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SPECIES SELECTION FOR PROFITABLE COMMERCIAL FISH CULTURE THROUGH BIOFLOC TECHNOLOGY

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Abstract

Biofloc technology is a recent concept in Bangladesh, it has numerous advantages for enhancing aquaculture production in several countries, thereby contributing to achieve sustainable development goals. To identify the most suitable fish species for profitable commercial fish culture through Biofloc, a 100-day experiment was conducted at Pran Fisheries Project in Razapur Village, situated in Sreemangal Upazilla of Moulvibazar district, commencing in March 2021. The experiment comprised three treatments: *Oreochromis niloticus, Anabus testudineus,* and *Labeo rohita* with two replicates for each treatment. Water quality parameters were meticulously monitored to ensure optimal conditions. All treatments were conducted at a temperature of 26°C, with pH levels of 7.6-7.8, dissolved oxygen concentrations of 5-6 ppm. During the study, *O. niloticus* exhibited the highest body weight (66.23 ± 0.94) compared to *A. testudineus* (50.82 ± 0.94) and *L. rohita* (53.92 ± 0.17). Furthermore, *L. rohita* displayed a higher average daily weight gain (1.8 ± 0.003) and specific growth rate (3.29 ± 0.29). The best feed conversion ratio (FCR) was observed both for *O. niloticus* (0.98 ± 0.33) and *A. testudineus* (0.98 ± 0.03). In terms of survival rate, *O. niloticus* outperformed the other species, with a rate of 98%. However, *O. niloticus* demonstrated better aquaculture performance compared to the other species using biofloc technology. This research provides valuable insights in effective cultural techniques that can enhance fish production through biofloc technology, contributing to economic growth in aquaculture sector and national development.

Key words: *Anabus testudineus,* Biofloc technology, Fish culture, *Labeo rohita, Oreochromis niloticus*, Species selection.

Introduction

Asia has been the dominant force in fish farming, accounting for 89 percent of the global total in terms of volume over the past 20 years. During this period, Africa and the America have also increased their shares in fish farming. Bangladesh, excluding China, has steadily strengthened its position in world aquaculture production. In 2018, Bangladesh contributed 10% to global inland waters capture production and 2.93% to aquaculture production, within Asia's overall contribution of 88.69% (FAO 2020).

Bangladesh is fortunate to have abundant open water resources and a diverse range of aquatic species, including 260 freshwater and 475 marine fish species (Hussain 2010). However, the country has experienced a decline in aquaculture production and a deterioration of aquatic biodiversity due to various natural and

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human activities such as wetland degradation, lack of knowledge on effective culture techniques, improper land utilization, chemical and technological misuse, and environmental destruction. As the global population continues to grow, it is crucial for aquaculture to develop in a sustainable manner. Sustainable aquaculture practices should prioritize environmental conservation, uphold quality and safety standards, optimize space and natural resource utilization, and allow for future expansion (Perez-Rostro et al. 2013). Bangladesh's aquaculture industry is increasingly vital as a source of protein for its growing population. To meet the rising demand, aquaculture needs to enhance its output while maintaining product quality. However, proper waste management in aquaculture has become a pressing environmental concern. The adoption of biofloc technology, can play a significant role in achieving sustainability by addressing these challenges.

Biofloc Technology (BFT) is an innovative, sustainable, and reliable system that allows for the continuous recycling and reuse of nutrients (Azim and Little 2008, Harini et al. 2016). Such technique is based on in situ microorganism production which plays three major roles: (a) maintenance of water quality, by the uptake of nitrogen compounds generating *in situ* microbial protein; (b) nutrition, increasing culture feasibility by reducing feed conversion ratio and a decrease of feed costs; and (c) competition with pathogens (Fig. 1).

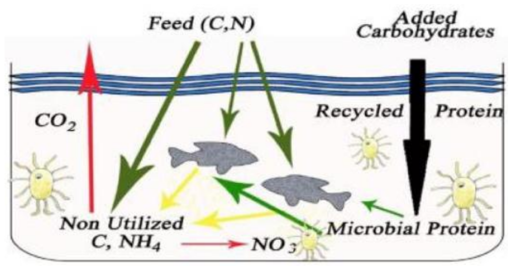

Fig. 1: Biofloc cycle (Avnimelech 2009).

The central theme of BFT involves continuous aeration and the supply of carbon sources to facilitate aerobic decomposition and maintain high levels of suspended microbial flocs (Avnimelech et al. 1986, Hargreaves 2006). In aquaculture systems, BFT utilizes microbial conversion of nutrient waste, particularly nitrogen waste, into microbial biomass that serves as food for cultured organisms (Avnimelech 2009, Schveitzer et al. 2013). By maintaining carbon to nitrogen (C:N) ratios above 10:1, bacterial growth is favored over phytoplankton growth, increasing the availability of microbial biomass as food for cultured animals (Hargreaves 2006, Avnimelech 2009). A high intensity of bioflocs provides more stable water purification compared to phytoplankton, minimizing ammonia regeneration and acting as a barrier against disease outbreaks (Avnimelech 1999, Ekasari et al. 2015, Deb et al. 2017, El-Sayed and Fattah 2021). Abundance of natural food such as bioflocs can lower the protein concentration required in artificial diets, reducing feeding costs as commercial diets constitute a significant portion of overall expenses (Chamberlain et al. 2001, Jatoba et al. 2014). Additionally, the introduction of BFT has shown positive effects on the growth, reproduction, and disease resistance of various aquaculture species (Xu and Pan 2014, Ekasari et al. 2015).

BFT is originated at Ifremer-COP in France (Emerenciano et al. 2011). It is popular for farming Tilapia, *Penaeus monodon*, Pacific white shrimp (*Litopenaeus vannamei*), and giant freshwater prawn (*Macrobrachium rosenbergii*) (Prajith 2011). Commercial application began in 1988 at Sopomer farm and Belize aquaculture farm, achieving 26 tons/ha/cycle in 1.6 ha ponds (Rosenberry 2010). BFT has successfully expanded globally, including South Korea, Indonesia, Malaysia, Thailand, China, Australia, Hawaii, Brazil, Ecuador, Peru, the United States, Mexico, Guatemala, and Belize (Emerenciano et al. 2011). In Bangladesh, research institutions and universities are intensifying studies on BFT, focusing on nursery and grow-out management, feed and nutrition, microbial biotechnology, and economics.

The selection of suitable fish species for biofloc technology is crucial for the success and sustainability of aquaculture operations (Samocha et al. 2019). Suitable species can adapt to the biofloc system, efficiently utilize nutrients, convert feed effectively, exhibit favorable growth performance, demonstrate disease resistance, and meet market demand (Avnimelech 2009). Considering these factors during species selection allows aqua culturists to optimize production outcomes, improve economic returns, and contribute to sustainable development goals (Samocha et al. 2019). In recent years, there has been an increase in research and scientific publications focusing on various species suitable for BFT. These include freshwater fish species like *Clarias gariepinus* (Putra et al. 2017), *Labeo rohita* (Mahanand et al. 2013), and *Rhamdia quelen* (Poli et al. 2015). Additionally, species of commercial interest such as the ornamental fish *Carassius auratus* (Faizullah et al. 2015), *Pseudotropheus saulosi* (Harini et al. 2016), and the sea cucumber *Apostichopus japonicus* (Chen et al. 2018), belonging to the phylum Echinodermata, show potential for cultivation using BFT. Recent use of species in biofloc technology is shown in Table 1.

However, the integration of fish and microbial biotechnology in Biofloc technology encompasses various aspects of fish culture, growth, and development. Regrettably, there is a scarcity of information regarding suitable species selection for biofloc culture technology in our country. The lack of comprehensive studies focusing on the economic viability and profitability of different fish species within the biofloc system is evident. Therefore, the present research is designed to identify suitable fish species that would facilitate profitable commercial fish culture through the implementation of biofloc technology

Table 1. Recent use of species in biofloc technology (BFT).

Species culture	Technology used	References
Mugil liza, Litopenaeus vannamei	BFT in integrated cultivation	Holanda et al. (2020)
Indian major carps, e.g., *Labeo rohita, Catla catla* and *Cirrihinus mrigala*	BFT for polyculture	Deb et al. (2020)
Litopenaeus vannamei	Biofloc-based super intensive tank system	Xu et al. (2021)
Oreochromis niloticus juvenile	BFT with prebiotics and probiotics	Laice et al. (2021)
Oreochromis niloticus	Jaggery- based BFT	Elayaraja et al. (2020)
Genetically improved Nile tilapia (*Oreochromis niloticus*)	FRP tank culture with isolated probiotic bacteria from BFT	Menaga et al. (2020)
Mono-Sex Nile Tilapia (*O. niloticus*)	BFT in aquaculture system	Nahar et al. (2015)
Heteropneustes fossilis	BFT in culture system	Shamsuddin et al. (2022)
Red Tilapia (*Oreochromis* spp.)	BFT	Sharma et al. (2015)
Labeo rohita	BFT	Prasad et al. (2018)
Penaeus monodon	Biofloc technology	Anand et al. (2013)
Clarias gariepinus	Biofloc technology	Putra et al. (2017)
Carassius auratus	BFT	Faizullah et al. (2015)
Pseudotropheus saulosi	BFT	Harini et al. (2016)
Anabus testudineus	BFT	Wankanapol et al. (2020)

Materials and Methods

Study area and duration

The current research was carried out at the Pran Fisheries Project, situated in Razapur Village within the Sreemangal Upazilla of Moulvibazar district (Fig. 2). The facility boasts a continuous supply of electricity, available 24 hours a day, complemented by a backup generator. Additionally, the project is equipped with 24 hours aeration facilities. The experiment spanned duration of 100 days, starting from mid-March and concluding in June 2021, as per the designated timeframe for the study.

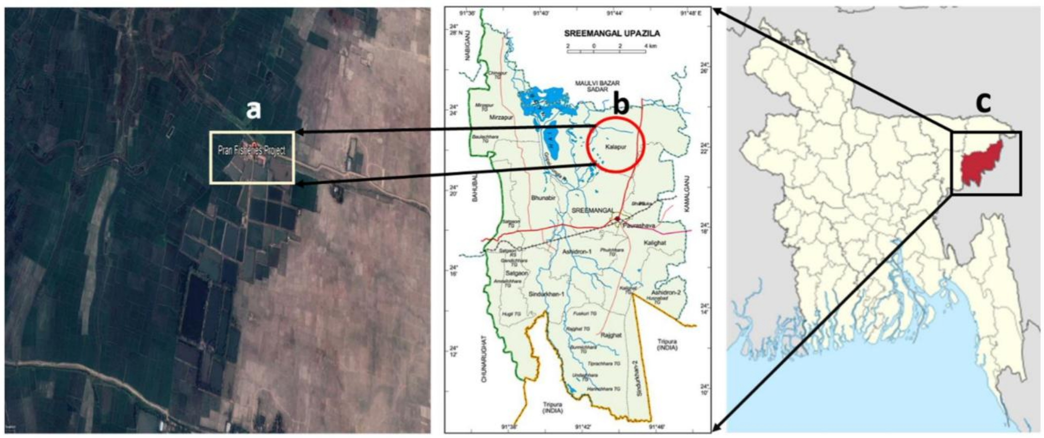

Fig. 2: Map of the experimental site, where the experiment was conducted (www.google.com/earth, accessed on: 6 September 2023).

Experimental design

Using the suitable probiotic for fish culture, we undertook a study to determine the most suitable fish species for commercial biofloc fish culture. For the biofloc fish culture experiments, a total of three species were carefully chosen (Table 2). Among these, *O. niloticus* and *A. testudineus* were chosen due to their hardiness and profitability for biofloc technology and *L. rohita* was included in the study due to its high market demand.

Table 2. Selected fish species for biofloc fish culture experiments.

Treatment (T)	Local name	Common name	Scientific name
T_1	Tilapia	Nile tilapia	*Oreochromis niloticus*
T_2	Koi	Climbing perch	*Anabas testudineus*
T_3	Rui	Roho labeo	*Labeo rohita*

Pre-stocking management

Pre-stocking management involves various management tasks before stocking fish species in the tanks. Its purpose is to eliminate factors that may result in poor survival or unsatisfactory growth, and to ensure the availability of sufficient quantity and quality of natural food for the fry/fingerlings to be stocked. In the biofloc-based culture system, the main requirement is tank made of solid materials; iron structure was used in this experiment. Some tanks were also made of concrete (Fig.3).

Fig. 3: Prepared tank for experimental work.

Before filling the tanks with water, they were treated with $KMnO_4$ and lime. Adequate aeration systems were then provided for all tanks. Salt and lime were given as 500-800 g and 5-10 g/1000 liter separately for expanding total dissolve solids and enhancing the water quality. Flocs, which consist of bacteria, algae, protozoa, metazoan, and other microbes, were prepared to convert ammonia into protein and serve as a food source for aquatic species. After two days of continuous aeration and water preparation in the tank, 10g of probiotic and 50 g of molasses per 40 liters of water were applied to promote microbial growth. Four commercially available probiotics in Bangladesh i.e. Everfresh-Pro, PondCare-3S, Profs, and MI Plus were used. Floc measurement was conducted after 15 days using an Imhoff Cone. Meanwhile, selected fish fry were collected for experimental purposes.

Stocking management

After collecting the fingerlings from the hatchery, it is necessary to disinfect them. In this experiment, the juveniles were disinfected using potassium permanganate ($KMnO_4$), commonly known as potash. Approximately 1 g/l of potash was applied to the polybag containing the fingerlings during transportation. Prior to stocking the fingerlings in the tanks, they were carefully arranged and evenly distributed. The initial weight of each fingerling was measured and recorded. Stocking density (fish. m^{-3}) of *O. niloticus* 600, *A. testudineus* 1200 and *L. rohita* 240 respectively.

Post-stocking management

Proper post-stocking management encompasses the exercises and maintenance activities from stocking to harvesting in aquaculture. In the case of a biofloc-based culture system, many activities resemble those of traditional systems, including feeding, sampling, chemical application, and harvesting. Feeding plays a vital role in achieving desirable outcomes in any type of aquaculture. To attain optimal results, it is essential to maintain a proper feeding regimen. Consequently, feeding was diligently carried out on a daily basis, with two feedings provided each day (9 AM, 2 PM, and 5 PM) throughout the study period. The feed rate administered during this period was set at 2% of the fish's body weight. Water is of utmost importance for fish as it serves multiple critical functions such as respiration, nutrition, growth, waste excretion, salt balance, and reproduction. Gaining a comprehensive understanding of the physical and chemical characteristics of water is therefore indispensable for the successful management of aquaculture operations.

Assessment of water quality parameters

The quality of water is of utmost importance in any aquaculture system, as it directly impacts the health of fish. A decline in water quality can lead to increased stress and susceptibility to illness among fish (Arulampalam et al. 1998). In biofloc-based aquaculture systems, Joseph (2009) emphasizes the significance of water quality control as a crucial element of a successful fish rearing approach. The parameters considered for assessing water quality include temperature, dissolved oxygen (DO), pH, total dissolved solids (TDS), and salinity. To monitor these parameters, temperature, dissolved oxygen (DO), and pH were measured on a weekly basis using specific instruments. A thermometer was utilized for temperature measurements, while a portable DO meter (Lutron D5510, Taiwan) and a pH meter (Hanna 981,017, USA) were employed for measuring dissolved oxygen and pH, respectively. The guidelines outlined in APHA (2005) were followed for proper sample collection and preservation during the measurement of DO and TDS.

Assessment of growth performance

Water quality parameters were assessed on a daily basis. At regular intervals of 7 days, fish were sampled to evaluate their growth performance, specifically in terms of body weight (g) and total length (cm) (Fig. 4). After a timeframe of 100 days, the final weight and total length of each individual fish in every treatment were recorded. In case of any mortality, the deceased fish were promptly removed, and the number of surviving fish was counted during each sampling period. The total number of surviving fish in each treatment was calculated at the conclusion of the experiment. The formula which was applied in this experiment is given in below-

Weight gain (g) = Final Weight – Initial weight

$$\text{Average daily weight gain (g/day)} = \frac{\text{Final weight} - \text{Initial weight}}{\text{Days}}$$

$$\text{Specific growth rate (\%)} = \frac{\ln \text{final weight} - \ln \text{initial weight}}{\text{Days}} \times 100$$

$$\text{Feed conversion ratio} = \frac{\text{Total feed consumed (g)}}{\text{Live weight gain (g)}}$$

$$\text{Survival rate (\%)} = \frac{\text{Number of fish survived}}{\text{Number of fish released}} \times 100$$

Fig. 4: Measurement of body weight (g) and total length (cm) for cultured fishes during experiment.

Statistical analysis

After the phase of data collection, the gathered data was organized, summarized, and analyzed in accordance with the study's objectives. To analyze the collected information, a tabular method was employed. MS Excel and SPSS were utilized for data analysis, with the aim of achieving more robust outcomes from the experimental results. In order to assess the non-repeatedly measured variables, specifically the snakehead growth parameters, statistical analysis was conducted using the one-way analysis of variance (ANOVA) along with Tukey's test. The PAST software was employed for this analysis, with a significance level set at $p<0.05$.

Results

Growth performance of fish

Initial and final body weight (g): The initial body weight of the fish in T_1 was recorded as 21.04 ± 0.48, while it was also 21.04 ± 0.48 for T_2. However, for T_3, the initial body weight was significantly lower at 6.20 ± 0.09. In terms of the final body weight, T_1 had a mean of 81.9 ± 0.68, T_2 had a mean of 71.86 ± 0.68, and T_3 had a mean of 60.12 ± 0.44. These values are presented in Table 3.

Weight gain (g): In Table 3, T_1 (*O. niloticus*) exhibited the highest weight gain of 66.23 ± 0.94, surpassing T_2 (*A. testudineus*) at 50.82 ± 0.94 and T_3 (*L. rohita*) at 53.92 ± 0.17 (Fig. 5).

Average daily weight gain and Specific growth rate (SGR): T_1 had an average daily weight gain of 1.68 ± 0.001, T_2 had 1.69 ± 0.003, and T_3 had 1.8 ± 0.003 (Table 3). Regarding specific growth rate, T_1 had 2.21 ± 0.08, T_2 had 1.78 ± 0.64, and T_3 had 3.29 ± 0.29 (Table 3). Notably, T_3 (*L. rohita*) showed higher daily weight gain and specific growth rate compared to the other treatments.

Feed conversion ratio (FCR): In the study, T_1 (*O. niloticus*) and T_2 (*A. testudineus*) had similar FCR values of 0.98 ± 0.33 and 0.98 ± 0.03, respectively; while T_3 *(L. rohita)* showed a higher FCR of 2.23 ± 0.13 (Table 3). Both T_1 and T_2 exhibited the best FCR values.

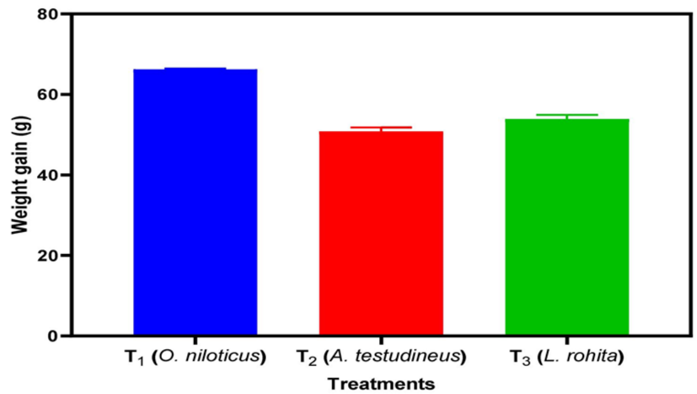

Fig. 5: Weight gain (g) of cultured fishes through biofloc technology.

Table 3. Growth performance for different treatment of *Oreochromis niloticus*, *Anabas testudineus*, and *Labeo rohita* in biofloc culture system.

Parameters	Treatments (T)		
	T_1 (*O. niloticus*)	T_2 (*A. testudineus*)	T_3 (*L. rohita*)
Initial body weight (g)	21.04 ± 0.48^a	21.04±0.48^a	6.20 ± 0.09^b
Final body weight (g)	81.9 ± 0.68^a	71.86±0.68^b	60.12 ± 0.44^c
Weight gain (g)	66.23 ± 0.94^a	50.82±0.94^b	53.92 ± 0.17^c
Average daily weight gain (g/day)	1.68 ± 0.001^a	1.69 ± 0.003^a	1.8 ± 0.003^b
Specific growth rate (% d^{-1})	2.21 ± 0.08^a	1.78 ± 0.64^b	3.29 ± 0.29^c
Feed conversion ratio	0.98 ± 0.33^a	0.98 ± 0.03^a	2.23± 0.13^b
Survival rate (%)	98.01 ± 1.12^a	96.00 ± 1.07^b	80.18 ± 1.24^c

Here, a, b, c indicates the significance level between treatments.

Survival rate (%): For the different treatments, T_1 (*O. niloticus*) had the highest survival rate at 98.01 ± 1.12, followed by T_2 at 96.00 ± 1.07, and T_3 at 80.18 ± 1.24 (Table 3). T_1 (*O. niloticus*) exhibited the highest survival rate compared to the other treatments (T_1 and T_2), as depicted in Fig. 6.

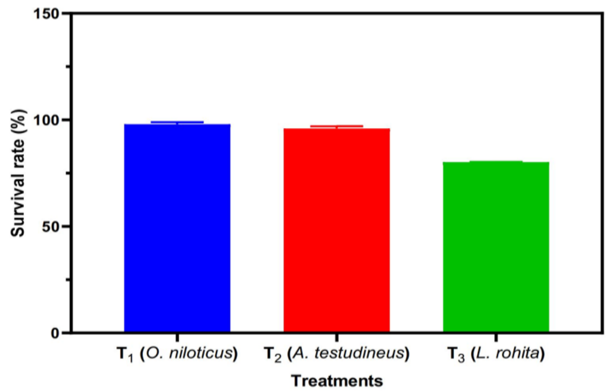

Fig. 6: Survival rate (%) of cultured fishes through biofloc technology.

Water quality parameter

The values of water quality parameters, including water temperature, dissolved oxygen (DO), pH, and total dissolved solids (TDS), for the different treatments are presented in Table 4. The average water temperature across the treatments was 26°C, with the highest recorded temperature of 30°C and the lowest of 20.26°C. These variations may be attributed to factors such as bright sunshine and cold weather conditions. The optimal temperature range for the study species is typically reported as 26-32°C (Bhatnagar and Devi 2013, Setiadi et al. 2019). Dissolved oxygen levels ranged from 5 ppm in T_3 to 6 ppm in T_1 and T_2, with all values falling within the suitable range. The suitable range for dissolved oxygen is generally considered to be less than 3 ppm. The amount of dissolved oxygen in the water is influenced by temperature and has a direct impact on the metabolism of both the microbial community and the cultured species, which in turn affects fish growth (Boyd 1982). The pH values in the different treatments were alkaline and ranged from 7.6 to 7.8, which aligns with the optimal pH range of 6-9. Changes in pH directly influence the stability of both the present bioflocs and the cultured fish in the ponds (Swingle 1969). pH serves as an environmental stressor that affects the physiological functioning of some fish species (Azim and Little 2008). Additionally, the average TDS values observed in the study were 980 ppm, which is below the recommended limit of 1000 ppm. The salinity was maintained at 0.8 ppt for all three treatments (Table 4).

Table 4. Water quality parameters on biofloc technology with different stocking densities over 100 days.

Parameters	Biofloc treatment			Suitable level
	T_1 (*O. niloticus*)	T_2 (*A. testudineus*)	T_3 (*L. rohita*)	(Bhatnagar et al. 2013, Setiadi et al. 2019)
Temperature (°C)	26°C	26°C	26°C	26-32°C
PH	7.8	7.6	7.8	6-9
TDS (ppm)	980	980	980	<1000 ppm
Salinity (ppt)	0.8	0.8	0.8	Depends on culture species
DO (ppm)	6	6	5 ppm	≥3 ppm

Discussion

There is a scarcity of comprehensive information regarding the selection of suitable fish species for profitable commercial fish culture through biofloc technology, both in the existing literature from Bangladesh and elsewhere. Consequently, the present study was designed with three treatments (*O. niloticus, A. testudineus, L. rohita*) with two replicates for each treatment that will be completed within 100 days to optimize the selection of suitable species for commercial culture through biofloc technology.

In this study, three species, namely *O. niloticus, A. testudineus*, and *L. rohita*, were cultivated under carefully controlled water quality conditions. The observed temperature was 26°C, with dissolved oxygen (DO) levels ranging from 5 to 6 ppm, pH values ranging from 7.6 to 7.8, and a total dissolved solids (TDS) measurement of 980 ppm. These parameters align closely with previous research conducted by Putra et al. (2019) on red tilapia, where similar temperature, DO, and pH ranges were reported (26-30°C, 5.20-6.25 ppm, and 7.5-7.8, respectively). Moreover, Azim and Little (2008) conducted a study on *O. niloticus* and reported temperature, DO, and pH values of 28°C, 6 ppm, and 6.7, respectively. Ekasari and Maryam (2012) found that red tilapia thrived within temperature, DO, and pH ranges of 26-29.3°C, 3.26-6.89 ppm, and 6.3-7.5, respectively. Debnath et al. (2022) studied climbing perch and maintained temperature within the range of 27.63-27.77 °C, while ensuring DO levels ranged from 5.74-5.83 ppm and pH ranged from 8.0-8.03. Similarly, Hanafie et al. (2023) conducted a study on climbing perch, noting temperature, DO, and degree of acidity within the ranges of 28.54-28.71, 5.77-6.90 ppm, and 6.34-7.27, respectively. In addition, Prasad et al. (2018) investigated *L. rohita* and found that DO levels between 5.5 and 8.0 ppm, and pH values ranging from 7.4 to 7.9 were conducive to successful cultivation. These studies collectively provide valuable insights into the optimal water quality parameters for the culture of *O. niloticus, A. testudineus*, and *L. rohita*. The similarity in findings across multiple studies suggests that these temperature, DO, and pH ranges are essential for the successful rearing of these species.

In the present study, *O. niloticus* (T_1) exhibited favorable growth performance. The weight gain was 66.23 ± 0.94, the average daily weight was 1.68 ± 0.001, the specific growth rate (SGR) was 2.21 ± 0.08, the feed conversion ratio (FCR) was 0.98 ± 0.33, and the survival rate was 98.01 ± 1.12 (Table 3). Comparing these results with the study conducted by Khanjani et al. (2021) on *O. niloticus* using different carbon sources, it is evident that our study achieved similar FCR and survival rate. However, the SGR obtained in our study was lower (2.21 % d^{-1}) compared to their findings (4.16 % d^{-1}). This difference could be attributed to various factors such as variations in experimental conditions, feed composition, or genetic variations among the fish populations. The elevated survival rate of *O. niloticus* can be attributed to the alleviation of stress resulting from the enhanced water environment, coupled with the incorporation of vital amino acids, fatty acids, and nutritional compounds present within biofloc (Yu et al. 2023). Putra et al. (2019) conducted a study on the growth and survival rate of red tilapia. Their results showed a daily growth rate of 7.86%, a survival rate of 82.22%, and an FCR of 0.85 using a specific molasses. The growth performance observed in our study for *O. niloticus* falls within a comparable range to their findings. However, it should be noted that the species and experimental conditions differ, which could influence the results. Ekasari and Maryam (2012) found a higher survival rate (94.78%) for red tilapia in a BFT system compared to the control treatment (91%), although the mean weight gain was lower. This suggests that the biofloc technology contributed to improved survival rates but did not necessarily enhance the growth performance of the fish. In the study by Nahar et al. (2015) on Mono-sex Nile tilapia through biofloc technology, the survival rate ranged from 78.67% to 83.33%, and no significant differences were observed among the different treatments. The specific growth rate (SGR) varied from 3.14 to 3.32. These findings indicate that the selected fish species can thrive in the biofloc system, with survival rates comparable to our study.

In T_2, significant differences were observed in the weight gain (50.82±0.94), average daily weight gain (1.69 ± 0.003), feed conversion ratio (0.98 ± 0.03), specific growth rate (1.78 ± 0.64), and survival rate (96.00 ± 1.07) of *A. testudineus*. However, contrasting findings were reported by Wankanapol et al. (2020), who found no significant difference in weight gain, average daily weight gain, feed conversion ratio, specific growth rate, and survival rate when using carbon sources such as molasses, rice flour, rice bran, or a combination of rice flour and rice bran with molasses at a 50:50 ratio. As a result, Wankanapol et al. (2020) identified climbing perch as one of the most suitable species for culturing in a biofloc system, highlighting the effectiveness of rice flour or rice bran as alternative carbon sources. Additionally, Debnath et al. (2022) investigated the initial stage of climbing perch culture in a biofloc system and determined an optimal stocking density of 300–450 fish per cubic meter (ft. m^{-3}). They suggested that higher stocking densities might be feasible with periodic water exchange and solid management, although further elucidation is required for this proposition.

In T_3, the values were obtained for weight gain (53.92 ± 0.17), average daily weight gain (1.8 ± 0.003), specific growth rate (3.29 ± 0.29), feed conversion ratio (2.23 ± 0.13), and survival rate (80.18 ± 1.24) of *Labeo rohita*. Conversely, Abbas et al. (2019) conducted a study on the potential of artificial feed regarding digestibility and growth potential in *Catla catla, Cirrhinus mrigala*, and *Labeo rohita*. They observed that *L. rohita* exhibited the highest protein digestibility compared to *C. mrigala* and *C. catla*. According to Rahman et al. (2008), *Labeo rohita*, due to their high market value and consumer preference, have currently gained immense popularity among farmers Additionally, Prasad et al. (2018) investigated the impact of water quality parameters on biofloc tanks during the culture of *L. rohita*.

Overall, the present study demonstrated promising growth performance of *O. niloticus* in the biofloc system, as evidenced by weight gain, average daily weight, specific growth rate, feed conversion ratio, and survival rate. While there are variations in the results compared to other studies, these differences can be attributed to factors such as experimental conditions, species selection, and specific operational parameters.

Nevertheless, BFT is widely recognized as a sustainable and environmentally friendly aquaculture system, tested at both laboratory and commercial scales for various species (Swingle 1969, Azim and Little 2008). However, tilapia production can be improved with BFT (Avnimelech 2007). Therefore, understanding biofloc parameters and influencing factors is crucial for BFT development in aquaculture in large. This study pointed out that, the most suitable species through BFT *O. niloticus* outperformed the other species (*A. testudineus*, *L. rohita*) and considered highly suitable for biofloc culture. The findings of this research will contribute to future exploration and advancements in biofloc technology for aquaculture.

Conclusion

In current study, *O. niloticus* (Nile tilapia) emerges as the preferred fish species for profitable commercial fish culture through biofloc technology when compared to *A. testudineus* (Climbing perch) and *L. rohita* (Rohu). Its adaptability to biofloc systems, rapid growth rates, survival rate, disease resistance and strong market demand make it the ideal choice for maximizing profitability in biofloc-based aquaculture.

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