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Probiotics from Marine Microorganisms in Sustainable Aquaculture

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Abstract:

Probiotics derived from marine microorganisms make available better health benefits when consumed. The term probiotic is currently used to name ingested microorganism associated with beneficial effects to humans and animals. Probiotics have diversified benefits as they act as nutrient sources, providing enzymes for better digestion thereby increasing the immune response against pathogenic bacteria. Aquaculture industry is often affected by disease outbreaks thereby causing loss of the live stock and limiting the economic benefit. Hence antimicrobials are often used for disease control. However there have been emerging trends to bring in alternative techniques for disease management in aquaculture practices. This has enabled the introduction of probiotics in aquaculture practices which has gained good momentum lowering antimicrobial usage. Bacteria *Vibrio sp.*, *Pseudomonas sp., and Bacillus sp.*, and many other *Lactobacilli sp.*, are tried as probiotics in mollusk, crustacean, and finfish aquaculture. There has been limited success with experimenting terrestrial bacteria in aquaculture and hence probiotics from marine microorganisms stands a far sighted and better approach in applications. *Streptomyces sp.*, and the newly discovered *Salinispora sp.*, also have promising traits of a probiotic and hold good future in aquaculture.

Key words: probiotics, aquaculture, enzymes, nutrient sources, marine, microorganisms

Introduction:
A probiotic is generally referred to as a substance secreted by one microorganism that stimulates the growth of another organism. Akhter *et al*., (2015) studied that probiotics are microorganism that are administered orally in a sufficient amount to alter the micro biota of the specific host, causing it benefit by improving immunity, helping in digestion, improves water quality, promotes growth and reproduction. To meet the global demand, aquaculture production practices have been intensified to a greater extent both in technological and practical measures, Tuan *et al.*, (2013). Disease management in aquaculture practices is a major hindrance, hence the usage of antimicrobials becomes necessitated, Newaj-Fyzul and Austin, (2014). The over usage of antimicrobials resulted in the succession of antibiotic resistant bacteria in aquaculture industry, causing alterations in the bacterial flora both in the sediments and in the water columns, Verschuere *et al*., (2000). This eventually caused the exploration of substitutes as antibiotics that are eco friendly and sustainable, Standen *et al*., (2013) ; Lazado et al., (2015).

Probiotics have taken an in-depth role as dietary supplements and its intake is correlated as functional and natural products. Moreover it has been noted that probiotics isolated from the same system where they would be applied do not show any adversities on the surrounding ecosystems. Hence there have been good approaches that have defined the success or failure of applications of probiotics. This is necessary in the standardization of protocols as the success of a probiotic in a specific host doesn't seem to bring in the same benefit in another species or the host microorganism. The application of probiotics in sustainable aquaculture is dependent on its effectiveness. The administration of probiotics is often mixed with the culture water or with the inoculums of green water. The other adopted method of administration of probiotics is through the live feed that is given to the fish, Sayes *et al*., (2017). Therefore the marine microorganisms considered as probiotics in aquaculture practices should be safe for the aquatic hosts, humans and the environment.

A group of marine microorganisms have been experimented as probiotics that included both Gram negative and Gram positive bacteria. Researchers have broadened the probiotics that have been tested on various species of fishes. These include *Bacillus licheniformis (TSB$_{27}$), Bacillus plantarum, Bacillus subtilis (B$_{46}$), Lactobacillus thuringiensis, Vibrio lentus, Rhodococcus SM$_2$, Enterococcus casseliflavus, Enterococcus faecalis etc*. the other known best probiotics are *Bifidobacteria, Lactobacilli* and *Streptococcus thermophilus.* Actinobacterial genus also seemingly possess the characteristics of a good probiont, hence *Salinispora* genus could act as a promising strain in aquaculture practices. Marine actinomycetes are considered to be enterprising by their capability to produce varied extracellular enzymes and also antibiotics, Barka *et al*., (2013). Hence newer marine microorganisms as probiotics probability in aquaculture are seemingly explored, Lazado *et al*., (2015).

The application of these marine probiotics at commercial level requires the production of massive biomasses and viable cells. There have been limitations with the marine medium and peptones being costly, hence continuous supply of marine probiotic microorganisms are also limited. The strains of *Streptomyces* have shown to produce potential activity against the disease causing organism in the fish and shell fish industry, Bharathi and Smitha, (2015). Recent research has emphasized more on the probability of *Streptomyces sp*. characterized with starch hydrolysis to act as an effective probiont in aquaculture. Its anti vibrio activity has formed the basis for this, in addition to its ability of producing amylase and protease enzymes. Marine actinomycetes are accredited with newer species with newer structures and newer bioactive compounds that gives good scope for future research.

The studies of Das *et al*., (2010) indicated that *Streptomyces* increased the weight of *Penaeus monodon* shrimp, which was a result of the secretion of hydrolytic enzymes that impact the digestive tract activity of the shrimps for efficient feed usage. This further indicated that the spore-forming capacity of *Streptomyces* with high acidity and bile acids tolerance makes the species a practicing approach in comparison with the abilities of the non-spore forming bacteria strengthening the potential of *Streptomyces* as an efficient probiotic in aquaculture, Das et al., (2010). Research studies have also entrusted that *Streptomyces* administration to the target organisms has been done in *Artemia* as a vector through bio-encapsulation enhancing the effectiveness of *Streptomyces* as a marine probiotic. Gatesoupe, 2002 and Suzer *et al*., (2008) elaborated and demonstrated the bio-encapsulation of probiotics in *Artemia* was more established in probiotics delivery to the digestive tracts of targeted organisms in aquaculture practices.

Aftabuddin *et al*., (2013) studied that the feed supplemented with *Streptomyces fradiae* isolated from the mangrove sediments enhanced the growth of the post-larval *Penaeus monodon* . These findings indicate that the spore-forming capacity of *Streptomyces* with high acidity and bile acids tolerance makes them a more practical alternative than those bacteria with non-spore forming capability strengthening its usage as probiotics in aquaculture. The formation of enzymatic digestion, sonic vibration and desiccation-resistant spores demonstrated by *Streptomyces* are also some of the attractive features for this genus of bacteria to resist the harsh environment conditions, thereby allowing them to retain longer shelf life in the aquaculture ponds before being taken up or to resist the low pH in the gastrointestinal tracts of the animals. However, it should be noted that *Streptomyces* spore is only resistant to moderately high temperature as compared to the highly heat resistant endospores of *Bacillus sp*. which is compositionally and physiologically different from the *Streptomyces* spore. Nourouzi *et al*., (2018) emphasized that for *Streptomyces* to be considered as a probiotic, a growth-stimulator factor in aquaculture ecosystems, performing further extensive research studies becomes essential. Hence *Salinispora* the most recently discovered genus also stands a good probability for research as a marine probiotic.

References:

- Aftabuddin, S, Kashem MA, Kadern MA, Sikder MNA, Hakim MA (2013): Use of *Streptomyces fradiae* and *Bacillus megaterium* as probiotics in the experimental culture of tiger shrimp *Penaeus monodon* (Crustacea, Penaeidae). *AACL Bioflux* .
- Akhter N, Wu B, Memon AM, Mohsin M (2015): Probiotics and prebiotics associated with aquaculture: A review. *Fish and Shellfish Immunology.*
- Barka EA, Vatsa P, Sanchezm L, Gaveau-Vaillant N, Jacquard C, Klenk HP, van Wezel GP (2016): Taxonomy, physiology, and natural products of Actinobacteria. *Microbiology and Molecular Biology Reviews*.
- Das S, Ward LR, and Burke C (2010): Screening of marine *Streptomyces* sp. for potential use as probiotics in aquaculture. *Aquaculture* .
- Gatesoupe FJ (2002): Probiotic and formaldehyde treatments of *Artemia nauplii* as food for larval pollack, *Pollachius pollachius*. *Aquaculture.*
- Lazado CC, Caipang CM, Estante EG (2015): Prospects of host-associated microorganisms in fish and penaeids as probiotics with immunemodulatory functions. *Fish Shellfish Immunology.*
- Newaj-Fyzul A, Al-Harbi AH, Austin B (2014): Review: developments in the use of probiotics for disease control in aquaculture. *Aquaculture.*
- Nikapitiya C (2013): Marine Bacteria as Probiotics and Their Applications in Aquaculture. *Book Marine Microbiology.*
- Nourouzi H, Danesh A, Mohseni M, Khorasgani R (2018): Marine Actinomycetes with Probiotic Potential and Bioactivity against Multidrug – resistant bacteria. *International Journal of Molecular and Cellular Medicine.*
- Sayes C, Leyton Y, Riquelme C (2017): Probiotic Bacteria as a healthy Alternative for Fish Aquaculture. *Intechopen.*
- Smitha MD, Bharti P (2015): Screening of Marine Actinomycetes as Probiotics for Production of Bacteriocin. *International Journal of Current Microbiology and Applied Sciences.*
- Standen BT, Rawling MD, Davies SJ, Castex M, Foey A, Gioacchini G (2013): Probiotic *Pediococcus acidilactici* modulates both localized intestinal- and peripheral-immunity in tilapia (*Oreochromis niloticus*). *Fish Shellfish Immunology*.
- Suzer C, Çoban D, Kamaci HO, Saka ş, Firat K, Otgucuoğlu Ö (2008): *Lactobacillus spp*. bacteria as probiotics in gilthead sea bream (*Sparus aurata*, L.) larvae: effects on growth performance and digestive enzyme activities. *Aquaculture*
- Tuan TN, Duc PM, Hatai K(2013): Overview of the use of probiotics in aquaculture. *International Journal of Research Fish Aquaculture.*
- Verschuere L, Rombaut G, Sorgeloos P, Verstraete W (2000): Probiotic bacteria as biological control agents in aquaculture. *Microbiology Molecular Biology Reviews*.