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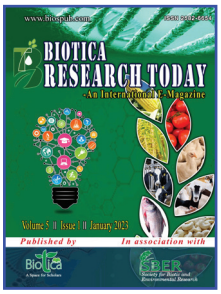

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Immunostimulants Used in Aquaculture

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Abstract

Fish farming is a most important food production sector in worldwide. Due to intensive fish farming practices, infectious disease pose a major threat in aquaculture system especially causing heavy losses to farmers. Various types of antibiotics, chemotherapeutic and vaccines are use to control or prevent fish diseases. The use of adjuvants or immunostimulants is good remedy to increase the vaccine efficacy to control of fish and shrimp diseases. Immunostimulants (IS) are naturally occurring compound that modulates the pathogens *via* facilitate the function of phagocytic cells and also stimulate the natural killer cells (NK), complement, lysozyme and antibody responses of fish.

Introduction

The aquaculture systems are subjected to many diseases like bacterial, virus, fungal and parasites that lead to great economic losses and decrease in fish production. The immunostimulants are used in aquaculture system for control of diseases. It is may be defined as the agent, which stimulate the non-specific immune mechanisms on their own or specific immune mechanism when coupled with an antigen. In general, immunostimulants comprise a group of biological and synthetic compounds that enhance the non-specific defense mechanisms in fishes (Barman *et al*., 2013). Immunostimulants promote a greater and more effective sustained immune response to those infectious agents, producing subclinical disease without risks of toxicity, carcinogenicity or tissue residues.

The immunostimulants enhance the level of duration of specific immune response, both cell-mediated and humoral, following vaccination methods. Immunostimulant supports to overcome of immunosuppressive effects of stress and of those infectious agents that damage or interface with the functioning of cells of immune system. A variety of substance have been used to fish culture and have the immunostimulatory effects which are microbial derivatives, plants or animal extracts, vitamins, hormones and synthetic chemical, but herbal extracts and animal originated product 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 (Jadhav *et al*., 2006).

Immunostimulants

The use of immunostimulants as an alternative to the drugs, chemicals and antibiotics currently being used to control fish diseases in aquaculture system is attracting the attention of many researchers. In this context, many have focused on the use of medicinal plant and animal originated

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products as potential therapeutic measures for modulating the immune response to prevent and control fish diseases without recourse to antibiotics and chemotherapeutics (Ian and Roy, 2005). Application of immunostimulant alone or together with vaccination has emerged as one of the more promising approaches to prevent fish diseases.

Different Types of Immunostimulants in Fish Culture

1. Levamisole, an anthelmintic used for treatment of nematodes in fishes (Synthetic Chemicals): It is enhancing metabolic and phagocytic activation of neutrophils and increases the number of phagocytes and leucocytes and the level of Lysozyme.

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

3. LPS (lipopolysaccharide) is a cell wall component of Gram-negative bacteria. LPS stimulate B cell proliferation and enhance macrophage phagocytic activity.

4. Vibrio Bacterin (Bacterial derivatives) increases protection of Rainbow trout against *V. anguillarum*. It has immunostimulant effects in Kuruma prawns and black tiger shrimp.

5. Animal Extracts from marine tunicate, glycoprotein fraction of water extract from abalone, it enhance killing of tumor cell and inhibited tumor growth. In vivo condition stimulates phagocytosis and increased survival of eel against *A. hydrophila*. It increases production of superoxide anion, potential killing activities by macrophages and lymphoblastic transformation of lymphocyte in vitro condition.

6. Vitamin E (Nutritional Factor) enhances both humoral and cellular defense mechanism in mammals. It increases phagocytic indices and superoxide anion production by leucocytes.

7. Cytokines are polypeptides or glycoproteins. It acts as modulators in the immune system. Cytokines such as Interleukin-2 reported as immunostimulants.

Method of Administration

Immunostimulants potentiate the immunity of the host strongly against pathogens. Several immunostimulants also stimulate the natural killer cells, complement, and lysozyme and antibody response of fish. There are mainly three ways to deliver immunostimulants of fish including injection, immersion and oral. Injection of immunostimulants can produce strong non-specific immune response but its costly affairs with lots of time and labour intensive as well, applicable only for large size of fish more than 10-15 g in body weight in intensive aquaculture system (Sakai, 1999). It has been reported that injection has wide protection against a range of pathogens like intra-peritoneal injection with glucan injected to channel catfish shows increased in phagocytic activity reducing fish mortality challenge with *Edwardsiella ictaluri*. Immersion method is very effective during acclimation of juveniles to ponds in field condition. Using immersion of levamisole showed increase in circulating leukocytes, phagocytic rate and increase protection against *P. damselae* sub sp. *piscicida* in European Seabass (Raa, 2016).

Mode of Action

The mode of action of immunostimulants is to activate the immune systems of fishes, to enhance the immunity level against invading pathogens.

Mechanism of Action

- Stimulators of T-lymphocytes- Levamisole, Freund's Complete Adjuvant (FCA), Glucans, Muramyl dipeptide.
- Stimulates of B-cells- Bacterial endotoxions, Lipopolysaccharides.
- Macrophage activator- Glucans, Chitin and Chitosan.
- Inflammatory agents including chemotoxins.
- Cell membrane modifiers- Detergents and Sodium dodecyl sulphate, Quaternary ammonium compounds (QAC), Saponins.
- Nutritional factors- Vitamin C and E, n-3 fatty acids.
- Cytokines- Leukotriene, Interferon
- Heavy metals- Cadmium.
- Animal and fish extracts- Mitogens.

Conclusion

Immunostimulants appear to be most promising and useful tools for prophylactic treatment of farmed fish and shrimp. It is safer than chemotherapeutics and their range of efficacy is wider than vaccination. However, these compounds will not replace vaccines proper nutrition or good management techniques. The strength of these compounds appear to lie in their ability to enhance larval culture before the specific immune system matures and the animals can be vaccinated and able to improve non-specific immune function against a broad spectrum of pathogens.

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