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The Effect of Using Different Probiotic Products in Biofloc Systems on the Growth of Snakehead (*Channa striata*)

Pengaruh Penggunaan Produk Probiotik yang Berbeda pada Sistem Bioflok terhadap Pertumbuhan Ikan Gabus (Channa striata)

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Abstract

Snakehead (*Channa striata*) is one of the popular freshwater commodities in Indonesia, but its cultivation is still relatively low due to its relatively slow growth. Biofloc technology, which relies on microorganisms such as probiotic bacteria, is a potential solution to increase cultivation efficiency. This study aims to evaluate the effect of using various types of probiotics in the biofloc system on the growth of cork fish and to determine which type of probiotic is most effective. The research was conducted at the Cultivation Technology Laboratory, Department of Aquaculture, Faculty of Fisheries and Marine, Universitas Riau, for 56 days from August to October 2024. The method used was experimental with a completely randomized design (CRD), using four treatments (P_0 = control, P_1 = Probio-7, P_2 = Multi-Cell, P_3 = Aquaenzyme) and three replications. The results showed that probiotics had a significant effect on growth parameters. The best treatment was P2 (probiotic Sel Multi), which produced the highest absolute weight (2.97 g), absolute length (3.63 cm), specific growth rate (2.02%), lowest feed conversion ratio (1.65), and highest survival rate (86.66%).

Keywords: Snakehead, Probiotics, Bioflocs, Growth, Culture system

Abstrak

Ikan gabus (*Channa striata*) merupakan salah satu komoditas air tawar yang populer di Indonesia, namun budidayanya masih tergolong rendah karena pertumbuhannya yang relatif lambat. Teknologi bioflok yang mengandalkan mikroorganisme seperti bakteri probiotik menjadi solusi potensial untuk meningkatkan efisiensi budidaya. Penelitian ini bertujuan untuk mengevaluasi pengaruh penggunaan berbagai jenis probiotik dalam sistem bioflok terhadap pertumbuhan ikan gabus, serta menentukan jenis probiotik yang paling efektif. Penelitian dilakukan di Laboratorium Teknologi Budidaya, Jurusan Budidaya Perairan, Fakultas Perikanan dan Kelautan, Universitas Riau, selama 56 hari pada Agustus sampai Oktober 2024. Metode yang digunakan adalah eksperimen dengan Rancangan Acak Lengkap (RAL), menggunakan empat perlakuan (P_0 = kontrol, P_1 = Probio-7, P_2 = Sel Multi, P_3 = Aquaenzyme) dan tiga kali ulangan. Hasil menunjukkan bahwa pemberian probiotik memberikan pengaruh yang signifikan terhadap parameter pertumbuhan. Perlakuan terbaik adalah P2 (Probiotik Sel Multi), yang menghasilkan bobot mutlak tertinggi (2,97 g), panjang mutlak (3,63 cm), laju pertumbuhan spesifik (2,02%), rasio konversi pakan terendah (1,65), serta tingkat kelulushidupan tertinggi (86,66%).

Kata kunci: Ikan gabus, Probiotik, Bioflok, Pertumbuhan, Sistem budidaya

1. Introduction

The Snakehead fish (*Channa striata*) is one of Indonesia's most popular freshwater fish. This fish can be found in various freshwater areas in Indonesia, including river basins and swamps scattered across Sumatra, Java, and Kalimantan. Despite its popularity, snakehead fish farming in Indonesia is still relatively low. Therefore, technology development that can support the efficient growth of snakehead fish is urgently needed. One innovation that is currently being developed is the biofloc system. The use of probiotics in the fisheries industry, particularly in fish farming, has become very important. This has the potential to overcome various problems encountered in intensive farming practices. Probiotics are active microorganisms that benefit fish health and contribute to improving water quality.

Various types of probiotics that are commonly used include Sel Multi, Probio-7, and Aquaenzyme. According to Listiani et al. (2024), Sel Multi brand probiotics contain bacteria such as *Nitrosomonas* sp, *Nitrobacter* sp, and *Bacillus* sp. One of the advantages of Sel Multi probiotic bacteria is their ability to improve and maintain water quality. These bacteria also oxidize organic compounds produced from feed residues, feces, and dead organisms. Biofloc technology is an innovative method involving a series of organisms, including bacteria, algae, protozoa, and worms, which gather to form floc clusters. Biofloc comes from the official term "Activated Sludge," adopted from the biological wastewater treatment process.

This technique aims to process aquaculture waste directly in ponds or plots by maintaining sufficient oxygen, microorganisms, and a certain carbon-to-nitrogen (C/N) ratio. One type of probiotic that plays a role in biofloc formation is *Bacillus* sp. Therefore, it is important to conduct further research on the effect of adding various probiotics in biofloc systems on snakehead. This study aimed to determine the impact of using different probiotics on the growth of snakehead and identify the best probiotic for snakehead growth.

2. Material and Method

2.1. Time and Place

This study was conducted from August to October 2024 at the Aquaculture Technology Laboratory, Department of Aquaculture, Faculty of Fisheries and Marine Sciences, University of Riau. The main objective of this study was to evaluate the effect of using various types of probiotics on the growth of snakehead fish (*Channa striata*) in a biofloc system.

2.2. Methods

The method used was an experiment with a completely randomized design (CRD) with one factor, four treatments, and three replicates, resulting in 12 experimental units. The treatments given were P0 = Control (without probiotics), P1 = Probio-7 Probiotics (0.2 ml/20 L), P2 = Sel Multi Probiotics (0.2 ml/20 L), P3 = Aquaenzyme Probiotics (0.2 ml/20 L).

2.3. Procedures

2.3.1. Preparation of Media and Fish

A 45 L bucket was washed, dried, filled with 20 L of fresh water, and aerated for 24 hours. The biofloc starter is made by adding dolomite lime, rock salt, molasses, and probiotics according to the treatment, and then it is aerated until flocs form for 7 days. The snakehead fish fry were quarantined for three days, then distributed into each rearing bucket at a rate of 40 fish per bucket.

2.3.2. Maintenance and Sampling

Feeding is carried out three times a day (at 08.00, 12.00, and 17.00 WIB) at 5% of the biomass weight. Probiotics and molasses are added every 7 days. Sampling was conducted on days 0, 14, 28, 42, and 56. The parameters measured included weight, length, specific growth rate, feed conversion, survival rate, water quality (temperature, pH, DO, and ammonia), and floc volume.

2.4. Measured Parameters

2.4.1. Water Quality and Floc Volume

The parameters measured in water quality are temperature, pH, DO, and ammonia. The floc volume was obtained by taking the maintenance media using a 1000 mL Imhoff cone, then allowing the water to remain in the tube for 15–20 minutes to allow the floc to settle (Gunarto & Rangka, 2012).

2.4.2. Absolute Weight Growth

Absolute weight growth was measured by weighing the average weight of the test fish at the end of the study and then subtracting the average weight of the test fish at the beginning of the study using the formula according to Effendie (2002), namely:

$$W = Wt - Wo$$

Description:

W = Absolute growth in fish weight (g)
Wt = Average fish weight at the end of cultivation (g)
Wo = Average fish weight at the start of cultivation (g)

2.4.3. Absolute Length Growth

Absolute length growth used based on Effendie (1979) is as follows: L = Lt – Lo

Description:

L = Absolute length increase (cm)
Lt = length of the fish fry at the end of cultivation (cm)
Lo = length of fish fry at the beginning of cultivation (cm)

2.4.4. Specific Growth Rate (SGR)

The specific weight growth rate is calculated using Effendie's (2002) formula as follows:

$$LPS = (\ln Wt - \ln Wo \times 100\%)/t$$

Description:

LPS = Specific growth rate (%)
Wo = Fish weight at the start of cultivation (g)
Wt = Fish weight at the end of cultivation (g)
T = Cultivation period (days)

2.4.5. Feed Conversion Rate

Feed conversion is the amount of feed required to produce 1 kg of fish biomass. The lower the feed conversion value, the better and more profitable it is. Feed conversion is calculated using the formula from NCR (1977), namely:

$$FCR: \frac{F}{(Wt+d) - Wo}$$

Description:

FCR = Feed conversion ratio
Wo = Biomass weight of test fish at the beginning of the study (g)
Wt = Biomass weight of test fish at the end of the study (g)
d = Biomass weight of dead test fish (g)
F = amount of feed consumed by test fish (g)

2.4.6. Survival Rate

The survival rate (SR) is used to determine the survival rate of snakehead during the rearing period. The survival rate of fish at the end of the rearing period is calculated using the formula in Effendie (2002), namely:

$$SR\ (\%) = \frac{No}{Nt} \times 100\%$$

Description:

SR = Survival Rate (%)
No = Number of test fish at the start of cultivation (fish)
Nt = Number of test fish at the end of cultivation (fish)

2.5. Data Analysis

The data were analyzed using one-way ANOVA at a 95% confidence level, followed by Student-Newman-Keuls (SNK) post hoc tests when significant differences were found.

3. Result and Discussion

3.1. Water Quality

Water quality is one of the key factors affecting fish growth, weight, and survival. Maintaining water quality in the rearing tank is crucial for ensuring optimal fish growth and increasing fish survival rates. Water quality measurement data can be seen in Table 1.

Table 2. Water quality

Treatment	Parameters			
	Temperature (°C)	pH	DO (mg/L)	Amonia (mg/L)
P0	25,2-28,8	6,1-6,7	4,2-5,6	0,037-0,511
P1	25,1-28,8	6,4-7,7	4,3-5,7	0,077-0,497
P2	25,3-28,9	6,4-7,6	4,3-5,7	0,079-0,324
P3	25,1-28,8	6,4-7,5	4,2-5,7	0,084-0,539

Description: P0 = Control; P1 = Probio-7 Probiotic; P2 = Multi-Cell Probiotic; P3 = Aquaenzyme Probiotic

Temperature plays a vital role in the growth of fish and shrimp. The water temperature in this study ranged from 25.1 to 28.9°C. In this study, the measured temperature was still within the optimal range for the life of snakehead fry. According to Kordi (2011), snakehead fish can survive and thrive at temperatures between 25 and 32°C. Thus, the temperature during this maintenance period was within the tolerance limits that support the survival and growth of snakehead. Extreme temperature changes, whether high or low, will affect the dissolved oxygen (DO) content and the fish's appetite (Fatmawati et al., 2022).

pH, or degree of acidity, is a measure used to assess the relative levels of free hydrogen and hydroxyl ions in water. When the amount of free hydrogen ions is high, the water is categorized as acidic. Conversely, the water is considered alkaline if the amount of free hydroxyl ions is more dominant. Based on Table 2, the pH measurement results in this study show a range of 6.1-7.7. Kordi (2011) states that the optimal pH for maintaining snakehead ranges from 6.5 to 9. Maintenance media pH conditions that are too high or too low can hurt the survival of organisms, as this can cause metabolic and respiratory disorders. According to Siegers et al. (2019), suboptimal acidity levels can also cause stress in fish, increase susceptibility to disease, and even lead to mortality.

Dissolved oxygen is a crucial factor supporting the life of snakehead. According to Kordi (2011), the ideal dissolved oxygen level for snakehead farming ranges from 3-6 mg/l. In this study, the measured dissolved oxygen level was 4.2-5.7 mg/L, optimal for snakehead fish farming. Snakehead, which belong to the family Labyrinthidae, can take oxygen directly from the air. With this ability, snakehead can survive even in waters with low oxygen levels, i.e., less than 5 mg/l (Nisa et al., 2013). According to Sumitro et al. (2020), adequate dissolved oxygen availability is critical to support the growth of cultivated biota. Conversely, a lack of dissolved oxygen in the rearing medium can decrease appetite in fish.

This study recorded ammonia levels ranging from 0.037 to 0.539 mg/l. This study is in line with Bijaksana (2011), who stated that ammonia levels ranging from 0.30 to 0.70 mg/L can support the growth of snakehead. Fish have low tolerance to high ammonia levels, as it can interfere with the oxygen-binding process in the blood, which can ultimately damage the fish's body system. In addition, the presence of ammonia also affects the growth of organisms in the water. Ammonia in water generally originates from aquaculture waste, resulting from microbial activity in the decomposition of organic matter, including feces, urine, or protein-rich feed.

Floc volume is the amount of flocs formed in the maintenance container. Floc volume is the amount of suspended solids during a specific period of time in an inverted cone container (Effendi, 2003). The floc volume in the snakehead fish maintenance media during the study is shown in Table 2.

Table 2. Results of the measurement of fish floc volume

Treatment	Sampling Day				
	Beginning (ml/L)	14 (ml/L)	28(ml/L)	42 (ml/L)	56 (ml/L)
P0	0	0	0	0	0
P1	2	3,7	5,3	7,0	9,3
P2	2	4,7	9,7	12,0	14,7
P3	2	3,7	6,7	9,7	11,3

The results of floc volume measurements shown in Table 3 indicate differences between each treatment, with treatment P2 having the highest floc volume of 14.7 ml/l, followed by P3 with 11.3 ml/l. Conversely, treatment P1 had the lowest volume of 9.3 ml/l. The results of the analysis of floc volume were able to increase the floc volume, in line with the opinion of Nyan (2010), who stated that the ideal floc volume is 15 ml/l. The significant increase in floc volume in treatment P2 was likely due to the use of probiotics containing various types of bacteria, such as *Nictrobacter* sp., *Bacillus* sp., and *Nitrosomonas* sp., which support floc growth. This high floc volume reflects the effectiveness of bacteria in acting as biofloc formers (Erlangga et al., 2021)

3.2. Growth

Absolute weight growth is the change in weight over a specific period (Effendie, 2002). Once the average weight is known, the absolute weight growth of snakehead for each treatment during the rearing period can be observed. The absolute weight growth data for snakehead are presented in Table 3.

Table 3. Absolute weight growth of snakehead

Treatment	Sampling Day					Absolute Weight(g)
	Beginning (g)	14 (g)	28 (g)	42 (g)	56 (g)	
P0	1,42	1,75	2,08	2,53	3,18	1,76 ± 0,17[a]
P1	1,41	1,83	2,48	2,90	3,52	2,11 ± 0,11[b]
P2	1,42	2,01	2,99	3,61	4,39	2,97 ± 0,15[c]
P3	1,41	1,85	2,51	2,77	3,63	2,21 ± 0,07[b]

Table 4, it can be seen that the absolute weight of snakehead fish ranges from 1.76 to 2.97 g. The highest absolute weight was achieved by treatment P2, adding multi-cell probiotics, with a value of 2.97 g, while the lowest weight was in treatment P0 (control) at 1.76 g. The low absolute weight in treatment P0 is thought to be due to the absence of probiotics in that treatment. Probiotics play an important role in supporting the absolute weight growth of snakehead fish. For example, Probio 7 probiotics contain the *Saccharomyces cerevisiae*, *Lactobacillus acidophilus*, *Bacillus subtilis*, *Aspergillus oryzae*, and *Rhodopseudomonas*. Aquaenzyme probiotics contain *B. subtilis*, *B.megaterium*, and *B. polymyxa*.

On the other hand, the high absolute weight in treatment P2 is likely due to the use of probiotics containing the bacteria *Bacillus* sp, *Nitrobacter*, and *Nitrosomonas* sp. These bacteria are known to have significant benefits in improving nutrient absorption, producing enzymes that regulate bodily functions, and overcoming diseases caused by fungi. The presence of these bacteria is very influential in improving water quality, which can support optimal fish growth. Multi-cell probiotics contain many *Bacillus* sp. bacteria, known as Gram-positive bacteria, which significantly benefit fish growth. Mulyadi (2011) states that using *Bacillus* sp. positively impacts fish growth, thanks to the enzymes produced by these bacteria. These enzymes, such as protease and lipase, are involved in digestion.

In addition, *Nitrobacter* sp. and *Nitrosomonas* sp. bacteria also play an important role in improving water quality in the culture medium. According to Shafiq et al. (2020), several types of bacteria can convert ammonia into protein cells, while others will be oxidized into nitrite by Nitrosomonas bacteria. Then the nitrite is converted into nitrate by Nitrobacter. The low absolute weight in treatment P0 can be influenced by various factors, including environmental conditions, fish appetite, and the quality of feed provided. According to Listyanto & Andriyanto (2009), fish growth will be more optimal if the nutritional content in the feed can be utilized well by the farmed fish. This opinion is in line with the findings of Lestari et al. (2022), which show that the absolute weight growth of snakehead raised with the addition of probiotics produced higher values compared to fish that were not given probiotics.

Growth can occur when there is excess free energy after the energy from the fish's feed is used to sustain life, including body maintenance, metabolism, and activity (movement). In addition, fish growth is influenced by various factors, both internal and external. Internal factors include age, heredity, resistance to disease, and the ability to digest food. Meanwhile, external factors include the chemical and physical properties of the environment, the amount of feed available, and fish population density (Siegers et al., 2019). The following is data on the absolute length growth of the snakehead during the research presented in Table 4.

Table 4. Absolute length growth of snakehead

Treatment	Sampling Day					Absolute Length (cm)
	Beginning (cm)	14 (cm)	28 (cm)	42 (cm)	56 (cm)	
P0	5,63	6,37	6,97	7,57	7,93	2.30 ± 0.40^a
P1	5,57	6,33	6,77	7,50	8,20	2.63 ± 0.15^a
P2	5,57	6,50	7,63	8,47	9,20	3.63 ± 0.47^b
P3	5,50	6,30	6,83	7,77	8,50	3.00 ± 0.10^a

Absolute length is one of the growth parameters measured to determine the growth of snakehead from the beginning to the end of cultivation. During the study, the highest absolute length growth was recorded in treatment P2, which used additional multi-cell probiotics, measuring 3.63 cm. In contrast, treatment P0 showed the lowest absolute length growth, 2.30 cm.

The low growth rate in the P0 treatment was likely due to the absence of additives that could support the growth process. The increase in the absolute length growth of tilapia was thought to be related to the ability of the feed to be digested well, so that it could be converted into energy optimally utilized by the fish. In addition, the addition of probiotics in the biofloc system could improve the fish's digestive system, thereby optimally increasing the growth rate (Fitria, 2012). In line with previous research conducted by Feroza et al. (2021), it was found that the absolute length growth of snakehead reared with the addition of probiotics in treatment P1 reached the highest value. Conversely, the absolute length of snakehead reared without any additions in treatment P0 showed the lowest value. Based on the study results, the specific growth rate of snakehead was measured in all treatments over 56 days of maintenance using the biofloc system with various probiotics. Specific growth rate data can be seen in Table 5.

Table 5. Specific growth rate

Treatment	Specific Growth Rate (SGR) %
P0	1.44 ± 0.10^a
P1	1.63 ± 0.05^b
P2	2.02 ± 0.65^c
P3	1.69 ± 0.03^b

Based on Table 5, the highest growth rate was observed in P2 at 2.02% and the lowest in P0 at 1.44%. The significant growth increase in treatment P2, which used multi-cell probiotics, is attributed to the nutritional value of biofloc, which can promote weight gain in snakehead fish. Apriani et al. (2016) support this, stating that floc in biofloc aquaculture contains high protein, which can increase fish growth rates. These probiotics contain bacteria that can improve water quality, break down organic compounds from feed residues, oxidize waste and dead organisms, and reduce toxic metabolites. In addition, harmful bacteria can be minimized, and plankton feed sources can be obtained from natural feed residues. Several types of beneficial bacteria can also be added.

The low growth rate in treatment P0 may be due to the absence of additives supporting the growth process. The decrease in specific growth rate is thought to be due to the lack of probiotics or substances that can stimulate growth (Wijaya et al., 2016). In addition, poor water quality also contributes to weak growth. Water quality is a significant factor affecting the development of farmed fish (Azhari & Tomasoa, 2018). Good water quality can increase fish appetite and affect the metabolic rate and energy assimilation for growth.

3.3. Feed Conversion Rate

Feed conversion ratio is the ratio of the amount of feed that can be utilized and converted by aquaculture commodities into meat. Table 6 shows the feed conversion results during cultivation.

Table 6. Feed conversion rate

Treatment	Feed Conversion Ratio (FCR)
P0	2.11 ± 0.18^b
P1	2.07 ± 0.07^b
P2	1.65 ± 0.08^a
P3	1.81 ± 0.12^a

Based on Table 6, the lowest FCR value was found in treatment P2 (multi-cell probiotics), which was 1.65, while the highest was found in treatment P0 (control), which was 2.11. The low feed conversion rate in P2 indicates that the fish could digest and absorb the feed content well during maintenance. One crucial factor that affects the feed conversion ratio is the composition and type of feed that suits fish's nutritional needs (Listiani et al., 2024). In the biofloc system, bacteria accelerate feed absorption by snakehead.

The activity of these bacteria can change rapidly if other microbes disturb the existing bacterial balance in the fish's intestines. When there is a balance between bacteria in the fish's digestive tract, probiotic bacteria can function antagonistically against pathogenic bacteria, making the digestive tract more effective in digesting and absorbing food nutrients (Ahmadi et al., 2012)

3.4. Survival Rate

The survival rate of snakehead fry is obtained by comparing the initial number of fish with the final number of fish after cultivation. The data on the survival rate of snakehead fry is presented in Table 7.

Table 7. Survival rate of snakehead

Test	Treatment (%)			
	P0	P1	P2	P3
1	80	80	90	82,5
2	77,5	77,5	87,5	80
3	85	87,5	82,5	82,5
Number	242,5	245	260	245
Average	80.83 ± 2.81	81.66 ± 5.20	86.66 ± 3.81	81.66 ± 1.44

The highest survival rate of snakehead fish fry in this study was found in treatment P2 (multi-cell probiotics), reaching 86.66%. Meanwhile, the lowest survival rate was recorded in treatment P0 (without probiotics), with a percentage of 80.83%. According to Andrila et al. (2019), survival rates below 30% are considered poor, between 30% and 50% are considered moderate, and above 50% are considered good. Armiah (2010) explains that fish survival is influenced by two factors: external and internal. External factors include abiotic factors, competition between species, fish stocking density, increased predators and parasites, and food shortages. Meanwhile, internal factors include age and the fish's ability to adapt to their environment.

According to Lestari et al. (2022), the survival rate of snakehead is influenced by good water quality and the addition of probiotics to feed, which causes optimal absorption in fish. Harmilia et al. (2020) stated that the bacterial content in probiotics can positively affect fish survival. Bacteria can also degrade feed residues and fish feces, thereby reducing ammonia levels in the rearing medium.

4. Conclusions

The results of this study indicate that the use of different probiotics in the biofloc system has a significant effect on the growth of snakehead. The best treatment was the administration of multi-cell probiotics with an absolute weight of 2.97 g, absolute length of 3.63 cm, specific growth rate of 2.02%, feed conversion ratio of 1.65, survival rate of 86.66%, floc volume of 14.7 mL/L, water temperature of 25.3-28.9 ℃, pH 6.4–7.6, dissolved oxygen 4.3–5.7 ppm, and ammonia 0.079–0.324 mg/L.

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