Journal of Fisheries Sciences©
5 (17) 2023 : 001-004 • Review Article

Applications of probiotics in freshwater murrel fishes

Podeti Koteshwar Rao*, K. Ganesh,

Department of Zoology, Kakatiya Government College, Hanamakonda, Telangana State, India

AUTHORS' CONTRIBUTION: (A) Study Design · **(B)** Data Collection . **(C)** Statistical Analysis · **(D)** Data Interpretation · **(E)** Manuscript Preparation · **(F)** Literature Search · **(G)** No Fund Collection

ABSTRACT

Probiotic products were seen as an alternative to antibiotic use in freshwater murrel fish farming. Probiotic microorganisms such as bacteria, yeast and fungi provide several benefits to fish such as growth promotion, pathogen suppression and improvement of food digestion, poor water quality and stress tolerance agents, and reproduction enhancement. As a result, the purpose of this review is to identify the major trends in probiotics in freshwater murrel fishes. In probiotic research and commercial uses for freshwater murrel fishes, strategies for including probiotic strains in fish feed or pellets to allow optimal survival of the strains when they reach the fish Gastrointestinal Tract (GIT) are critical.

Keywords: Probiotic; Yeast; GIT; Microorganisms

Address for correspondence:

Podeti Koteshwar Rao,
Department of Zoology, Kakatiya University, Telangana, India
E-mail: kotesh_rao37@yahoo.co.in

Word count: 2,139 **Figures:** 02 **Tables:** 00 **References:** 13

Received: 14.06.2023, Manuscript No. IPFS-23-14046; **Editor assigned:** 17.06.2023, PreQC No. P-14046 (PQ); **Reviewed:** 02.07.2023, QC No. Q-14046; **Revised:** 18.08.2023, Manuscript No. R-14046 (R); **Published:** 15.09.2023

INTRODUCTION

The aquaculture business in many tropical and subtropical nations is dominated by *Channa* species, which is one of the most important protein sources from freshwater fish. Antibiotics and chemicals have traditionally been used to treat infectious illnesses in fish. Probiotics derived from the native gastrointestinal microbiota of fishes have been more popular as an alternative to antibiotics during the last two decades. Probiotic species such as bacteria, yeast, and fungi are frequently found in fish GIT and can be used singly or in mixes or consortia [1,2].

More than 150 million tonnes of fish were produced worldwide in 2017, with China producing the most, accounting for 4 million tonnes of the total. By 2030, aquaculture is predicted to account for nearly 62% of consumed fish, with wild-caught fish accounting for 38%. However, one of the major challenges in commercial aquatic organism culture is the emergence of infectious illnesses that threaten industrial sustainability. Disease is cited as the primary cause of productivity and economic resource losses by a number of academics and producers [3,4].

Aquaculture is the farming of aquatic creatures by intervention in the raising process in order to increase production and private ownership of the stock being grown. In comparison to this fishing output. Aquaculture has grown in importance around the world as a result of overfishing of wild species. Aquaculture has made a significant contribution to global food production, raw materials for industrial and pharmaceutical application and aquatic organisms for stocking or ornamental commerce in recent decades [5].

According to the World aquaculture 2012 report, worldwide aquaculture production increased by more than 30% between 2006 and 2011, from 47.3 million tonnes to 63.6 million tonnes. Furthermore, under these intense production settings, aquatic species are subjected to high-stress conditions, increasing the frequency of illnesses and decreasing productivity. Outbreaks of viral, bacterial and fungal illnesses have resulted in massive economic losses around the world; for example, China recorded disease-related losses of $750 million in 1993, while India claimed $210 million losses from 1995 to 1996. Furthermore, considerable animal mortality has been recorded as a result of inadequate farm environmental conditions, uneven feeding, toxin production and genetic variables [6].

LITERATURE REVIEW

Proper probiotic strain selection is crucial because inappropriate

strains can have negative effects on the host. The basic goals of selecting probiotics are that they be safe and deliver desirable results. They must also maintain their ability during manufacture, manufacturing, distribution and storage before reaching the customer. The good and successful probiotics should have a few specific characteristics that are listed below [7].
The characteristics of good probiotics are:

- It should be a strain capable of exerting a beneficial effect on the host animal, e.g. increased the growth or resistance to disease.
- It should be a non-pathogenic and non-toxic.
- It should be present as viable cells and preferably in large number.
- It should be capable of surviving and metabolizing in the gut environment, e.g. resistance to low pH and organic acids.
- It should be stable and capable of remaining viable for longer periods under storage and field conditions.

Definition of probiotics

The name "probiotic" is derived from the Greek words pro and bios, which signify "life" and has taken on several meanings over time. Dr. Elie Metchnikoff was the first to describe the beneficial role of some bacteria among farmers who consumed pathogen-containing milk in 1905 and he stated that "reliance on gut microbes for food makes it possible to take steps to change the flora of our bodies and to replace harmful microbes by beneficial microbes". However, Lilly and Stillwell did not coin the name "probiotic" until 1965 as a derivative of the original word "probiotika."

It was used to explain microorganism-produced compounds that prolong the logarithmic growth phase in other species. It was described as an agent that serves the opposite purpose of antibiotics. Sperti later amended the term "tissue extracts that stimulate microbial growth." Parker coined the term to denote a microbial feed/food supplement in 1974. It was defined by him as "organisms and substances that contribute to intestinal microbial balance." Fuller broadened the definition to "live microbial food supplement that benefits the host (human or animal) by improving the microbial balance of the body" and claimed that it would be successful under a variety of extreme temperature and salinity fluctuations [8].

Probiotics were later defined as "monocultures or mixed cultures of microorganisms applied to animals or humans that benefit the host by improving the properties of indigenous microflora". Guarner and Schaafsma postulated in 1998 that probiotics are live bacteria that, when taken in sufficient quantities, offer health advantages to the host.

DISCUSSION

Applications of probiotics

The requirement for sustainable aquaculture has fueled research into the use of probiotics on aquatic species. The early focus was on their usage as growth promoters and to improve animal health; however, other areas of interest have been discovered, such as their effect on reproduction or stress tolerance, albeit this requires more scientific study [9].

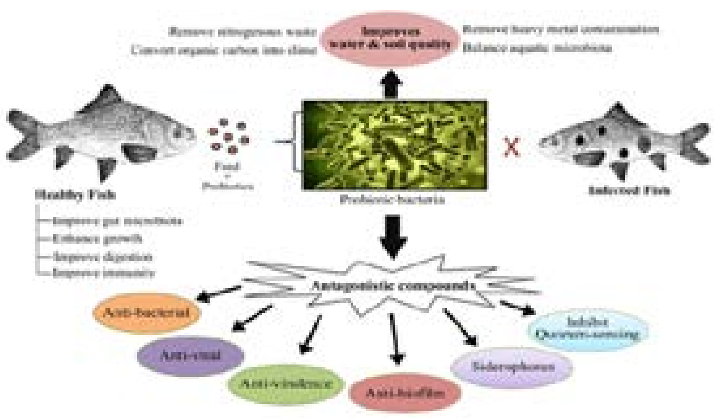
Growth promoter

Probiotics have been employed in aquaculture to boost the growth of cultured species; however, it is unknown whether these items increase hunger or improve digestibility by nature. Some people believe that it could be a combination of both aspects; additionally, it would be crucial to verify whether probiotics genuinely taste good for aquaculture animals.

According to Balcazar, et al. probiotic microorganisms can colonise the gastrointestinal tract when administered over time because they have a higher multiplication rate than the rate of expulsion, so as probiotics are constantly added to fish cultures, they adhere to the intestinal mucosa, developing and exercising their multiple benefits. H ydrobiont s pecies, b ody t emperature, enzyme levels, genetic resistance and water quality all have a role [10].

Probiotics have been tested on phytoplankton (microalgae), which forms the foundation of aquatic food chains due to its nutrient-producing photosynthetic machinery, which higher organisms are unable to synthesise in most situations, such as polyunsaturated fatty acids and vitamins. Central diatoms such as *Chaetoceros* spp. have proven to be an excellent live food within groups of microalgae utilised in aquaculture; nevertheless, production is limited due to the intricacy of their nutritional requirements. Figure 1 depicts the use of probiotics in freshwater murrel fishes (**Fig. 1.**).

Fig. 1. Applications of probiotics in freshwater aquaculture.



The inhibition of pathogens antibiotics

They have long been used in aquaculture to avoid crop diseases. However, this resulted in a number of concerns, including the accumulation of antibiotic residues in animal tissues, the development of bacterial resistance mechanisms, and an imbalance in the gut microbiota of aquatic species, which harmed their health. The European Union, in fact, has limited the use of antibiotics in organisms intended for human consumption. Consumers today want natural products that are free of ingredients such as antibiotics; also, there is a trend towards disease prevention rather than disease treatment. Thus, the use of probiotics is a potential option for pathogen suppression and disease control in aquaculture species [11].

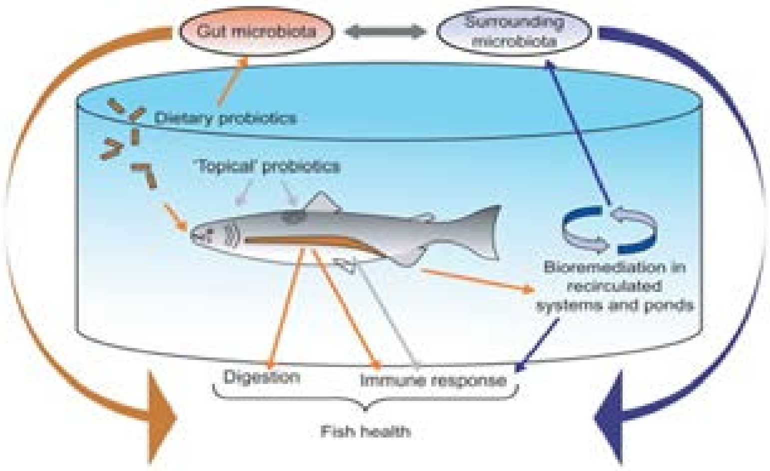
Improvement in nutrient digestion

According to the study, probiotics benefit aquatic animals' digestive processes since probiotic strains synthesise extracellular enzymes such as proteases, amylases, and lipases as well as supply growth factors such as vitamins, fatty acids, and aminoacids. As a result, when probiotics are added to feed, nutrients are absorbed more efficiently. In this regard, probiotics have been employed in edible species, such as European bass larvae (*Dicentrarchus labrax*).

The probiotic yeast *D ebaryomyces hansenii* HF1 has been shown to be capable of producing spermine and spermidine, two polyamines important in the differentiation and maturation of the gastrointestinal tract in mammals. Water quality was measured in various studies after the inclusion of probiotic bacteria, particularly those from the gram-positive genus *Bacillus*. Probably because this bacterial type converts organic materials to CO2 more efficiently than gram-negative bacteria. Maintaining high levels of probiotics in production ponds may allow fish farmers to reduce the accumulation of dissolved and particulate organic carbon throughout the growing season [12].

Furthermore, this can balance phytoplankton production. This theory, however, could not be substantiated in studies conducted during prawn or channel catfish production employing one or more species of *Bacillus*, *Nitrobacter*, *Pseudomonas*, *Enterobacter*, *Cellulomonas*, and *Rhodopseudomonas*. Except for nitrification, published evidence for enhancing water quality is so limited. Figure 2 depicts the microbial modifications of probiotics (**Fig. 2.**).

Fig. 2. Applications of probiotics and other microbial manipulations in murrel fish feeds.



Stress tolerance

Aquaculture practises necessitate intensive output in shorter periods of time, putting crop species under stress. Chronic stress, for example, has been shown in *Channa striatus* and *Channa punctatus* fish to cause an overall decrease in muscle protein synthesis. As a result, probiotics were used to boost stress tolerance. In addition to assessing growth improvement, the stress hormone cortisol was measured in fish tissue as a stress marker because it is directly implicated in the animal's response to stress.

Another method for measuring stress in fish is to subject them to heat shock, as was done with Japanese flounder (Paralichthys olivaceus) grown in a recirculating system. Breeding aquaculture species have high nutritional requirements, hence reproductive capacity is dependent on adequate concentrations of lipids, proteins, fatty acids, vitamins C and E and carotenoids, according to. Furthermore, the interaction of these components effects reproduction in a variety of processes like as fertility, fertilisation, birth and larval development. At the moment, most cultured fish species have commercially available "broodstock diets" that are simply larger-sized diets.

Unprocessed fish products frequently may not supply enough quantities of nutrients required by broodstock fishes, increasing the risk of disease transfer to parents and offspring, including parasites, bacteria, and viruses. As a result, probiotics given to food or water were employed to prevent illnesses and investigate their effect on reproduction. Conducted the first study on the effect of probiotic supplementation on fish reproductive performance, employing a strain of *B. subtilis* obtained from the intestines of *Channa* striatus and *Chnna punctatus*. Furthermore, these researchers hypothesised that complex B vitamins synthesised by the probiotic, particularly thiamine (vitamin B1) and vitamin B12, help to lower the amount of dead or deformed alevins [13].

Safety considerations of probiotics

Probiotics used in the food sector have traditionally been believed harmless; in fact, no human dangers have been identified, serving as the best indication of its safety. In theory, probiotics could cause four types of negative effects in vulnerable people: Systemic infections, harmful metabolic activities, excessive immunological stimulation and gene transfer. However, no concrete proof has been discovered. There have been few instances of bacteremia in people, when the isolation of probiotic bacteria from illnesses appears to be the result of an opportunistic infection caused by skin sores, cancer, chronic sickness or a drug-induced aberration. These circumstances cause a breakdown in the intestinal barrier, allowing bacteria to penetrate through the mucosal epithelium. Subsequently, these microorganisms are transported to the mesenteric lymph nodes and other organs, leading to bacteremia that may progress to septicemia.

CONCLUSION

The current global food crisis, as well as rising fish production costs, have put pressure on governments and the international community to secure a sustainable food supply for a growing population. Thus, aquaculture is presented as a way to meet the growing demand for fresh water food or seafood, as well as to meet current challenges related to ongoing globalisation of trade, intensification and diversification of aquaculture, progress in technological innovations for food production, changes in ecological systems and human behaviour, including a greater awareness to protect biodiversity, public health, and the environment. These issues will raise interest in improving aquaculture practises, making it an important alternative to the overexploitation and alteration of aquatic ecosystems caused by capture fisheries. Using biochemical, morphological, and molecular approaches, a variety of probiotic strains found in the GIT of aquatic animals and nitrifying bacteria from biofilters have been identified and characterised. The evolution of molecular tools such as PCR, FISH (Fluorescent In situ Hybridization), DGGE (Denaturing Gradient Gel Electrophoresis), and genomic library production has begun to reveal the diversity present in aquaculture systems. At the moment, next-generation sequencing technologies hold significant promise for phylogenetic identification of probiotic microbes without the need of traditional cultivation procedures.

ACKNOWLEDGEMENT

Authors with to thanks Dr. P. Srinivas plant pathology and microbiology laboratory, department of biotehnology, Kakatiya university, Warangal for his continuous support and inspiration and providing necessary facilities for the work.

CONFLICT OF INTEREST

All authors declare no conflict of interest.

REFERENCES

1. **Pandiyan P, Balaraman D**, Thirunavukkarasu R, et al. Probiotics in aquaculture. *Drug Invention Today*. 2013; 5(1): 55-59.
2. **Lafferty KD, Harvell CD, Conrad JM, et al**. Infectious diseases affect marine fisheries and aquaculture economics. *Annu Rev Mar Sci*. 2015; 7: 471-496.
3. **Ebeling JM, Timmons MB.** Recirculating aquaculture systems. Aquaculture. 2012; 11: 245-277.
4. **Nachimuthu R, Royam MM, Manohar P, et al.** Application of bacteriophages and endolysins in aquaculture as a biocontrol measure. *Biol Control. 2021*; 160: 104678.
5. **Bondad-Reantaso MG, Subasinghe RP, Arthur JR, et al.** Disease and health management in Asian aquaculture. *Vet Parasitol*. 2005; 132: 249-272.
6. **Kautsky N, Ronnback P, Tedengren M, et al.** Ecosystem perspectives on management of disease in shrimp pond farming. *Aquaculture*. 2000; 191: 145-161.
7. **Ige BA.** Probiotics use in intensive fish farming. *Afr J Microbiol Res*. 2013; 7: 2701-2711.
8. **Fuller R.** Probiotics in man and animals. *J Appl Bacteriol*. 1989; 66: 365-378.
9. **Michael ET, Amos SO, Hussaini LT**. A review on probiotics application in aquaculture. *Aqua Fish*. 2014; 5: 1-2.
10. **Shewale RN, Sawale PD, Khedkar CD, et al.** Selection criteria for probiotics: A review. *Int J Probiotics Prebiotics*. 2014; 9: 16-17.
11. **Balcazar JL, de Blas I, Ruiz-Zarzuela I, et al.** The role of probiotics in aquaculture. *Vet Microbiol. 2006*; 114: 173-186.
12. **Gatesoupe FJ.** The use of probiotics in aquaculture. *Aquaculture*. 1999; 180: 147-165.
13. **Gram L, Melchiorsen J, Spanggaard B, et al.** Inhibition of Vibrio anguillarum by Pseudomonas fluorescens AH2, a possible probiotic treatment of fish. *Appl Environ Microbiol*. 1999; 65: 969-973.