

## Probiotics and its use in aquaculture

### What is probiotics?

Probiotics are defined by Food and Agriculture Organization/World Health Organization as "live microorganisms which when administered in adequate amounts confer a health benefit on the host"

The term probiotics was first used by Lilly & Stillwell in 1965. Probiotic was defined as the microbiological origin factor that stimulates the growth of other organisms. In 1989 Roy Fuller introduced the idea that probiotics generate a beneficial effect to the host. He defined probiotics as live microorganisms which, when administered in adequate amounts, confer benefit to the host's health, improving the balance of the microbiota in the intestine.

The purpose of its use is to install, improve or compensate for the functions of the indigenous microbiota that inhabit the digestive tract or the surface of the body.

### Probiotic organisms

The requirements that a probiotic organism must meet are:

1. Resistance to the acid stomach environment, bile and pancreatic enzymes;
2. Accession to the cells of the intestinal mucosa;
3. Capacity for colonization;
4. Staying alive for a long period of time, during the transport, storage, so that they can colonize the host efficiently;
5. Production of antimicrobial substances against the pathogenic bacteria; and
6. Absence of translocation.

The species normally used as probiotics in animal nutrition are usually non-pathogenic normal microflora, such as lactic-acid bacteria (*Bifidobacterium*, *Lactobacillus*, *Lactococcus*, *Streptococcus* and *Enterococcus*) and yeasts as *Saccharomyces* spp.

### Mechanisms of action

Competition for binding sites: also known as "competitive exclusion", where probiotics bacteria bind with the binding sites in the intestinal mucosa, forming a physical barrier, preventing the connection by pathogenic bacteria;

Production of antibacterial substances: probiotic bacteria synthesize compounds like hydrogen peroxide and bacteriocins, which have antibacterial action, mainly in relation to pathogenic bacteria. They also produce organic acids that lower the environment's pH of the gastrointestinal tract, preventing the growth of various pathogens and development of certain species of *Lactobacillus*;

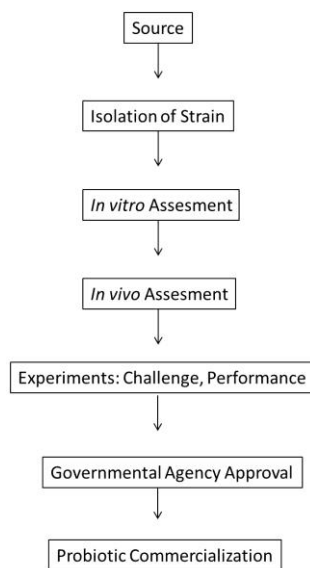
Competition for nutrients: the lack of nutrients available that may be used by pathogenic bacteria is a limiting factor for their maintenance;

Stimulation of immune system: some probiotics bacteria are directly linked to the stimulation of the immune response, by increasing the production of antibodies, activation of macrophages, T-cell proliferation and production of interferon.

The mechanism of action of yeasts still needs substantiation by means of research. A likely mechanism of action of yeasts is related to total inhibition (*in vitro*) or partial inhibition of pathogens. Inactive yeasts contain large quantities of protein and polysaccharides in its walls, which can act positively in the immune system and in the absorption of nutrients. In addition, yeasts produce nutritious metabolites in digestive tract that boost animal performance, besides possessing minerals (Mn, Co, Zn) and vitamins (A, B<sub>12</sub>, D<sub>3</sub>) that enhance the action of beneficial microorganisms.

Although some mechanisms had been suggested on the action of probiotics, they are not completely clarified, but it is known that they inhibit growth of pathogenic microorganism by producing antimicrobial compounds; they compete with pathogens for adhesion sites and nutrients; and they model immune system of the host.

### Selection of probiotics



### Use of probiotic in aquaculture

Probiotics are living microbial cells (although heat-inactivated versions have been shown to retain benefits for the host). Although probiotics were initially used for disease control, their use in aquaculture has now extended to improving fish growth and reproduction through addition to the body of water or feed.

Probiotics function by acting as nutrient sources, providing enzymes for better digestion, modulating the immune system and increasing the immune response against pathogenic bacteria. The most common probiotics used in aquaculture include lactic acid bacteria such as *Lactobacillus-sp.*, *Bacillus-sp.*, *Enterococcus-sp.*, and yeast, *Saccharomyces cerevisiae*.

Changes in salinity, temperature and dissolved oxygen variations, change the conditions that are favorable to different organisms, with consequent changes in dominant species, which could lead to the loss of effectiveness of the product.

Accordingly, the addition of a given probiotic in the farming water of aquatic organisms must be constant, because the conditions of environment suffer periodic changes.

Thus, the variety of microorganisms present must therefore be considered in the choice of probiotic to be used in aquaculture.

Intensive farming systems utilize high stocking densities, among other stressors (e.g. management), which often end up resulting in low growth and feed efficiency rates, besides of weakness in the immune system, making these animals susceptible to the presence of opportunistic pathogens present in the environment.

In this sense, the effect of probiotics on the immune system has led to a large number of researches with beneficial results on the health of aquatic organisms, although it has not yet been clarified how they act.

In addition, probiotics can also be used to promote the growth of aquatic organisms, whether by direct aid in the absorption of nutrients, or by their supply.

In short we can say that:

1. To regulate the microflora of aquaculture water and pathogenic microorganisms.
2. To enhance decomposition of the undesirable organic substances in aquaculture water and improve ecological environment of aquaculture by minimizing the toxic gases like ammonia, nitrite, hydrogen sulfide, methane etc.
3. To increase the population of food organisms improves the nutrition level of aquaculture animals and improve immunity of cultured animals to pathogenic microorganisms.
4. The frequent outbreaks of diseases can be prevented.

#### **Beneficial effects of Probiotics**

- i. Neutralization of toxin and suppression of viable count
- ii. Production of antibacterial compounds and competition for adhesion sites
- iii. Alternation of microbial metabolism, stimulation of immunity in the host
- iv. Accelerate the sediment decomposition by producing organic acids
- v. Production of hydrogen peroxide and enzymes