28. Prophylactic Health Products in Aquaculture

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Introduction

There is widespread use of antibiotics in aquaculture and large variation exists between countries and regions on the use of antibiotic in the field. The usage of antibiotic in different countries varies between 1 g for every1000 kg seafood produced in Norway to 700 g per 1000 kg of production in Vietnam. Based on the estimates nearly 500–600 tons of antibiotics is used in shrimp aquaculture. The most widely used antibiotics used in aquaculture are oxytetracycline, sulphadiazine and florfenicol and about 67 antibiotics are applied in aquaculture based on a study in 15 countries. It is difficult to assess the use of antimicrobial agents in aquaculture since there are lot of differences in the regulations, distribution and registration of antimicrobials between countries. Also, there is lot of variation in the antibiotics used between different countries. With the increase in the use of antibiotics in aquaculture as prophylactics, the risk of antimicrobial resistance has gone high, thereby the medications have become less effective. The genes responsible for antimicrobial resistance may get transferred from aquatic animals or environment to terrestrial livestock and to human and vice-versa. This leads to adverse effects on aquatic environment and health of human and animals. Intensified aquaculture resulted in farming that promotes indiscriminate use of antibiotics, resulting in antibiotic residues in aquatic products. Almost 75% of the antibiotics given to aquatic animals are wasted due to defecation or dispersal into the surrounding water. With the growth of intensive aquaculture, there is increased incidence of several bacterial diseases, resulting in further use of antibiotics. Presence of antibiotics in aquatic environments can affect the diversity of bacteria, including the taxa that are involved in primary productivity and carbon and nitrogen cycling. Pathogens may acquire antibiotic resistance genes from the environmental resistome leading to long term health consequences. The environment gets polluted due to unrestricted use of antibiotic in the environment, thereby there is selection and distribution of antibiotic resistant bacteria, and also changes in the microbial ecosystems.

Use of probiotics

Probiotics that control the pathogens in aquatic animal and environment through different mechanisms are considered as alternative to antibiotic treatment. Probiotics were used in human and animal nutrition since long. The use of probiotics in aquaculture is very recent.

Probiotics are defined by FAO/WHO (2001) as "Live microorganisms, which when consumed in adequate amounts, confer a health benefit for the host". Aquaculture probiotics can be defined as "Live microorganisms provided in adequate amount *via* the diet or rearing water that confer a health benefit for the host fish/shrimp by modifying the host-associated or ambient

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microbial community."

Mechanism of action

Probiotics acts through different mechanisms including competitive exclusion of pathogens, as a source of nutrients, contributes enzymes for digestion, enhanced immune response and different other mechanisms.

The probiotic concept was initially developed for terrestrial animals that are completely different from the aquatic animals. The gastrointestinal tract of the larvae of fish and shrimp are exposed to external environment at a very early life stage unlike in terrestrial animals that undergo embryonic development in the amnion. The initial trials for the use of probiotics in aquaculture feed was with a probiotic strain *Bacillus toyoi*, used in terrestrial animals. The bacterial strain was found to reduce mortality of Japenese eel infected by *Edwardsiella* sp.,. Most probiotics used in aquaculture belong to the genus *Bacillus,* lactic acid bacteria (*Lactobacillus* and *Carnobacterium*), *Vibrio*, and *Pseudomonas*, although other genera or species have also been used.

Due to the ability of the probiotic microorganism to produce various digestive enzymes including amylases, proteases, and lipases, etc., and to provide nutrients (amino acids, fatty acids, vitamins etc., they contribute to the feed utilisation, digestive process and the absorption of nutrients resulting in improved health and growth performance of aquatic animals.

Supplementation of probiotic was found to improve the appetite and increase the digestibility of nutrients. Probiotics enhances the survival and growth of the aquatic animals by improving the feed efficiency in aquatic animals and maintaining balance of intestinal microbes and stimulating digestive enzymes resulting in improved nutrient absorption and utilisation. Inclusion of probiotics in diets of aquatic animal results in increased immune response by interaction between intestinal epithelial cells and bacterial cells. Probiotics can also stimulate the immune system against infectious diseases. Probiotics can increase sodium and water absorption, produce short-chain fatty acids and support host health.

Probiotics also interact with pathogenic bacteria and are sometimes antagonistic to pathogenic bacteria by directly inhibiting or by resisting colonisation and also by reducing the incidence of opportunistic pathogens. Probiotics also enhances host health by immune modulation.

Probiotics have bactericidal activity on the intestinal pathogenic bacteria of the host and are able to prevent multiplication of opportunistic pathogens. The bactericidal activity of the probiotic bacteria is due to the production of molecules having bactericidal activity.

Probiotics can also be used for improving the water quality of the rearing water, by modifying the microorganisms and inhibition of pathogenic bacteria in the aquaculture environment which results in improving the health status of aquatic animals.

Need for regulation in probiotic

The application of probiotics in aquaculture shows promise, but needs considerable efforts of research. The quality and safety of the commercial aquaculture probiotics sold in the market in many countries are under question as this emergent market lacks appropriate regulatory framework. Improper labeling, mismatch with claims, presence of infectious agents, antibiotic residue, high AMR profile, fake health claims and safety issues of probiotics raises concern on the availability of a good aquaculture probiotic in market. Most of the probiotics with unjustified claims comes at a high-cost relative to budget of smallholder producers, imposing an economic burden. Since the aquaculture probiotics are directly applied to farms and are released to open environment, risk related to the propagation of hazard and health-safety threats are high.

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