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Biofloc Technology: An Overview and Its Application

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Abstract

The growing demand for pertinacious food, in particular animal protein, is responsible for the growth of animal husbandry and fisheries. But now, due to the over-exploitation of fisheries and environmental pollution through the emission of toxic metabolites, aquaculture faces both environmental and economic un-sustainability. One of the innovative waste management and nutrient retention technologies is Biofloc Technology (BFT) that offers a solution to the problem. In aquaculture ponds, Biofloc Technology removes toxic metabolites and helps to retain more nitrogen in the form of fish or shrimp biomass through the production of microbial mass protein. BFT is a C/N ratio optimization technology. Microbial flocs also have a probiotic effect on the environment through the production of poly β-hyroxy butyrate. Quorum sensing and co-aggregation of microbial groups determines the quality of floc and also helps to eliminate or suppress the influence of pathogens in the aquaculture system.

Introduction

Increasing human population trends from 1.5 to 6.4 billion and is projected to increase to 9 billion by 2050 requires production diversification, which has been estimated at 840 million, to reduce malnutrition. Animal husbandry and fishing are the two sources of animal protein to ensure the health of the world population by providing nutritionally balanced, particularly protein-rich food. Fish and fish products Animal protein containing all essential amino acids, essential fatty acids of series n-3, n-6, is the safest group of animal proteins. But today there is a huge gap between production and demand compared to the exponential growth of the world population. In order to solve these problems, organisms culture under controlled conditions in water, i.e. the only way is aquaculture. But the intensification of aquaculture is necessary to satisfy the demand for food. BFT was first developed at the French Sea Exploitation Research Institute, Oceanic Pacific Centre. It is become a popular technology in the family of Tilapia, *Penaeus monodon*, Pacific white shrimp (*Litopenaeus vannamei)*, Giant freshwater prawn (*Macrobrachium rosenbergii)*.

Need of Biofloc Technology (BFT)

Biofloc system was developed to improve the environmental control over the aquatic animal production. In aquaculture the strong influencial factors are feed cost (60% of total cost) and most limiting factor is the water and land availability. High stocking density and rearing of aquatic animal requires a wastewater aquaculture. The principle of this technique is the generation of nitrogen cycle by maintaining higher C/N ratio through stimulating heterotrophic microbial growth which assimilates nitrogenous waste that can be exploited by cultured species as feed.

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Higher C/N ratio is maintained by the addition of carbohydrate source (molasses) and the water quality is improved through production of high quality single cell protein. Immobilisation of toxic nitrogen species occurs more rapidly in BFT as the growth rate and microbial production per unit substrate of heterotrophs are 10 times greater than autotrophic bacteria. Due to its bottom dwelling habit and resistance to environmental changes, the technology was implemented in shrimp farming. An improved growth rate and larval growth has been reported in BFT as compared to normal cultivation.

Composition and Nutritional Value

Biofloc is a heterogeneous aggregate of suspended particles associated with extracellular polymeric substances and a variety of microorganisms. Microbes such as bacteria, fungi, invertebrates and detritus are composed of it. It is a live feed rich in protein formed as a result of the conversion of unused feed formed and excreta in a culture system to a natural food on exposure to sunlight. In a loose matrix of mucus that is secreted by bacteria and linked by filamentous microorganisms or electrostatic attraction, each Biofloc is held together. Large floc can be seen in naked eye, but most of them are microscopic. The size of the flock varies from 50-200 microns. Biofloc is found to have good nutritional value. The dry protein weight varies from 20-50 percent to 0.5-15 percent of fat. It is a good source of vitamins, minerals and phosphorus, in particular.

Advantages of Biofloc Technology

- The environmentally friendly system of culture.
- It decreases the environmental impact.
- Improves the effectiveness of land and water usage.
- Limited exchange of water or zero.
- Higher productivity (increased rate of survival, development, conversion of feed).
- Greater Biosecurity.
- Reduces and cost effective water pollution.
- Reduces the pressure on fishing catches.

Disadvantages of Biofloc Technology

- Increased energy requirements for mixing and aeration.
- Reduced response time due to higher rates of water respiration.
- The start-up period is required.
- Supplementation of alkalinity required.
- Increased potential for pollution from nitrate accumulation.
- Inconsistent and seasonal performance of sunlight exposed systems.

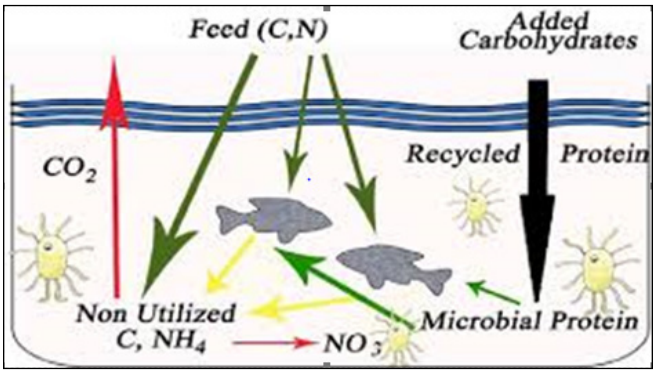

Figure 1: Biofloc Technology Model

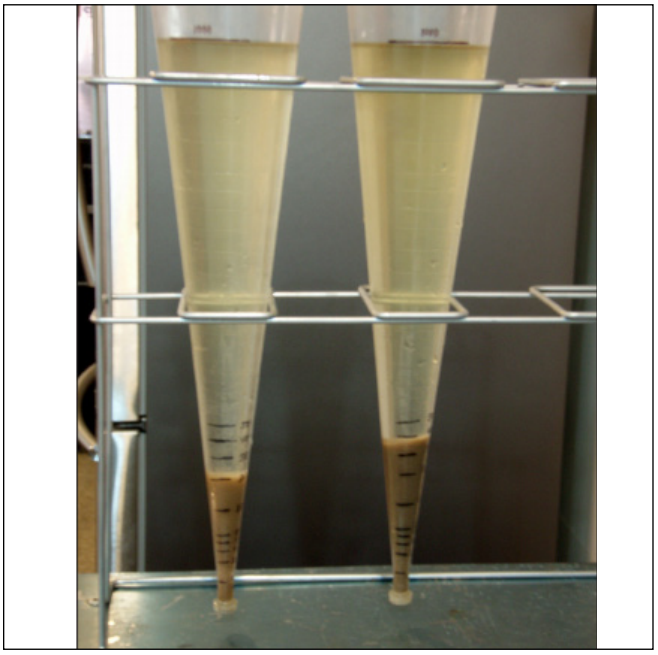

Figure 2: Imhoff Cone/Imhoff flask (For quantifying biofloc during biofloc fish culture)

Figure 3: Biofloc fish culture in tanks

Conclusion

Although research has been underway since the early 1990's with the precursors of biofloc systems and commercial application has been in place since the early 2000's, some key issues of the function of the biofloc system are still poorly understood. Biofloc technology is the best for closed system management and providing bio-security in aquaculture, as per research. The periodic increase of total suspended solids is one of the major risk factors of these technologies, because clogging in shrimp and fish gills and requires more energy to meet the oxygen demands. It is necessary to investigate the Biofloc probiotic effect. It has the ability, particularly in shrimp culture systems, to regulate vibrio bacteria. However, some studies have shown that vibrio species is also present in biofloc, but there is a switch on systems that determines the ability to promote or discourage the possibility of disease outbreak. The common way for BFT systems is to co-culture aquaculture species and heterotrophic bacterial biomass by adding the source of carbohydrates. However, the multiplication of heterotrophic bacteria in the system causes excessive turbidity, which may have adverse effects on sensitive fish species, not all of which are adaptable to turbid water growth. So, the compartmental design of the BFT is suggested by most scientists. In such applications, fish cultivation and microbial production take place in separate compartments, enabling better management options. For future BFT practise, a good understanding of the microscopic mechanisms (microbes, particularly bacteria) involved in bio-flocculation is necessary. For the closed examination of microbes, such as the FISH procedure and Real time Polymerized Chain Reaction (PCR) and denaturing gradient, Gel Electrophoresis, advanced biological biofloc monitoring technologies are necessary.

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