2014, 5.
7. Gopakumar K, Ayyappan S, Jena JK, Sahoo SK, Sarkar SK, Satapathy BB *et al*. National Freshwater Aquaculture Development Plan. Central Institute of Freshwater Aquaculture, Bhubaneswar, India, 1999.
8. Harikrishnan R, Balasundaram C, Moon-Soo H. Impact of plant products on innate and adaptive immune system of cultured finfish and shellfish. *Aquaculture*. 2011; 317(1-15)
9. Jirong C, Chunzhen C, Junjie Y, Qibing W. Pathogen infection drives patterns of nutrient resorption in citrus plants. Sci Rep. 2015; 5:14675. [Pub Med]
10. Aruldoss K, Kannan R, Chandira A, Samipillai S. Effect of *Cynodon dactylon* on the heamatological parameters in the blood of *oreochromis mossambicus* Int. J Modn. Res. Revs. 2014; 2:171-177.
11. Lall SP, Dietary lipids. immune function and pathogenesis of disease in fish. The Eighth International Symposium on Feeding and Nutrition in Fish, 1-4 June Las Palmas de Gran Canaria, Spain, 1998, 169.
12. Maloy Kumar S, Swarnakumar NS, Sivakumar K, Thangaradjou T, Kannan L. Probiotics in aquaculture: importance and future perspectives. Indian Journal of Microbiology. 2008; 48(3):299-308.

13. Moriarty D. The role of microorganisms in aquaculture ponds. Aquaculture. 1997; 151:333-349
14. Moriarty DJW. Diseases control in shrimp aquaculture with probiotic bacteria. In: Microbial Biosystems: New Frontiers. Proceedings of the 8th International Symposium on Microbial Ecology (Bell CR, Brylinsky M and Johnson-Green P). Atlantic Canada Society for Microbial Ecology, Halifax, Canada Lall, S.P., Nutrition and health of fish, 1999.
15. Patricia Martínez Cruz, Ana L, Ibáñez, Oscar A. Monroy Hermosillo, and Hugo C. Ramírez Saad. Use of Probiotics in Aquaculture. ISRN Microbiology. 2012, 1-13.
16. Sakai M. Current research status of fish immunostimulants. Aquaculture. 1999; 172:63-92.
17. (Sinha, 1998) www.cifri.ernet.in/Bulletins/Bulletin%20No.83.pdf
18. Ganguly S. Feed Supplements for Sustainable Aquaculture with Special Emphasis to Immunostimulant Additives for Prevention of Disease Transmission in Aquatic J Chem. Env. Sci. 2013; 1(3):01-02
19. Talwar PK, Jhingran AG. Inland Fisheries, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1991; (1, 2):615.
20. Thavasimuthu C. Herbal biomedicines: a new opportunity for aquaculture industry Aquacult Int. 2010; 18:403-414
21. Lovell T. Nutrition and Feeding of fish. Springer Science & Business Media, Science. 1998, 267.
22. Verschuere L, Rombaut G, Sorgeloos P, Verstraete W. Probiotic bacteria as biological control agents in aquaculture. Microbiol. Mol. Biol. Rev. 2000; 64:655-667