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Review Article

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ROLE OF PROBIOTICS IN AQUACULTURE- A REVIEW

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Abstract

Aquaculture is concerned with the propagation and rearing of aquatic organisms under complete human control involving manipulation of at least one stage of an aquatic organism's life before harvest in order to increase its production. Resistance mechanisms of bacteria can arise in one of two ways chromosomal mutation or acquisition R-plasmid. Forty percent of world aquatic product (including capture fisheries) derives from aquaculture being valued at US$ 78 billion. Aquaculture produced molluscsaccount for 21% of total aquaculture product and make up 65 % of total molluse product when capture fisheries are considered (FAO, 2007). Diseases caused by vibrio spp and Aeromonas spp are commonly implicated in episodes of mortality. This review article focuses the 4 use of probionts in aquaculture.

Key Words: Aquaculture, probiotics, probionts, feed, growth, immunostimulation.

INTRODUCTION

Probiotics that currently used in aquaculture industry include a wide range of taxa-from *Lactobacillus, Bifidobacterium, Pediococcus*. Lake *Streptococcus* and *Carnobacterium*spp. *Bacillus, Flavobacterium, cytophage, Pseudomonas, Alteromonas, Aeromonas, Enterococcus, Nitrosomonas, Nitrobacter* and *Vibrio* spp., and Yeast *Saccharomyces, Debaryomyc*(Irianto and Austin 2002; Sahu *et al*., 2008; Hemaiswarya *et al*., 2013).

Aquaculture has grown tremendously during last years becoming an economically important industry (Subasinghe 2009). Today it is the fastest growing food- producing sector in the world with the greatest potential to meet the growing demand for aquatic food (FAO 2006). Although aquaculture activity in Nigeria is started about 50 years age (Olagunju 2007), aquaculture production in Nigeria is currently about 40,000 metric tonnes contributing only 6% of domestic fish production (Adeogum 2007). Nigerians are high fish consumers and offer the largest market for fisheries production in Africa. Thus, Nigeria has become one of the largest fish importers in the developing world, importing about 600,000 metric tonnes annually (Olagunju 2007).

A significant issue affecting production is the loss of stock through disease. Diseases caused by *Vibirio* spp and *Aeromonas* spp are commonly implicated in episodes of mortality. Aquaculture is viewed as an important food security sector for a growing global human population and has rapidly developed due to intensified culture methods (Hai 2015). Although prodiotics offer a promising alternative to chemicals and antibiotic in aquatic animals (Rekiel *et al*., 2007) and as an aid in the protection of aquacultured species, the ways that probiotics are used in aquaculture need to be considered to avoid producing negative results.

As aquatic animals interact with a diverse range of micro-organisms within animals and their habitat, a screening probiotic process for particular fish species plays a vital role to make them species specific for obtaining desired results in which in *vitro* and in *vivo* tests need to be carried out carefully.

Probiotic administrations have been widely applied via water routine or feed additives (Moriaty 1998 ;Skjermo and Vodstein 1999) with either single or a combination of probiotics or even a mixture with prebiotics or other immunostimulants (Hai and Fotedar 2009).

There is a developing social attitude against unnecessary use of ADS and where possible it is the move away from non- essential AD use that the responsible farmer now seeks. Give the threat that both ADs and bacterial pathogens pose to farmers, as well as in human health, alternatives are being sought probiotics is one field commanding considerable attention.

Probiotics Difinifion

The term "probiotic" comes from Greek *pro* and *bios* meaning "prolife" (Gismondo *et al*., 1999). Elie Metchnikoff's work at the beginning of this century is regarded as the fist research conducted on probiotics (Fuller1989). As the intestine micro biota in aquatic animals con- stantlyinteratcts with the environment and the host functions, a probiotic is defined as a live microbial adjunct which provides beneficial effects viz,

1. Modifying the host – associated or ambient microbial community,
2. Improving the use of feed or enhancing its nutritional value, enhancing the response of the host towards dis- eases or
3. Improving the quality of its ambient environment (Verchuere *et al*., 2000).

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In addition, probiotics have been widely used in human and veterinary medicine. They are mainly lactic acid bacteria, putative *Lactobacillus* spp. (Fullar1989). He defined a probiotic as a "live microbial feed supplement which beneficially affects the host animal by improving its intestinal balance". Today probiotics are quite commonplace in health promoting "functional foods" for humans, as well as therapeutic, prophylactieand growth supplements in animal production and growth supplements in animal production and human health (Mombelli and Gismondo 2000; Ouweh and *et al*.,2002 Sullivan and Nord 2002; Senok *et al*., 2005). Other commonly studied probiotics include the spore forming *Bacillus* spp and *Yeasts Bacillus spp*. have been shocon to possess adhesion abilities, produce bacteriocins(antimicrobial peptides)and provide immunostimulation(Chetif *et al*.,2001;Cladera Oliver *et al*.,2004 ; Due *et al*.,2004 ; Barbosa *et al*.,2005).

Potential Probiotic Bacteria In Use

Probiotics are harmless bacteria that help the wellbeing of the host animal and contribute directly or indirectly to protect the host animal against harmful bacterial pathogens. The highly researched and most used probiotcs according to Berger (2002) are *Lactobacillus* acldophillus, *L.bulgericus*. *Bifidobacterialongum*and *Binfantis*some of the commercial probiotics currently available in use include Aqualact, probela; Lacto-SaccEpicin, Biogreen, Enviro, wunopu-15and Epizyme (Abidi,2003).

Desirable characteristics for the selection of potential probiotics include(i) no harm to the host; (ii) acceptance by the host through ingestion, and colonization and proliferation within the host; (iii) ability to reach target organs where they can work; and (iv) no virulent resistance or antibacterial resistance genes (Verschuere *et al*.,2000; Kesarcodi Watson *et al*.,2008).

Aquacticprobitics are mainly of two types

1. Gut probiotics which can be blended with feed and administrated orally to enhance the use full microbial flora of the gut and
2. Water probiotcs which can proliferate in water mediumand exclude the pathogenic bacteria by consuming all available nutrients. Thus the pathogenic bacteria are eliminated through starvation(Sahu *et al*., 2008).

Application of Probiotics In Aquaclture

These organisms can be administered to the aquaculture organisms through feeding injection or immersion of the probiotic bacteria (Irianto and ansitin 2002).

Application In Feed

Probiotics are applied with the feed and a binder (egg or liver oil) and most commercial preparation containeither *Lactobacillus*sp or *Saccharomyces cervisiae*(Abidi 2003). Regular use of probiotic in feed of fish in U.K and other European countries has been reported to have several health benefits.

Live feed are very important for shrimp larvae.Unicellular algae (*Cheatocerous and Skeletoneme*), brine shrimp.Artemia, and Rotifer are the two live feeds widely used in shrimp seed production (Naessene *et al*.,1997). Uhi cellular diatoms and algae are give as feed before the Naupli mounts in to Zoea. According to FAO and WHO guidelines, probiotic organisms used in food must be capable of surviving passages through the gut i.e they must have the ability to resist gastric juices and exposure to bile(Senok *et al*., 2005).

Feed addictives such as probiotics *(Latctobacillusrhamnosus)* improved the fecundity of zebra fish (*Daniorerio*) (Gioacchini *et al*.,2010). The immerstionmetod is also useful (Sung *et al*.,1994;Itami *et al*., 1998).

Direct To Culture Water/Pond

The water probiotics contain multiple strains of bacteria like *Bacillus acidophilus, B.Subtilis, B.lecheniformis, Nitrobacter sp,.Aerobacter and Sacharomyces, carevisiae*. Application of probiotic through water of tanks and ponds may also have an effect an fish health by improving several qualities of water, since they modify the bacteria composition of the water and sediments (Ashraf 2000; Venkateswera ,2007). When probiotics are applied in culture water they multiply and over grow the pathogenic organism present in the water. Beside this Venkateswara (2007) reported that probiotic bacteria are generally called bacteria which can improve the water quality of aquaculture and inhibit the pathogens in water thereby increasing production.

Application Through Injection

Application of probiotics by injection is a possibility. Austin *et al* ., (1995) suggested the possibility of freeze drying the probiotic like vaccine and applied either through bathing, or injection. Except for experimental purposes application of probiotic by injection has not been widely reported.

Yassir *et al*., (2002) has demonstrated the experimental administration of probiotic *Micrococcus luteus to Orochromisniloticus* by injection through intra peritoneal route which had only 25% mortality as against 90% with *Pseudomonas* using the same route. According to Yassir*et al*., (Yassir 2002; Nikoskelainen 2003). The use of probiotics stimulate Rainbow trout immunity by stimulating phagocytes activity. Complement mediated bacterial killing and immunoglobulin production (Noh 1994).

Developing Probiotics For Aquaclture

It has been widely published that a probiotic must possess certain properties (Verschuere et al., 2000a). These properties were proposed in order to aid correct establishment of new effective and safe products. The properties include:

1. The probiotic should not be harmful to the host it is desired for,
2. It should be accepted by the host, e.g. through ingestion and potential colonization and replication within the host,
3. It should reach the location where the effect is required to take place,
4. It should actually work in *vivo* as opposed to in *vitro* findings,
5. It should preferably not contain virulence resistance genes or AB resistance genes.

The future application for probiotics in aquculture looks bright. There is an ever- increasing demand for aquaculture, Probiotcs and a similar increase in the search for alternatives to antibiotics. The field of probiotics intended for aquacultured animals is now attracting considerable attention and a number of commercial products are available, particularly directed at shrimp larval cultures. However the advent of new probiotic screening techniques that incorporate an initial in *vivo* component will allow for a wider range of bacteria to be inidentified as probiotics. The successful acquisition of such novel probiotics might also depend on obtaining a better understanding of the microbial ecology of a cultured species as well as restricting the probiotic screens to the bacterial species that share the immediate environment with the cultured species. Probiotic strains that are already adapted, through natural processes, to the dynamics of an aquaculture, production system will probably lessen any farm management environmental manipulation practices required to achieve the desired probiotic effect in the final product. Introducing such specifically intended probiotics is bound to favour an increase in the application of probiotics, particularly in mollusk production.

Benefits of Probiotics

Although some of the effects of probiotics have been documented clearly, research is stil on going in the area with so many questions on the reality of some of the benefit remaining unanswered. However it is crucial to remember that different probiotic strains are associatd with different health benefits (Senok *et al*., 2005).

Improvement In Water Qualities

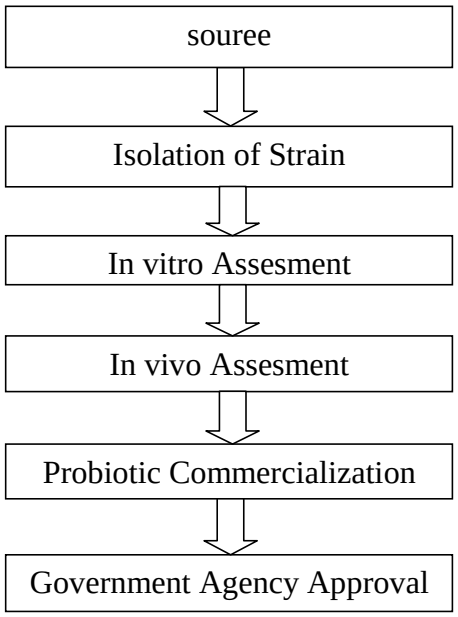
According to Venkateswara (2007), probiotics have reported to regulate micro flora, control pathogenic ones, enhances the decomposition of the undesirable organic substance, improve ecological environment by minimizing the toxic gasses like NH_3, N_2O, H_2 O_2, Methane etc, increases population of food organism in the water increases nutritional level of the aquatic host and improve their immunity in the culture water. In several studies, improved water quality has been recorded during the addition of the probiotics especially with *Bacillus* sp (Verschuere *et al*.,2000). The rationale is that Gram positive *Bacillus* sp. are generally more effective in converting organic matter back to CO_2 than G negative bacteria which could convert a greater percent age of organic carbon to bacterial biomass or slime.

Probiotics have proven their effectiveness in improving water quality in different approaches. They enhanced decomposition of organic matter reduced nitrogen and phosphorus concentrations and controlled ammonia, nitrite and hydrogen sulphide(Boyd and Massaut1999 ; Ma *et al* 2009 ; Cha *et al* ., 2013). Probiotics reduced metabolic wastes during transportation of cardinal tetra (*Paracheirodon aexlorodi*) (Gomes *et al*.,2009). Probiotcs improved water quality by reducing a number of pathogenic bacteria (Park *et al*.,2000 ; Dalmin *et al*.,2001).

Selection of Probiotics

The initial major purpose of using probiotics is to maintain or re- establish a favourable relationship between friendly and pathogenic Microorganism that constitute the flora of intestinal or skin mucus of fish. A successful probiotic is expected to have a few specific properties in order to certify a beneficial effect.

Guidelines recommend that in the cause of selecting probiotics; the probiont should be evaluated for a number of parameters such as, antibiotics susceptibility patterns, toxic production, metabolic and hemolytic activities infectivity in immune compromised host and side effects.



And in order to produce probiotics for commercialization, the following steps are to be put in to consideration as in Fingure: 1

A healthy source of microorganisms from a digestive tract of healthy aquatic animals must be selected. The microorganisms with which the work is to be carried out are isolated and identified by means of selective culture.

A new culture with only colonies of interest for conducting in vitro evaluation such as inhibition of pathogens; pathogenicity to target species; resistance conditions of host; among others are performed.

In case of the absence of restrictions on the use of the target species, experiments with in vivo supplementation and small and large scale, are carried out to check if there are real benefits to the host. Finally the probiotic that presented significantly satisfactory result can be produced commercially and utilized.

Characteristics of Good Probiotics

Filler (1989) listed the following as features of good probiotic bacteria;

1. It should be a strain, which is capable of exerting a beneficial effect on the host animal e.g increased growth or resistance to disease.
2. It should be non - pathogenic and non –toxic.
3. It should be present as viable cells preferable in large numbers.
4. It should be capable of surviving and metabolizing in the gut environment e.g. resistsance to low pH and organic acid.
5. It should be stable and capable of remaining viable for periods under storage and field conditions.

A probiotic agent with all these features has considerable advantage over antibacterial supplements such as antibiotics currently is use. They do not induce resistance to antibiotics which will compromise therapy.

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