

## Prophylactic Strategies for Enhancing Disease Prevention for Sustainable Aquaculture

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### SUMMARY

Aquaculture has experienced rapid growth globally, emerging as a crucial economic sector. However, disease remains a significant challenge hindering the progress of aquaculture species and impacting socioeconomic development. To address losses due to infectious diseases in aquaculture, it is imperative to implement scientifically proven and locally relevant strategies for ensuring aquatic animal health. Prophylactic measures, including the use of immunostimulants, vaccines, probiotics, and prebiotics, play a vital role in disease prevention and enhancing the host health by promoting beneficial microbial flora in the gut. Aquatic probiotics, tailored for aquatic environments, differ in parameters from terrestrial probiotics due to the distinct micro biota interactions and environmental factors in aquatic organisms. Vaccination, a critical preventive measure and immunostimulants elevate immune responses, contributing to better immunological status and disease prevention. Adhering to these strategies ensures sustainable growth and mitigates disease-related challenges in aquaculture, paving the way for economic and societal advancements.

### INTRODUCTION

Over the past several years, aquaculture has expanded rapidly over the world to become a significant economic sector. But disease is the main factor preventing many aquaculture species from growing, and it is currently seriously obstructing the socioeconomic and economic advancement of several nations worldwide. To overcome losses because of infectious diseases in aquaculture, it is necessary to act upon every health constraint based on scientifically proven and recommended as well as locally applicable ways and approaches in keeping aquatic animal health safe. (E. J. Peeler and N. G. Taylor, et.al 2011). The most effective methods for controlling infectious diseases in fish are immunostimulants, vaccines, probiotics, prebiotics. (V. Kumar, S. Roy, et al 2016).

### What is prophylaxis?

Prophylaxis is the term used to describe all the preventative measures, like as immunization, probiotic usage, and vaccination, that are conducted during a hatchery or farming operation to reduce the load of pathogens and avoid the onset of disease. It also includes group improvement normal husbandry techniques. In vertebrates, those who have survived a pathogen's infection develop resistance to the pathogen's future infection. This resistance card adaptive immunity lasts for a comparatively longer amount of time and is targeted against a difficult pathogen (immunomemory).

The following components are undertaken in prophylactic measure for disease prevention in aquaculture:

1. Prebiotics
2. Probiotics
3. Vaccine
4. Immunostimulants.

#### 1) Prebiotic:

Prebiotics are indigestible dietary ingredients that have positive effects on the host by encouraging the development and/or activity of one or a small number of bacteria in the colony. This enhances the health of the host and supports the intestinal balance of the organism. Prebiotics are most frequently used to increase the presence of health-promoting bacteria, such as those of the genera *Lactobacillus* and *Bifidobacteria*, which have

the ability to reduce the amount of dangerous bacteria. Mannanoligo-saccharides, lactose, galactogluco-mannans, oligofructose, and inulin are a few examples of prebiotics.

**2) Probiotics:**

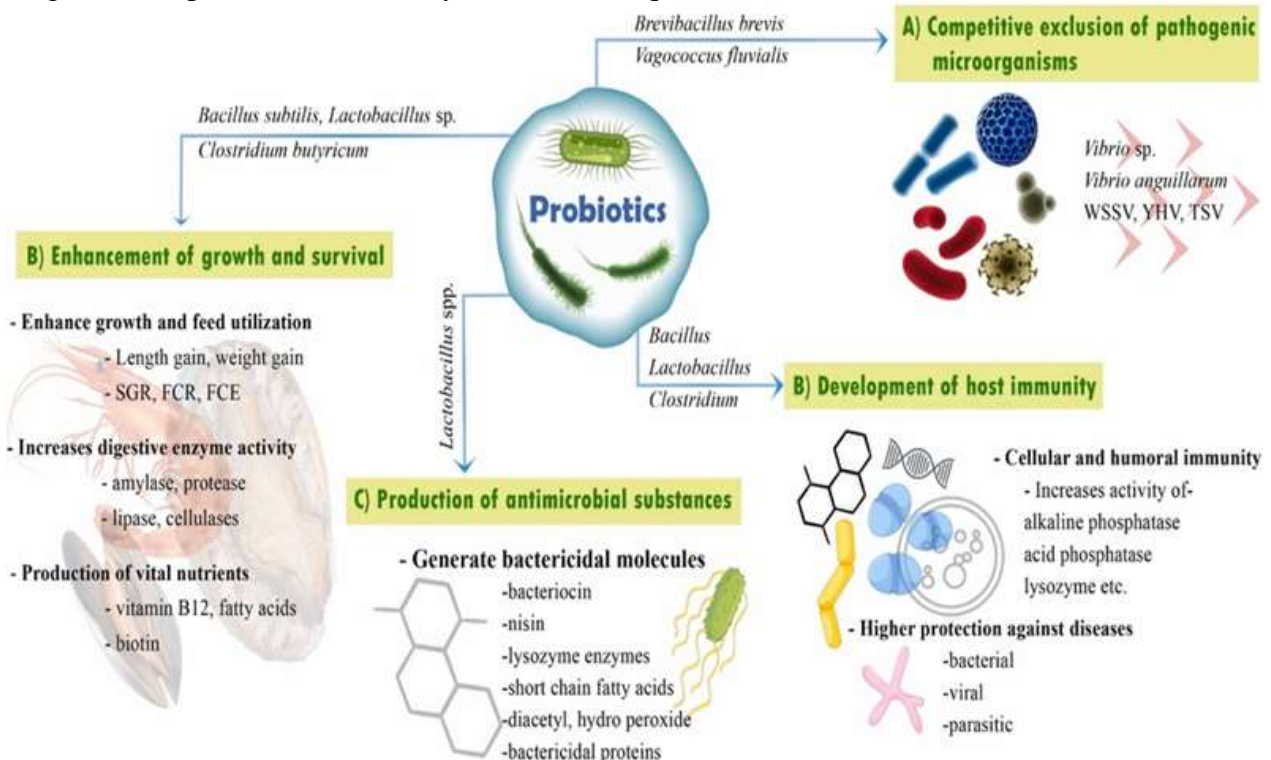
- The probiotics were defined as live microbial feed supplements that improve health of man and terrestrial livestock. The gastrointestinal microbiota of fish and shellfish are peculiarly dependent on the external environment, due to the water flow passing through the digestive tract.
- In the gut, the majority of bacteria are transitory and constantly generate food and water. Certain commercial items are called probiotics, even if their intended use is to treat the raising medium rather than as a dietary supplement.
- Probiotics are ingested through food or water and work by preventing the growth of harmful bacteria, increasing feed utilization through the addition of digestive enzymes, offering additional growth-promoting elements, and boosting the immune system of the organism.
- Biotics that may influence fish immunity, disease resistance, and other performance indices include those of the genus *Bacillus* and various lactic acid bacteria (*Lactobacillus*, *Lactococcus*, *Carnobacterium*, *Pediococcus*, *Enterococcus* and *Streptococcus*).

**What are aquatic probiotics?**

Although aquatic probiotics are meant to be used in aquatic environments, it's critical to take certain parameters into account that are fundamentally different from those of terrestrial probiotics. Animals that live in water have a much deeper contact with their surroundings. The degree of interaction between the gut microbiota and the surrounding environment varies significantly between aquatic and terrestrial species. On the other hand, potential pathogens are able to maintain themselves in the external environment of the aquatic organisms and proliferate independently of the host.

**Aquatic probiotics are two types:**

Gut probiotics which can be blended with feed and administrated orally to enhance the useful microbial flora of the gut. These probiotics are mainly used on fish aquaculture.



(Sumon, T. A., Hussain, M. A., Sumon, et al 2022.)

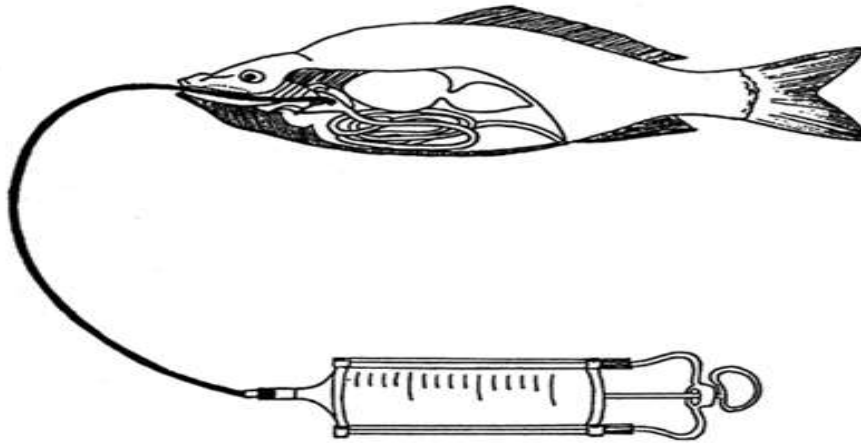
- Water probiotics which can proliferate in water medium and exclude the pathogenic bacteria by consuming all available nutrients. Thus, the pathogenic bacteria are eliminated through starvation. These probiotics are mainly used in shrimp aquaculture.

**3) Vaccine:**

A vaccination is any biologically based substance designed to create or enhance immunity against a specific illness or set of related disorders. Normally, vaccinations are given to healthy animals before a disease epidemic. Vaccines function by first exposing an animal's immune system to an antigen or a fragment of a pathogen. This gives the immune system time to form a reaction and "memory" that will speed up this response in subsequent infections by the intended disease-causing organism.

**Different types of vaccines:**

There are many different types of vaccines, and new kinds are continuously under development.



(FAO Aquaculture)

**a. Bacteria vaccines:**

Bacterins are vaccines comprised of killed, formerly pathogenic bacteria. Bacterins stimulate the antibody-related portion of the immune response (i.e., the humoral immune response).

**b. Live, attenuated vaccines**

Live, attenuated vaccines are comprised of live micro-organisms (bacteria, viruses) that have been grown in culture and no longer have the properties that cause significant disease. Live attenuated vaccines will stimulate additional parts of the immune system (i.e., a cell-mediated, as well as a humoral [antibody] response).

**c. Toxoid vaccines:**

Vaccines called toxoids are made of toxins that have been rendered inactive, meaning they can no longer spread illness. The tetanus toxoid vaccination is one such that is administered to people.

**d. Recombinant vector vaccines:**

Recombinant vector vaccines allow a weak pathogen to produce antigen.

**e. DNA vaccines**

DNA vaccines are made up of a circular segment of genetic material that may constantly create an immune-stimulating section of a pathogen (i.e., antigen) once it has been introduced into the animal. This provides a "internal" supply of vaccine material. Research and development are also being done on other vaccination approaches.

**4) Immuno-stimulants:**

Immunostimulants is chemicals, drugs, stressors or action that elevates the specific or non-specific immune response. Immunostimulants enhance the humoral and cellular response in both specific and non-specific ways. These medications are frequently used to stabilize better immunological status and treat compromised immune function. A potential recent advancement is the use of immunostimulants in the aquaculture of fish, shrimp, or other species to avoid illness.

**Types of Immuno-stimulants:**

- Bacterial derivatives- if toxicity and harmful inflammatory factors are deleted, bacterial derivatives can be good immunostimulants for e.g. Muramyladipetide (MDP), the mycobacterium peptidoglycan derivative has been used experimentally in clinical use for immunostimulant response in cancer in patient.
- Yeast derivatives- Glucans, long chain poly saccharide extracted from yeast are good stimulators of non-specific defence mechanism in animal including fish and shellfish.

**Preventive Measures for Animal Health in Aquaculture:**

In addition to vaccine, immunostimulants and probiotics, some of the important prophylactic steps that are to be routinely adopted for successful farming hatchery operations.

**Hatchery Level:**

- Use of good quality water (UV filter, sand filter)
- Use of healthy pathogen free brood stock
- Following strict sanitary and hygienic conditions
- Adopting strict sanitary and hygienic conditions
- Regular health monitoring
- Use of good quality live feeds
- Use of treated water

**Farm Level:**

- Proper pond preparation (drying, waste removal, liming etc.)
- Use of good quality water
- Use of good quality seed (seeds screening, healthy seed selection)
- Rational feeding and fertilization schedule
- Adopting rational stocking policy in order to reduce stress
- Following strict hygienic condition and quarantine programme
- Regular health monitoring programmes
- Use of good quality live feeds.

**CONCLUSION**

The use of prophylactic method is used various purpose for treatment of controlling disease. World Health Organisation is advised to reduction in the excessive and inappropriate use of Anti-microbials in aquaculture. Most widely accepted alternative for use of antimicrobial is disease control is the use of prophylactic measures. The newest attempt being made to improve water quality in aquaculture is the application is the probiotics or enzyme to the ponds. The greatest success has been in the field of vaccines, with very effective multivalent vaccines now available for control of bacterial diseases in salmonids and sea bass.

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