Prophylactic Strategies in Mitigating Disease Risks in Indian Carp Farming

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ABSTRACT

Carp farming is the dominant sector of inland aquaculture in India, accounting for over 85% of the total freshwater aquaculture production. Nevertheless, this industry has faced challenges by the disease outbreaks leading to partial crop losses. The traditional method of managing infectious diseases in carp farming involves the use of antibiotics, parasiticides, and other pharmaceuticals, which are known to have long-term harmful effects on both the host and the environment. The old proverb "prevention is better than treatment" holds true, and it is wise to prioritize disease prevention over treatment in carp farming. Implementing improved husbandry practices, imposing movement restrictions, use of immunostimulants and probiotics, administering vaccines, and ensuring water disinfection are all effective strategies for preventing and managing infectious diseases in fish farming. This article aims to highlight some of these prophylactic approaches to reduce disease risks in carp farming.

INTRODUCTION

Indeed, there is no doubt that the shift in carp aquaculture practices from extensive and modified extensive to semi-intensive cultures, driven by scientific interventions, has significantly boosted carp production in the country. These advancements have been instrumental in implementing effective management practices, resulting in increased

yields and improved productivity in carp farming. Despite the significant advancements in carp farming, several economically consequential challenges have emerged, posing threat to the sustainability of the carp industry. The expansion and intensification of aquaculture practices have given rise to health problems among cultivated fish, subsequently affecting production rates. Additionally, the deteriorating environmental conditions have contributed to the increased occurrence of infectious diseases (Barrett *et al*. 2019). Among these challenges, parasitic diseases stand out as a substantial hindrance to carp aquaculture, affecting both economic and socio-economic aspects. For instance, the economic losses attributable to argulosis alone have been estimated at ₹29,532 per hectare annually in India (Sahoo *et al*. 2013). Further, tropical climatic conditions exacerbate the conditions conducive to disease development and its transmission.

Prophylactic strategies cover all preventive measures, including vaccination, immunostimulation, and the use of pre and probiotics, as well as the improvement of routine husbandry practices. These measures are implemented during hatchery and farming operations to minimize pathogen loads and prevent the occurrence of diseases. Prophylactic measures are crucial for maintaining the health and hygiene of fish species in aquaculture. It is important to note that therapeutic treatment is only employed in cases where a disease has developed, and the life or performance of the cultured fish is immediately at risk or expected to be at risk in the near future. Therapeutic treatments should be considered emergency measures when prevention measures have failed. Adopting the prophylactic strategies in aquaculture can reduce our reliance on antimicrobial agents, disinfectants, and anti-parasitic drugs, which are known to have long-term harmful effects on both the host and the environment.

Prophylactic measures in Indian Aquaculture

Prophylactic measures employed in Indian aquaculture encompass a range of strategies and practices, including:

1. Implementing best management practices to maintain optimal culture environments includes ensuring disease-free fish seed, optimizing feed, enhancing husbandry techniques, and maintaining good sanitation.

2. Utilizing prebiotics and probiotics to promote the fish health and enhance their disease resistance.

3. Boosting the overall disease resistance of carps through the application of immunostimulants.

4. Immunizing the fish against specific pathogens by administering vaccines (however, currently there are no fish vaccines available in India on a commercial scale).

These measures collectively contribute to the prevention and control of diseases in aquaculture, ensuring the health and well-being of cultured species.

Vaccination

Vaccination has been recognized as an effective preventive method for a wide range of bacterial and viral diseases in aquaculture. Taking an example of Norwegian salmon farming, it is evident that the use of vaccines has resulted in a significant reduction in use of antibiotics, ultimately leading to a substantial increase in production (Rodger, 2016). It is important to note that currently, there are no fish vaccines available in India at a commercial scale. However, in recent past there are ongoing efforts to establish commercial partnerships for vaccine production for Indian aquaculture.

Vaccine manufacturer Indian Immunologicals Ltd, Hyderabad has recently announced a partnership with ICAR-CIFA, Bhubaneswar, to commercially develop a vaccine for freshwater fish to combat Hemorrhagic Septicemia. This condition, also known as Aeromonas Septicemia, Ulcer Disease, or Red-Sore Disease, is caused by *Aeromonas hydrophila*, an opportunistic pathogenic bacterium, and affects carps (The Times of India, 13 March 2023). Similarily, in November 2023, ICAR-CIFE, Mumbai transferred the technologies of two fish vaccines developed to combat two significant bacterial diseases, Columnaris caused by *Flavobacterium columnare*, and Edwardsillosis caused by *Edwardsiella tarda*. These technologies were transferred to Indian Immunological Private Limited (IIL), Hyderabad, which will work on developing commercial-scale vaccines for use in freshwater fish (Mint, 30 November 2022).

Immunostimulants

In recent years, there has been a growing recognition for the use of immunostimulants as feed additives in carp aquaculture for disease management (Kumar *et al*., 2022). Immunostimulants typically boost specific components of the non-specific immune response, thereby providing a general level of protection. Although this doesn't always assures increased survival. Moreover, if immunostimulants are administered at high doses or for prolonged periods, they can actually suppress the immune system of cultured animals. The protection out of immunostimulation can be particularly valuable for carps that are raised into environments where the specific pathogens are unknown, rendering immunization through specific vaccines ineffective. Depending upon the sources from which they are derived, immunostimulants are of many types.

a. Plants derived immunostimulants- Plant extract has been used since time immemorial to enhance immunity/fight against any disease in human. In aquaculture, these knowledge has also gained much importance. Farmers use Neem, turmeric, aloe vera extract as prophylactic measure. Crude plant extract have resulted in enhanced innate immunity parameters like antiprotease, phagocytosis, lysozyme, complement etc. The extracts are used as such in the aquatic feed without any processing. The extracts are directly incorporated into fish feed without any processing. Some examples include:

- **Aloe vera and Citrus sinenesis**: these have shown resistance against *Streptococcus iniae* (Gabriel *et al*., 2015; Acar *et al*., 2015).
- **Azadirachta indica:** It enhances resistance against *Aeromonas hydrophila* (Mona *et al*., 2015).
- **Allium sativum:** It increases resistance against *Neobenedinia sp*. (Militz *et al*., 2013), among others.

b. Microbial derived immunostimulants

They are the first kind of immunostimulants being used in aquaculture. Lipopolysaccharide (LPS) is one of the good examples. Many other examples include beta-glucan, poyhydroxybutyrate, dextran, β-1,3-glucan, ethanol extract off mycelium. A few microbial compounds have been commercialized for use in aquaculture and animal husbandry, with β-glucan being one such example (Meena *et al*., 2012).

c. Algal derived immunostimulants-

Algae also serve as promising immune stimulators that enhance innate immunity in fish. For instance, Nile tilapia exhibited increased survivability when fed with dried cell of Spirulina (Mahmoud *et al*., 2018).

Furthermore, Futerpenol®, a licensed immunostimulant, provides protection to a variety of fish species, including Rainbow Trout, against *Piscirickettsia salmonis* (Hernandez *et al*., 2016).

Probiotics

The word 'Probiotics' is derived from Greek, which means 'for life'. Probiotics are nothing but the beneficiary microbes which when administered improve the gut microbiome that in turn improves the immune response. It helps in enhancing the number of various cytokines. Studies show that probiotics help in proliferation of B-cells, T-cells and Granulocytes. While applying probiotics one has to consider several factors like gut pH, prevailing environmental factors, health condition of fishes etc. One of the important factors to be considered while applying probiotics is that they are host and strain specific in nature. Lactic acid bacteria and Bacillus strains are among the most extensively studied probiotic bacteria and are commonly included in commercial probiotics available in market for aquaculture industry (Kumar *et al*., 2015; Ranjit Kumar *et al*., 2012). The commercial products are available in liquid or powder presentations. In several studies, water quality parameters have been observed to be optimal when probiotic strains, particularly those belonging to the gram-positive genus *Bacillus*, are used.

CONCLUSION

Prophylactic strategies play a significant role in intensified aquaculture scenario, helping to reduce reliance on various antibiotics and drugs that pose potential threats to the environment. Among the discussed prophylactic strategies, the probiotics and immunostimulants are commercially available for aqua farmers. Plant-based immunostimulants are already in use by the farmers, but the precise mechanisms of immune stimulation for many herbs are not well understood and require further scientific investigation. The use of probiotics can enhance the benefits by increasing pathogen tolerance, improving water quality, and enhancing nutrient digestion, ultimately leading to better aquaculture yield.

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