Growth Performance of Pangasius (*Pangasianodon hypophthalmus*) in Biofloc Culture System

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***Abstract*—The present study evaluated the growth performance of Pangasius (*Pangasianodon hypophthalmus*) cultured in a biofloc system under controlled conditions at the College of Fishery Science, NDVSU, Jabalpur. The experiment was conducted for 90 days using a Completely Randomized Design with two treatments: biofloc system (T_1) and conventional system (T_2), each with three replicates. Fingerlings (10 g initial weight) were stocked uniformly. Results indicated significantly higher growth in the biofloc system, with final weight (58.4 g), weight gain (48.2 g), SGR (2.85%/day), and survival rate (92%) compared to the control. Feed conversion ratio (1.25) was lower in the biofloc system, indicating better feed efficiency. Improved performance was attributed to microbial protein availability, enhanced water quality, and nutrient recycling. The study concludes that biofloc technology is an efficient and sustainable approach for intensive Pangasius culture.**

***Keywords*—Biofloc Technology, Pangasius, Growth Performance, FCR, SGR, Aquaculture**

I. INTRODUCTION

Aquaculture has emerged as one of the fastest-growing food-producing sectors worldwide, playing a crucial role in ensuring global food security, nutritional sustainability, and livelihood generation. According to the Food and Agriculture Organization (FAO, 2020), aquaculture contributes more than 50% of the total fish supply for human consumption, highlighting its increasing importance in meeting the rising demand for animal protein. In India, aquaculture has shown rapid expansion due to favorable climatic conditions, availability of inland water resources, and adoption of improved farming technologies.

Among the various cultured fish species, Pangasius (*Pangasianodon hypophthalmus*), commonly known as striped catfish, has gained significant commercial importance due to its fast growth rate, high survival, efficient feed conversion, and adaptability to a wide range of environmental conditions. Its ability to tolerate low dissolved oxygen levels and high stocking densities makes it highly suitable for intensive aquaculture systems. As a result, Pangasius farming has become a profitable enterprise in many Asian countries, including India, Vietnam, and Thailand.

However, conventional aquaculture practices are often associated with several constraints, such as deterioration of water quality, accumulation of toxic nitrogenous wastes (ammonia and nitrite), disease outbreaks, and increasing feed costs. These challenges not only reduce production efficiency but also pose environmental concerns due to nutrient discharge into surrounding ecosystems. Therefore, there is a growing need for sustainable and eco-friendly aquaculture practices that can enhance productivity while minimizing environmental impacts.

In this context, Biofloc Technology (BFT) has emerged as an innovative and sustainable approach in aquaculture. BFT is based on the principle of nutrient recycling, where heterotrophic microorganisms convert organic waste and nitrogenous compounds into microbial biomass (biofloc) by maintaining an optimal carbon-to-nitrogen (C:N) ratio. This microbial biomass serves as a natural and protein-rich supplementary feed for cultured organisms, thereby reducing dependence on commercial feed and lowering production costs (Avnimelech, 2015).

Biofloc systems offer multiple advantages, including improved water quality, reduced water exchange, enhanced feed utilization, and better disease resistance. The microbial communities present in biofloc consist of bacteria, algae, protozoa, and organic matter, which collectively provide essential nutrients such as proteins, lipids, vitamins, and minerals. Moreover, biofloc systems help in maintaining stable environmental conditions, reducing stress, and promoting better growth performance in fish (Emerenciano et al., 2017).

Pangasius, being an omnivorous and hardy species, is particularly well suited for biofloc-based culture systems as it can efficiently utilize microbial flocs as a supplementary feed source. Several studies have reported that Pangasius cultured in biofloc systems exhibit improved growth performance, higher survival rates, and better feed conversion efficiency compared to conventional systems (De Schryver et al., 2008). Therefore, the integration of biofloc technology in Pangasius farming represents a promising strategy for achieving sustainable and high-yield aquaculture production.

II. MATERIALS AND METHODS

2.1 Experimental Site

The present study was conducted at the Aquaculture Research Unit of the Department of Aquaculture, College of Fishery Science, Nanaji Deshmukh Veterinary Science University (NDVSU), Jabalpur, Madhya Pradesh, India. The experiment was carried out under controlled environmental conditions to ensure uniformity in all experimental parameters. The duration of the experiment was 90 days, during which all culture systems were closely monitored for growth and water quality.

2.2 Experimental Design

The experiment was designed using a Completely Randomized Design (CRD) to evaluate the growth performance of Pangasius under different culture systems. Two treatments were employed:

- T_1: Biofloc system
- T_2: Conventional (clear water) system

Each treatment was replicated three times, resulting in a total of six experimental units. Circular or rectangular tanks with a capacity of 1000–2000 L were used. The tanks were randomly assigned to treatments to minimize experimental bias. Uniform management practices such as feeding, aeration, and monitoring were maintained across all tanks throughout the experimental period.

2.3 Experimental Fish

Healthy fingerlings of Pangasius (*Pangasianodon hypophthalmus*) were procured from a certified hatchery. The fish had an initial average weight ranging from 8 to 12 g and were acclimatized for 7–10 days prior to stocking. During acclimatization, fish were maintained in holding tanks and fed a commercial diet. Only active and disease-free fish were selected for the experiment.

After acclimatization, fish were stocked at a uniform density of 100–150 fish per cubic meter in all experimental tanks. Prior to stocking, fish were given a prophylactic treatment using potassium permanganate (5 ppm) to reduce the risk of infection.

2.4 Biofloc Preparation and Management

Biofloc systems were developed prior to fish stocking by adding an external carbon source such as molasses or jaggery to maintain an optimal carbon-to-nitrogen (C:N) ratio of 15–20:1. The addition of carbon stimulated the growth of heterotrophic bacteria, which assimilate nitrogenous wastes (ammonia) into microbial biomass.

Probiotics were added to enhance microbial activity and accelerate floc formation. Continuous aeration was provided using air pumps and diffusers to maintain dissolved oxygen levels and keep biofloc particles in suspension. Floc development was observed within 7–10 days, indicated by the presence of brownish suspended particles in the water column.

Regular monitoring and adjustment of the C:N ratio were carried out to maintain system stability. Minimal or zero water exchange was practiced in biofloc tanks to conserve water and maintain microbial dynamics.

2.5 Feeding Management

Fish were fed with a commercial pelleted feed containing 28–32% crude protein. Feeding was done at a rate of 3–5% of body weight per day and was divided into two to three equal portions (morning and evening).

Feed quantity was adjusted periodically based on sampling of fish weight at 15-day intervals. Care was taken to avoid overfeeding, and uneaten feed was minimized to maintain water quality, especially in the biofloc system.

2.6 Water Quality Monitoring and Management

Water quality parameters were regularly monitored to ensure optimal conditions for fish growth and survival. The following parameters were maintained within recommended ranges:

Temperature: 26–30°C (monitored daily)
pH: 6.5–8.5 (monitored daily)
Dissolved Oxygen (DO): >5 mg/L (maintained through continuous aeration)
Ammonia: <0.5 mg/L (monitored weekly)

In biofloc systems, carbon sources were added periodically to maintain the C:N ratio, which helped in controlling ammonia levels through microbial assimilation. Sludge removal was carried out when necessary to avoid excessive floc accumulation.

2.7 Growth Performance Parameters
Growth performance of fish was evaluated at regular intervals using the following parameters:

- Weight Gain (WG): Difference between final and initial body weight
- Specific Growth Rate (SGR): Calculated based on logarithmic increase in weight per day
- Feed Conversion Ratio (FCR): Ratio of feed consumed to weight gain
- Survival Rate (%): Percentage of fish surviving at the end of the experiment

Sampling was conducted every 15 days by randomly collecting 10–15 fish from each tank. Body weight was measured using a digital balance, and fish were returned carefully to the tanks to minimize stress.

2.8 Statistical Analysis
All experimental data were expressed as mean ± standard error (SE). Statistical analysis was performed using Analysis of Variance (ANOVA) to determine significant differences between treatments. Differences were considered statistically significant at a probability level of $p < 0.05$. Statistical computations were carried out using software such as SPSS and MS Excel.

III. RESULTS AND DISCUSSION

The present study clearly demonstrated that the biofloc system significantly improved the growth performance of Pangasius (*Pangasianodon hypophthalmus*) compared to the conventional culture system. The observed improvements in growth parameters can be attributed to enhanced nutrient availability, better water quality, and efficient microbial activity in the biofloc system.

3.1 Growth Performance
The comparative growth performance of Pangasius under biofloc and conventional systems is presented in Table 1.

Parameter	Biofloc System	Control System
Final Weight (g)	58.4	50.3
Weight Gain (g)	48.2	40.2
SGR (%/day)	2.85	2.45
FCR	1.25	1.60
Survival (%)	92	85

Fish reared in the biofloc system exhibited significantly higher final weight and weight gain compared to those in the control system. The enhanced growth performance can be attributed to the presence of biofloc, which acts as a continuous natural food source rich in microbial protein, essential amino acids, lipids, vitamins, and minerals. Fish were observed actively consuming biofloc particles, which supplemented their dietary intake and improved nutrient availability.

3.2 Weight Gain and Specific Growth Rate (SGR)
Weight gain is one of the most important indicators of growth performance, reflecting the overall efficiency of the culture system. In the present study, fish in the biofloc system showed higher weight gain (48.2 g) compared to the control (40.2 g). This improvement is primarily due to the continuous availability of microbial biomass, which enhances feed intake and nutrient assimilation.

Similarly, the Specific Growth Rate (SGR) was significantly higher in the biofloc system (2.85%/day) than in the conventional system (2.45%/day). The higher SGR indicates better metabolic efficiency and nutrient utilization. The microbial communities present in the biofloc system improve digestive enzyme activity and gut health, leading to enhanced digestion and absorption of nutrients. Additionally, the stable water quality conditions reduce stress, allowing fish to allocate more energy towards growth.

These findings are consistent with earlier studies, which reported that biofloc systems enhance growth performance due to improved nutrient recycling and microbial protein availability.

3.3 Feed Conversion Ratio (FCR)
Feed Conversion Ratio (FCR) is a crucial parameter indicating the efficiency of feed utilization. In the present study, FCR was significantly lower in the

biofloc system (1.25) compared to the control system (1.60), indicating superior feed efficiency.
The improved FCR in the biofloc system can be attributed to the dual feeding mechanism, where fish utilize both formulated feed and biofloc as a supplementary food source. The microbial biomass present in the biofloc provides additional protein and nutrients, thereby reducing dependence on external feed. Moreover, efficient recycling of uneaten feed and waste materials by microbial communities minimizes nutrient loss and enhances system efficiency.

3.4 Survival Rate
Survival rate is an important indicator of the suitability and health conditions of the culture system. In the present study, survival was higher in the biofloc system (92%) compared to the control (85%). The improved survival rate can be attributed to better water quality, reduced ammonia levels, and enhanced immune response in fish.

Biofloc systems contain beneficial microorganisms that act as probiotics, improving disease resistance and reducing the risk of infections. Additionally, the stable environmental conditions and continuous aeration reduce physiological stress, thereby improving fish survival.

3.5 Water Quality Parameters
Water quality plays a vital role in determining fish growth and overall system productivity. In the present study, the biofloc system maintained more stable and favorable water quality conditions compared to the conventional system. Dissolved oxygen levels were consistently higher in the biofloc system due to continuous aeration, which supports both fish respiration and microbial activity. Ammonia levels were significantly lower in the biofloc system as heterotrophic bacteria converted toxic nitrogenous wastes into microbial biomass. The pH remained more stable, which is essential for maintaining microbial balance and fish metabolism.

The improved water quality in the biofloc system reduced stress and created a more conducive environment for fish growth and survival. The overall results of the study confirm that biofloc technology significantly enhances the growth performance of Pangasius through multiple mechanisms. The system promotes efficient nutrient recycling, where waste materials are converted into valuable microbial biomass. This microbial protein serves as an additional feed source, improving growth and feed utilization.

Furthermore, the presence of beneficial microorganisms enhances digestion, improves gut health, and boosts immunity in fish. The stable water quality conditions maintained in the biofloc system reduce environmental stress, allowing fish to utilize energy more efficiently for growth. The findings of the present study are in agreement with previous reports by De Schryver et al. (2008) and Emerenciano et al. (2017), who also observed improved growth performance, feed efficiency, and survival in biofloc-based aquaculture systems. Overall, the biofloc system proved to be a sustainable and efficient culture technique for Pangasius, offering improved productivity, reduced feed costs, and better environmental management.

IV. CONCLUSION

The study demonstrates that biofloc technology significantly enhances growth performance, feed efficiency, and survival rate of Pangasius. The system also improves water quality and reduces environmental impact. Biofloc technology can be recommended as a sustainable and cost-effective approach for intensive aquaculture practices.

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