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Immunity Enhancement through Seaweed Extracts in Fish

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Abstract

Seaweeds are floating and submerged plants of shallow marine meadows. Marine macro algae are important ecologically and commercially to many regions of the world, especially in Asian countries. Seaweeds are potential source of bioactive metabolites for the pharmaceutical industry in drug development. This paper provides details in immunity enhancement of seaweeds from finfish.

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INTRODUCTION

As seafood consumption has increased in the last several decades, aquaculture has filled the gap between wild stock harvest and the present demand. Now it is a vigorous growing production sector for higher protein food. Intensive aquaculture production has led to a growing need in treating or preventing diseases-the most important constraints of fish production both in culture as well as wild conditions. Protecting the fishes from disease can be done through two ways. One is by the enhancing the immunity to fight against pathogens and second is through medication. In commercial aquaculture, antibiotics, chemicals, drugs, chemotherapeutants etc. are used for prevention and control the diseases. The commercial vaccines are costly for fish farming practices and are pathogen specific. Numerous studies have been carried out to find the newer compounds from plant sources. In this context, marine algae or seaweeds are significant sources of bioactive compounds. Basically, all the seaweeds have active ingredients which are responsible for various biological activities. Many have already been tested against fish microbial diseases for its immunostimulants efficacy.

Microbial diseases in aquaculture

Diseases cause the major economic losses in aquaculture. Bacterial [1], fungal [2] and viral infections [3,4] are reported by many researchers. So far, it is well known that disease is not necessarily caused by single species, but involve synergistic interactions between two or more taxa. Many fish larvae such as sea bream, seabass and yellowtail kingfish etc. have low survival rate in intensive hatcheries system. Many factors such as environmental conditions, pathogens, larvae vulnerability and low immune system development in organisms play a key role in survival [5]. Different types of chemicals are presently used in aquaculture [6]. Some of these include disinfectants like hydrogen peroxide, malachite green, antibiotics like sulfonamides, tetracyclines, anthelmintic agents likepyrethroid insecticides and avermectins [7]. Further, to reduce the public health hazards related to antimicrobial use in aquaculture, various regulations have been developed.

Seaweed as immunostimulants

Already, remarkable success has been achieved with use of immunostimulants as a more environmentally friendly approach to fish disease management. It is also well known fact that the innate immune system in fish can be triggered by many immunostimulants [8]. Nevertheless, some of the immunostimulants could not be used because of high cost. In contrast, a large number of plants have been used in traditional medicine for the treatment and control of several diseases [9].

Ergosan is an algal based product composed of 0.002% unspecified plant extract, 1% alginic acid from *Laminaria digitata* and 98.998% algal based carrier. It is used in aquaculture for its immunomodulatory activity. In rainbow trout (*Oncorhynchus mykiss*) and striped snakehead (*Channastriata*), immune enhancement has been observed following intraperitoneal administration of ergosan [10,11].

Streptococcus disease known to occur among the population of rainbow trout [12] caused huge economic losses, but its occurrence was reduced by using vaccine [13]. The immunostimulatory effects of alginic acid and anti-streptococcus vaccine on some of the physiological parameters of rainbow trout shows that fish resistance increases to environmental stress and pathogen due to the stimulated lymphocyte proliferation [14]. Alginic acid added at 4 g kg^{-1} diet has the best effect on growth and immune system parameters in *Husohuso* juvenile [15]. Similarly, lyophilized alginate-plasmid complexes added to feed showed strong protection and better survival rate against pancreatic necrosis virusinfections in *Oncorhynchus mykiss* [16].

The effects of high-M alginate on spotted wolffish and cod fry with regard to growth and survival was studied by Vollstad et al., [17]. *Epinephelus coicoides* which received sodium alginate at 20 mg kg^{-1} or i-carrageenan at 30 mg kg^{-1} increased the nonspecific

immune response and resistance from *Vibrio alginolyticus* infection. Harikrishnan et al., [18,19] recommended dietary administration of sodium alginate to enhance the innate immunity and disease resistance in kelp grouper against *Streptococcus iniae*. Likewise, in *E. fuscoguttatus* which was fed with a diet containing sodium alginate and k-carrageenan enhanced innate immunity and increased resistance from *V. alginolyticus* infection was observed [20].

The immunostimulants mostly facilitate the function of phagocytic cells and increase their bactericidal activities. Moreover, they stimulate the natural killer cells, increase lysozyme and antibody responses of fish. Lymphocytes are also activated by immunostimulants that may simulate antibody. The immune enhancers activate the pro-PO system and thereby phagocytosis. The role of vitamin C, vitamin E and carotenoids at higher levels is immunity enhancement and also act as stress busters due to their antioxidant properties.

CONCLUSION

Seaweeds are well known for the antimicrobial and antioxidant properties. They have polysaccharides, flavonoid, alkaloid, amino and fatty acids, essential trace minerals, including vitamins. Several published research has established that seaweed components can enhance immune function. Hence for effective use of seaweed extract as immunostimulant further studies on optimal dosage, duration, method of administration, active component of the extract, feeding protocols for feed additives etc. and also the side effects must be taken into consideration.

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