

## Review Article

# Significance of Immunostimulants in Aquaculture: A Review

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### Abstract

The use of immunostimulants to enhance activities in the immune system has been given considerable attention in aquaculture in order to increase disease resistance in farmed fish. Use of Immunostimulants in aquaculture is gaining importance as the other therapeutic measures like antibiotics; vaccines and chemotherapy have their own limitations. This review stated the importance of immunostimulants, its application, objectives, types, advantages and disadvantages in aquaculture. Therefore, immunostimulants were found to be most promising for used in aquaculture to control diseases.

**Keywords:** Aquaculture; Fish; Immunostimulants; Significance

### Introduction

Immunostimulant is a natural occurring compound that modulates the immune system by increasing the host's resistance against diseases [1]. Immunostimulant comprise a group of biological and synthetic compounds that enhance the nonspecific cellular and humoral defense mechanism [2]. It may be chemical, drug or naturally occurring compound that elevates the nonspecific defense mechanisms or the specific immune response of the host and may be given alone to activate non-specific defense mechanisms as well as heightening a specific immune response.

An immunostimulant is a biological or synthetic compound administered either orally or through body fluids into the body of the fish or shrimp for enhancing the immune status of the host to overcome the adverse environmental conditions, stress, pathogens and opportunistic microbes. An immunostimulant, used in vaccines to amplify the specific immune response or administered as feed additives to modulate non-specific immunity, have been demonstrated to play a

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role in protection against diseases in fish [3]. Phagocytic cells play an important role in the defense mechanisms of the host by adhering to and engulfing the invading particles. Such cells include tissue macrophages, circulatory monocytes, and neutrophils. There are numerous reports of microbial products having immunostimulatory qualities that enhance phagocytic activity. Such immunostimulants include bacilli Calmette-Guérin and *Corynebacterium parvum* [2].

Various strategies are adopted for the management of fish health. Therapeutic approaches are amongst the most direct ones, while the more efficient and aquaculture-compatible and environmentally sound means of health management involve the use of immunostimulants to enhance the general well-being and health of fish. Immunostimulants and non-specific immune enhancers mostly in the form of natural products stimulate the immune system, reduce susceptibility to diseases and protect fish from stress and diseases in aquaculture. This reduces the dependence on chemicals or drugs and minimizes the negative environmental impact. It can also render aquaculture products more acceptable to consumers. Emerging trends show that eco-friendly approaches through the use of probiotics and immunostimulants can contribute significantly to health management in fish farming [4]. Aquaculture is likely to adopt the increased use of immunostimulants as feed additives since it can improve the efficiency of the system, enhance production, reduce the use of chemicals and render aquaculture products more acceptable and safe. There is a considerable emphasis on health management in aquaculture based on prevention rather than treatment [5]. Recently a number of studies have supported the rationale in incorporating the use of immunostimulants into the overall health management plan [1]. A more efficient and health management could lead to reduced cost and stability in the production system and improve the economics of aquaculture operations. Therefore, the review of the significance of immunostimulant in aquaculture.

### Application of Immunostimulants

- [4] Conducted an extensive review on the use of immunostimulants in aquaculture. Immunostimulants can increase resistance of fish to environmental stress and are therefore suitable for use in aquaculture. They can be used in complementing the activity of vaccines. However, overdosing can lead to immunosuppression [4].
- Immunostimulants enhance disease resistance by improving non-specific defense mechanisms. Their use, in addition to other agents and vaccines is acceptable to farmers. There seems to be a wider efficacy and greater safety with immunostimulants in comparison to chemotherapeutics and vaccines. Immunostimulants have been used as feed additives for many years in aquaculture, and yeast  $\beta$ -glucan may be the one with the longest track record. In nature,  $\beta$ -glucans are widespread and have been characterized in microorganisms, algae, fungi and plants [6]. Boosting Fish Immune System: The immune system of fish has witnessed a surge in interest over the past two decades, occasioned by the demand of the fish farming industry for the control of infectious diseases.

Although fish are poikilothermic, aquatic vertebrates, they possess a system of defence mechanism displaying many similarities with those of their mammalian counterparts. Moreover, it is now indisputable that fish are closer to mammals than to any invertebrate taxon [7]. The first line of defense mechanism present in fish is the innate or non-specific mechanism [4].

## Objectives of Immunostimulation

The objectives of incorporating immunostimulant source in the diet of fish and other animals are as follows:

- To promote a greater and more effective sustained immune response to those infectious agents producing subclinical disease without risks of toxicity, carcinogenicity or tissue residues.
- To enhance the level and duration of specific immune response, both cell mediated and humoral, following vaccination.
- To selectively stimulate the relevant components of the immune system or nonspecific immune mechanism that preferentially confers protection against microorganisms. For example via interferon release, especially for those infectious agents for which no vaccines currently exists and
- To maintain immune surveillance at heightened level to ensure early recognition and elimination of neoplastic changes in tissues.

## Types of Immunostimulants used in Aquaculture Section

**Levamisole:** is an anthelmintic used for treatment of nematodes in man and animals (Synthetic Chemicals): Levamisole is enhancing metabolic and phagocytic activation of neutrophils and increase the number of phagocytes and leucocytes and the level of Lysozyme. In Coho salmon, it increase resistance against *Aeromonas salmonicida* infection, in carp, it enhance phagocytic activity, myeloperoxidase activity in neutrophils, increase leukocytes number and serum lysozyme levels.

**FK-656 Hepatonoyl-y-glutamyl-(L) Mrsodiaminopimely-(D)-alanine** is a peptide Related to lactoyl tetra peptide (Synthetic Chemicals). FK-656 has been shown activity against microbial infection. It increases the resistance of Rainbow trout against *A. salmonicida*. In Yellow tail, it elevate humoral antibody titers and splenic producing Antibody.

**MDP (Muramyl dipeptide) N-acetylmuramyl-L-alanyl-D-Isoglutamine**, derived from *Mycobacterium* (Bacterial derivatives). It activate macrophages, B lymphocytes and alternative pathway of complement. MDP increase the phagocytic activities, respiratory burst and migration activities of kidney leucocytes as well as resistance of the fish to *A. salmonicida* challenge.

**LPS (lipopolysaccharide)** is a cell wall component of Gram-negative bacteria (Bacterial derivatives). LPS stimulate B cell

**Herbs as Immunostimulant:** Natural plant products have been reported as anti-stress, growth promotion, appetite stimulation, tonic, immunostimulation, and to have aphrodisiac and antimicrobial properties in finfish and shrimp larviculture due to the presence of active principles such as alkaloids, flavanoids, pigments, phenolics, terpenoids, steroids and essential oils. The other merits that herbs as

immunostimulants are local availability, broad spectrum effect, cost effective, no side effects and biodegradable. [8] Fed catfish (*Mystus montanus*) with dietary *Ocimum tenuiflorum*, *Zingiber officinale* and *Allium sepa* (0.5g/100g each) for 45 days and analysed growth, haematological and serum biochemical parameters. Specific growth rate, total erythrocytes, haemoglobin, total leucocytes, total serum protein, glucose, cholesterol, magnesium levels, serum amylase, alkaline phosphatase, SGOT, SGPT and GGT have increased in all herbal supplemented fishes (especially in *Z. officinale*) than control. Thus concluded that all the three herbs have immunostimulant potential and among the three herbs *Zingiber officinale* is more potent.

## Mode of action

The mode of action of immunostimulants is to activate the immune systems of organisms, to enhance the immunity level against invading pathogens. The approach is very diverse in nature or may be poorly understood and also depends on the type of immunostimulants, dose, and route of administration, time and period of exposure.

## Advantages of Immunostimulants

- They are widely and successfully applied to improve fish welfare, health and production [9].
- It facilitate function of phagocytic cells, increase their bactericidal activities and stimulate natural killer cells, complement system, lysozyme activity and antibody response in fish and shellfish which confer enhanced protection from infectious diseases [10].
- It consider as enhancer to the non-specific immune responses along with the improvement of aquatic environmental quality [11].
- Controls fish diseases by enhancing both specific and non-specific defense mechanisms.
- Immunostimulants increase the immunocompetency and disease resistance of fish.
- Many IS have been developed to improve immunity of domestic animals.
- Some immunostimulant enhanced phagocytic activity and myeloperoxidase activity in neutrophils.

## Disadvantages of Immunostimulants

- They are expensive.
- Limited efficiency upon parentally administration [5].
- They are not effective against all diseases.
- They induce immunosuppression when overdosed [12-19].

## Conclusion

In conclusion, immunostimulants can reduce the losses caused by various diseases in aquaculture; but they may not be effective against all diseases. For the effective use of immunostimulants, the timing, dosages, method of administration and health status of animal need to be taken into consideration. Immunostimulants are substances that control diseases in aquaculture. They enhanced the function of phagocytic cells and increase their bactericidal activities. They also stimulate and complement lysozyme and antibody responses of fish. The effective method of administration of immunostimulants to fish is by injection. Oral and immersion methods have also been observed, but the efficacy of these methods decreases with longterm administration.

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