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Popular Article

# Biofloc Technology: Emerging Avenue in Aquatic Animal Healthcare and Nutrition

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## Introduction

As demand for proteinaceous food is increasing for particularly protein that is responsible for the growth of animal husbandry and fisheries but now due to over greed and overexploitation of fisheries by humans. The toxic metabolites and environmental pollution some are the problem that causes environmental and economic sustainability to get rid of this one of the most innovative waste managements and nutritional retentional technique that is biotechnology gives the solution of this problem. By using this Biofloc technology (BFT) it removes the toxic metabolites and helps to maintain nitrogen in the form of fish biomass through the production of microbial mass protein. As BFT is C/N ratio optimization technology microbial flocs also have a probiotic effect on environment through production of poly beta hydroxybutyrate. Quorum sensing and co-aggregation of microbial groups determines the quality of floc and also helps to eliminate influence of pathogens in aquaculture system. The technique of enhancing water quality through the addition of extra carbon to the pond, through an external carbon source or elevated carbon content of the feed is called BFT. In BFT nutrients could be continuously recycled and reused which is based on growth of microorganism in the culture medium benefited by the minimum or zero water exchange. Hargreaves (2013) defined the biofloc as “a mixture of algae, bacteria, protozoans and other kinds of particulate organic matter such as faeces and uneaten feed in addition to some of zooplankton and nematodes, formed together to be an integrated and independent system”.

Biofloc has two major roles:(i) maintenance of water quality, by the uptake of nitrogen compounds generating “in situ” microbial protein; and (ii) nutrition, increasing culture feasibility by reducing feed conversion ratio and a decrease of feed costs.

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## Composition & Nutritional Value

Biofloc is a heterogenous aggregate of suspended particles associated with extracellular polymeric substances and a variety of microorganisms. The dry protein weight varies from 20-50% to 0.5-15% of fat. It is a good source of vitamins, minerals and phosphorous, in particular. Floc comprises of 2-20% living microbial cells, 60-70% organic matter, and 30-40% of total inorganic matter. A typical bio-floc contains four components: Bacterial colony, Filamentous bacteria, absorbed matter and Algae. In a study using molasses as a carbon source, 28.7-43.1% of protein & 2.11 and 3.625% of lipids were reported in biofloc used to culture *Litopenaeus vannamei* whereas in another study cultured Tilapia with wheat flour, was obtained protein level of 38%, and for lipids of 3.16 and 3.23% (Becerril–Cortès et al., 2018). Proximal composition of some planktonic species that are found in bio-floc shows that rotifers can contain 54-60% of crude proteins whereas Cladocerans 50-68% and copepods 70-71% (Berners-Lee- Cortèset al., 2018).

### I. Microorganisms In BFT

Regarding to maintainence of water quality and control of bacterial Community over automorphism microorganisms is achieved using a high C/N ratio which nitrogenous by products can be taken up by heterotrophic bacteria. Bacteria that have been observed in BFT such as flagellates and protozoans are: ciliates, Protozoa, nematodes, and copepeods. According Ju et. Bioflocs collected from *Litopeneaus vannamei* tanks contained 24.6% of phytoplankton dominated by diatoms like *Thalassiosira*, *Chaetoceros* and *Navicula*, 3 bacterial biomass a small amount of protozoan community and 33.2% of detritus and remaining quantity was Ash.

### A. Species Cultured Through BFT

Inspire the vast growth of biofloc research in outside the world India has been introducing BFT in our country that gives better growth, nutrient utilisation to improve the Ecological and economical sustainability of fish farmers.

#### 1. Tilapia

Tilapia is one of the best adapted species of the BFT system. Tilapia biomass can reach upto 200-300mt/ha. It has been farmed in separate tanks and ponds worldwide due to it having the tendency to be an intensive variety.

#### 2. Salmon

An adult salmon can weigh around 4 to 5 kgs, while a king salmon can go anywhere around 10 kgs or even more. Typically, salmon are anadromous: they hatch in fresh water, migrate to the ocean, then return to freshwater to reproduce. However, populations of several species are

restricted to fresh water throughout their lives, making them an ideal candidate for a biofloc fish farm environment.

**3. Shrimps And Prawns**

The major function of BFT in crustacean farming is to reduce the nitrogenous metabolic waste (like ammonia and nitrites) produced by shrimp feeding and production. Ammonia consumed by heterotrophic bacteria and it is then converted to protein, which can then be consumed by the crustaceans.

**4. Catfish**

While illegal to farm in some regions due to its invasive nature which may pose danger to the biodiversity of the region, catfish still remains a popular fish variety, both in terms of production and consumption.It has a reputation to be ugly fish but it is Richie healthy fats and proteins, makingita delicacy in many cuisinesacross India, especially in the Eastern part of the country.

**5. Crap**

Carp is a fleshy freshwater fishtail originally attributed Europe and Asia. This river fish is well adapted to the biofloc fish farming setup and is an omnivorous species, well-adjusted to a plethora of feed options. The best growth is obtained in this variety when the water temperature is maintained 23°C and 30°C. These fish can stand cold winter periods and salinity up to 5%. The optimal pH range that is required for this fish to thrive is anywhere between 6.5 to 9.0. These fish are known to be robust and can survive low oxygen concentration (0.3-0.5 mg/litre) as well as super saturation.

**6. Trout**

Trout naturally feeds on other smaller fish and invertebrate aquatic life, and can also be grown in tanks within BFT systems. A 100-gm fillet of this fish has over 18 gm of protein, making it an affordable source of healthy fats and other nutrients, thereby making it popular among consumers.

**7. Bass**

The term bass encompasses both marine and freshwater varieties, and in this family, one of the most famous species is the marine Seabass, which is well-admired by patrons around the globe. Its freshwater counterpart is a suitable species for growing in a BFT set-up and gives high yields in controlled environments. There are over 400 recognised varieties of bass, and on an average, a 100-gm fillet of bass has over 23 gm of protein and many other nutrients, making it

popular in the consumer market.

**B. BFT in Pond Systems**

BFT can be applied both in semi-intensive and intensive pond systems and intensive tank. In fact, extensive research has been carried out on tilapia culture in biofloc system under experimental and commercial conditions. Therefore tilapia is currently the most farmed species in BFT. They are using biofloc as an additional protein source which helps for the reduction of production inputs for the farmers. Tilapia biofloc can contribute to about 50% of their protein requirement. Biofloc also increased nine tilapia production by 45% compared to tilapia growing in traditional culture. Growth and survival of Tilapia cultured in green House ponds with BFT were also good ranging from 80-97% depending on the fish size.

**C. BFT in Raceways**

In addition to the fish and shrimp culture, BFT has been applied in super intensive raceway to produce over 9 Kg shrimp/cubic meter. The raceway application has supported nursery, growout and shrimp brood stock operations.

**II. Application Of BFT**

1. Presently, studies by several major universities and private companies are using biofloc as SCP for aquafeeds. According to some authors, biofloc crude protein content ranges 35-50%, and its crude lipid represent 0.6-12% of volume.
2. BFT holds potential for carnivorous fish species: Juvenile carnivorous African catfish performed well in biofloc based systems which could help to produce better quality and more disease resistant seed of this aquaculture species and support the expansion of African catfish farming industry.
3. BFT production promising in temperate zones: A study was conducted to access the feasibility to grow channel catfish in an outdoor biofloc system during winter in a temperate zone. High biomasses of Market size channel catfish were successfully maintained through winter 2ith high survival and in good conditions.
4. BFT-Possible prevention for shrimp disease: Facing viral problems under raising energy costs, the use of BFT I bio secure systems offers for sustainable shrimp aquaculture. The main attributes of BFT in reducing disease risk include the fact that low water exchange improves pathogen exclusion.

## V. Advantages Of BFT

1.BFT is generally based on zero water exchange that is water exchange is not required in culture ponds. Hence it requires less water input which is not only economical to the farmers but these also minimise the pathogenic entry of animals through water and gives more biosecurity in fish culture.

2. BFT allows the animals to rear under high stocking density with effective feed management.

3. Feed requirement becomes less as biofloc itself will be fed for the cultivable animals hence it reduces the feed cost to the farmers.

4. BFT increases survival rate of fish since the beneficial microorganisms dominate in the biofloc and acts as a antagonism to pathogenic bacteria and helps to prevent the disease outbreak and increases the percentage of survival during the harvest.

5. Biofloc enhances the gene expression of immune related genes such as ProPO1,ProPO2, PPAE, ran, mas and SP1 in the shrimp to protect them from harmful disease.

6. Unlike artificial feeds biofloc is available for the whole day which facilitates animals to eat whenever they feel hungry. So it increases the body weight of aquatic animals when reared under BFT.

## VI. Disadvantages

1. Reduce response time due to high rates of water respiration.
2. Inconsistent and seasonal performance of sunlight exposed system.
3. Supplementation of alkalinity required.
4. non-availability of skilled manpower for BFT.
5. Increased energy requirements for mixing and aeration.
6. Increased potential for pollution from nitrate accumulation.

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