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A Review on the Application and Benefits of Probiotics Supplements in Fish Culture

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Abstract

Probiotics are supplements that impose health benefits to the host fish when applied at the right amount. Probiotics stabilizes the microbial population of the fish's gastrointestinal tract through elimination of pathogenic microbes and increased digestibility and bioavailability of nutrients required for optimal growth and good health. Fish farmers and fish consumer also benefits from probiotics application in several ways such as improved growth, carcass and flesh quality, boosting of immune system, high survival rate and reduced malformations. Farmers should be encouraged to include probiotics in feed in order to enjoy the corresponding benefits it presents

Kewords: Probiotics; Supplement; Benefits; Aquaculture

Introduction

As aquaculture continues to be intensified globally, new innovations and biotechnologies have been introduced to economically boost aquaculture production which is more peculiar to countries with shortfall of fish supply from the wild. One of such biotechnology is probiotics supplements which is beneficial in different areas of aquaculture. Generally, probiotics is a term that is used to signify bacteria that beneficially promote the health status of other organisms [1]. To World Health Organization, probiotics is defined as live microorganisms that confer health benefit on the host when administered in adequate amounts [2]. The application of probiotics in the rearing water is noted by Luazon et al., [3] to complicate the definition process since it is like terms such as bioaugmentation, biocontrol and bioremediation. Maeda *et al*., [4] and Moriarty [5] suggested that microbes that are antagonistic to aquatic pathogens, but not found in the host's gastrointestinal tract, should be termed biocontrol agents. Similarly, termed the application of aquatic microbes to improve water quality by breaking down of waste or pollutants as bioaugmentation or bioremediation [5-7]. Based on these observations, Merrifield *et al*., [8] proposed a broader and classical definition of probiotics intended for use in aquaculture as 'any microbial cell provided via the diet or rearing water that benefits the host fish, fish farmer or fish consumer, which is achieved, in part at least, by improving the microbial balance of the fish'.

The need for alternative prophylactic methods needed to remedy the survival issues faced at different stages of intensive rearing activated research on probiotic microorganism's application in aquaculture. According to Lauzon et al., [3] probiotics are increasingly accepted as an alternative prophylactic measure for both animals and humans, either to be used in preventive treatments or in the treatment of pathogen-related diseases. According to FAO [9], fish and other aquaculture products provides a very useful source of essential micronutrients and protein needed for good health and balanced nutrition worldwide. With the world population expected to grow annually at a rate of 1.6 % there is an indication of a possible shortage in food supply especially protein sources. To meet up the demand of fish protein for the growing global population, aquaculture remains one of the most economic and reliable option for sustainable fish supply [10-12]. However, there is need for an environment friendly aquaculture production system. The use of probiotics supplement in aquaculture is now gaining popularity to increase safety and high-quality protein production for both human and livestock instead of chemotherapy and antibiotics. Therefore, the aim of this mini review paper is to evaluate the application and benefits of probiotics supplements in aquaculture.

Application of Probiotics in Aquaculture

According to Macey and Coyne [13], probiotics usage in culture of aquatic organisms has been very effective in improving growth,

disease resistance and nutrition. Traditionally, probiotics were incorporated into animal feed to boost the growth performance, disease resistance and health [14]. In aquaculture, probiotics can be used in aquaculture either as an additive to the water to enhance quality or feed supplement to enhance growth, health and disease control resulting in the improvement of fish welfare [15].

Mode of Action of Probiotics Application in Aquaculture

Several studies have been focused on growth promotion, physiological as well as immune responses of fish exposed to probiotics supplements [16]. However, these is only possible if the modes of action of probiotics are clearly understood. There are four modes of action exhibited by probiotics in aquaculture [17] which include:

i. Competitive exclusion of pathogenic (disease causing) bacteria through nutrient and habitat competition and alteration of pathogen's enzymatic activities.

ii. Improvement of water quality

iii. Enhancement of immune response

iv. Enhancement of host nutrition.

Some common Probiotics used in Aquaculture

Some common probiotics applied and studied in aquaculture include microorganisms, such as *Alteromonas*, *Aeromonas*, *Arthrobacter*, *Bacillus*, *Clostridium*, *Debaryomyces Enterobacter*, *Flavobacterium*, Lacto Acid Bacteria, *Micrococcus*, *Phaeobacter*, *Pseudoalteromonas*, *Pseudomonas*, *Roseobacter*, *Shewanella*, *Saccharomyces* and *Vibrio* species [8,18-20].

Benefits of Probiotics in Aquaculture

The benefits of probiotics usage in aquaculture cannot be overemphasized. Several authors such as Qi *et al.,* [21], Wang and Gu [22], Soundarapandian *et al.,* [23], Faramarzi *et al.,* [24], Ngan and Phu [25], Mohapatra *et al.,* [26], Peterson *et al.,* [27] and Nimrat *et al.,* [28], have highlighted the benefits of probiotics in aquaculture as summarized below:

- Promotes appetite resulting in a better food utilization
- Improve feed conversion efficiency (FCE) and feed conversion ratio (FCR).
- Improves feed digestibility and bioavailability of nutrients.
- Stimulate the uptake of dissolved organic material (bacteria-mediated)
- Boost immune system thereby reducing disease outbreaks
- Enhance growth performance
- Improves water quality
- Stabilize the intestinal bacterial group
- Reduced mortality
- Stress alleviation
- Improved carcass and flesh quality
- Reduced malformations

Criteria for Probiotic selection

For a microorganism to be selected as probiotics for use in aquaculture, two categories of criteria including essential (E) and favorable (F) given by Merrifield *et al*., [8] should be considered:

Essential Criteria (E)

i. Must not be pathogenic, with regards to the host species, aquatic animals in general and human consumers.

ii. Must be free of plasmid-encoded antibiotic resistance genes.

iii. Must be resistant to bile salts and low pH.

Favorable Criteria (F)

i. Should be able to colonize the intestinal epithelial surface.

ii. Should be recognized as safe for use as a feed additive.

iii. Should be able to adhere to and/or grow well within intestinal mucus.

iv. Should display advantageous growth characteristics (e.g. a short lag period, a short doubling time and/or growth at host rearing temperatures).

v. Should be indigenous to the host or the rearing environment.

vi. Should produce relevant extracellular digestive enzymes (e.g. chitinase if chitin-rich ingredients are to be incorporated into the diet, or cellulase if the diet is rich in plant ingredients) and/or vitamins.

vii. Should exhibit antagonistic properties towards one or more key pathogens.

viii. Should remain viable under normal storage conditions and be robust enough to survive

industrial processes.

Conclusion

Probiotics application in aquaculture is of great benefit to the host fish, fish farmer or fish consumer in several ways. Importantly, probiotics stabilizes the microbial population of the fish's GI tract through elimination of pathogenic microbes and increased digestibility and bioavailability of nutrients required for optimal growth and good health. Farmers should be encouraged to include probiotics in feed in order to enjoy the corresponding benefits it presents.

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