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Judul artikel : **Biofloc-Aquaponic Floating System Technology for Striped Snakehead Fish (Channa striata) Rearing**

Konferensi : Proceedings of the 3rd Sriwijaya International Conference on Environmental Issues, SRICOENV 2022, October 5th, 2022

Penulis : M Wijayanti, M Fitrani, N Fuadi, D Jubaedah, M Amin

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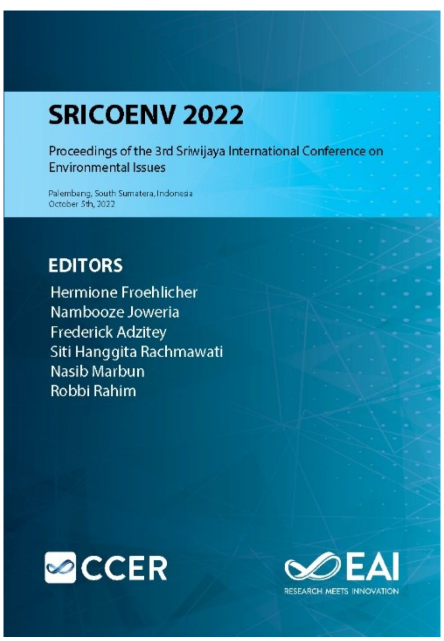

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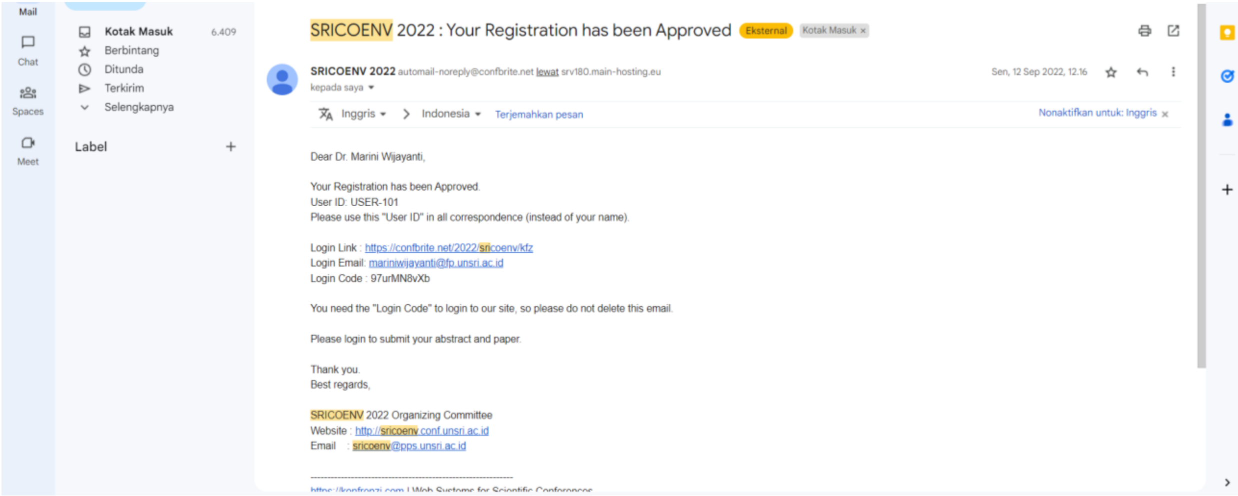

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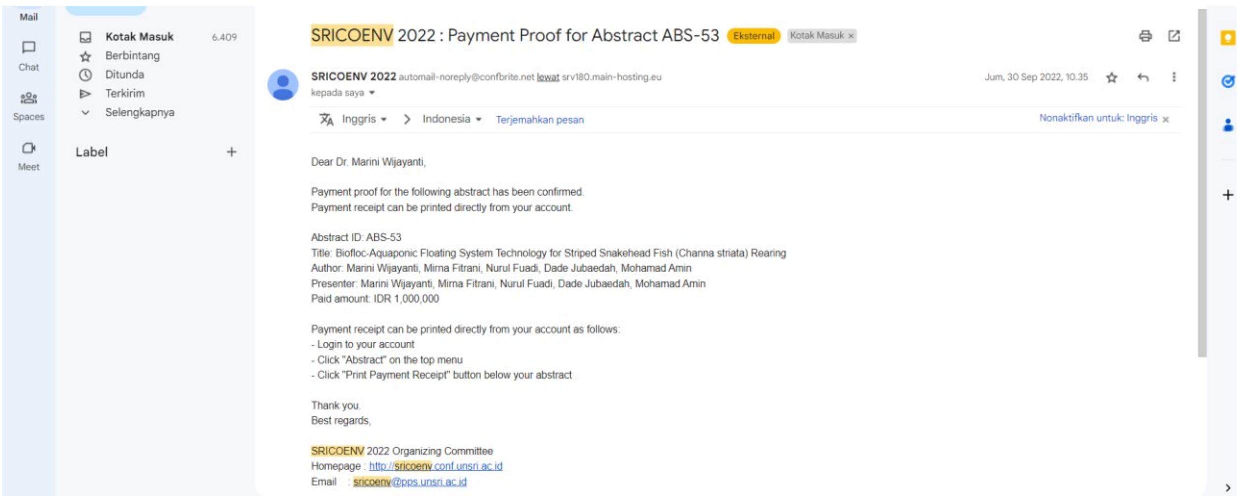

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Biofloc-Aquaponic Floating System Technology for Striped Snakehead Fish (*Channa striata*) Rearing

M Wijayanti[1], M Fitrani, N Fuadi, D Jubaedah, M Amin

Aquaculture Study Program, Department of Fisheries, Faculty of Agriculture, Universitas Sriwijaya, Indralaya, Ogan Ilir, South Sumatra, Indonesia

[1]E-mail of the corresponding author: mariniwijayanti@fp.unsri.ac.id

Abstract. With the application of biofloqua technology (biofloc-aquaponic), the addition of swamp bacteria can increase fish growth, and have an impact on the survival, feed efficiency, and productivity of cultured fish as well as being environmentally friendly. This study aims to determine the effectiveness of the application of biofloc technology and floating aquaponics in increasing the productivity of snakehead fish culture using swamp probiotics. This study used a completely randomized design with three replication and two treatments of snakehead fish rearing using an aquaponic biofloc floating system and a biofloc only system. Striped snakehead fish were stocked in a pond with a density of 100 fish.m-3 and added molasses every week. The results of this study indicate that the aquaponic biofloc system with probiotics from swamps can maintain the water quality of the rearing media, increase the efficiency of fish feed, fish growth, and fish survival. The integration of biofloc and aquaponics technology with swamp probiotic starter can be used as an integrated aquaculture system with continuous vegetable production.

1. Introduction

Stiped snakehead fish (*Channa striata*) is a species of freshwater fish native to Indonesia that has been successfully domesticated and cultivated. Snakehead fish is one of several types of swamp fish that is quite popular among the people, especially in South Sumatra, especially in the city of Palembang [1]. Snakehead fish farming has been developed to increase production and meet high market demand. One way to increase the production of snakehead fish cultivation is by applying aquaculture technology.

Commented [EN1]: The first paragraph after a section or subsection heading should not be indented, along with the other first paragraphs are the same

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The application of biofloc and aquaponics technology for snakehead fish cultivation is the right solution to increase production to meet high market demand, especially in South Sumatra. The application of biofloc and aquaponics technology has shown good results for other fish commodities such as catfish. According to the research of [2], catfish rearing using the biofloqua system showed growth better and a survival performance of 96% with FCR < 1.00.

The combination of biofloc and aquaponics with the addition of swamp bacteria will assist in maintaining water quality in fish farming to optimize stocking density in aquaculture as well as research on optimizing the distribution density of catfish with biofloc and Nitrobacter systems which support the highest specific growth rate and the lowest FCR [3], as in the laboratory scale snakehead biofloc in a biofloc study with a swamp probiotic starter [4].

The combination of biofloc and aquaponics can provide benefits that can guarantee business sustainability because it is profitable and environmentally friendly [5][6]. However, there are also drawbacks to the combination of cultivation technology between biofloc and aquaponics still often require additional water pumps in the aquaponics system. The biofloc methods could be combined with the floating system aquaponics for removing the water pumps. The swamp probiotic is Bacillus sp. and Streptomyces sp. The isolations were selected from swamp sediments in the Lebung Karangan, Ogan Ilir Regency, South Sumatra [7]. *Bacillus* sp. and *Streptomyces* sp. are used as probiotic bacteria in aquaculture that can improve feed efficiency, survival, and growth of snakehead fish while maintaining water quality [4]. This study aims to determine the effectiveness of the application of biofloc technology and floating aquaponics in increasing the productivity of snakehead fish culture using swamp probiotics.

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2. Materials and methods

The research was carried out at the Aquaculture Laboratory, Fisheries Basic Laboratory and Aquaculture Experimental Pond, Aquaculture Study Program, and Microbiology-Biochemical-Fishery Products Laboratory, Fishery Products Technology Study Program, Department of Fisheries, Faculty of Agriculture, Sriwijaya University.

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This study used a completely randomized design (CRD) consisting of 2 treatments and 3 replications. The treatments were: P1 = Maintenance of 100 head of snakehead fish.m^{-3} using a floating biofloc-aquaponics system and P2 = Maintenance of 100 head of snakehead fish.m^{-3} using a biofloc system.

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The maintenance container used is a round tarpaulin pond with a diameter of 2 m, a height of 1 m, and a water level of 0.5 m. At the top of the pond is given a rope and wire that has been attached to a cup containing charcoal and water spinach. The function of the wire itself is as a reinforcement to keep it in position when exposed to rain and wind. It was given aeration of 5 points in each pond. Molasses and swamp probiotics were poured into the media as a starter of 10 mL m^{-3}, with a bacterial density of 10^5 CFU mL^{-1}. Fish stocking and acclimatization for 10 days. Fish were given commercial feed 40% protein 3 times a day at satiation. The maintenance of snakehead fish was carried out for 42 days after treatment and every week a sampling of the weight and length of fish was carried out. Molasse was added as much as 100 mL.m^{-3} every week.

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Water spinach seeds were sown in rockwool for 14 days in a humid room without sunlight. After the roots and some leaves appeared on the rockwool growing media, they were then stocked into aquaponics containers. Stocking was done on aquaponic media after three days of stocking fish in the rearing pond. Water spinach plants were harvested after 21 days.

The parameters in this study included survival, absolute weight growth of fish, growth of the absolute length of fish, feed efficiency, growth of absolute weight of water spinach, growth of the absolute length of water spinach, volume and type of floc, total bacterial colonies and water quality of snakehead fish rearing (pH, TDS, BOD, and DO). Data on water quality, flock volume, survival, growth, and feed efficiency were analyzed by T-test. Bacterial population data and floc composition were processed descriptively.

3. Results and Discussion

The pH value at P1 or biofloc pond ranged from 6.1–7.7 while the pH value at P2 or biofloc pond ranged from 6.0–7.7. The pH value obtained showed that the pH of the rearing media was still within the tolerance range for the maintenance, survival, and growth of snakehead fish. Snakehead fish as a swamp fishery commodity tends to have an acidic to neutral pH (4-7) [8]. The application of the cultivation of biofloc and biofloqua systems that utilize the activity of bacteria and other aquatic microbes in forming flocs is proven to be able to maintain the pH value of the water within the tolerance of snakehead fish culture during the study. The activity of bacteria in breaking down organic materials can form organic acids which affect the decrease in pH value. The increase in pH value is due to a

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decrease in bacterial activity so that the organic acids produced are low. It has an impact on increasing the pH in the maintenance medium [9].

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Based on the results of the T-test analysis showed that the range of DO obtained in the rearing media ranged from 4.45±0.10 - 5.95±0.36 mg L-1. Treatment of P1 or biofloc ranged from 4.45±0.10 - 5.90±0.12 mg L-1 and P2 or biofloc ranged from 5.25±0 - 5.95±0.17 mg L-1. The difference in DO levels or dissolved oxygen is thought to be caused by photosynthesis and respiration of fish and microbes in the water that differs between biofloc and biofloc ponds, but the dissolved oxygen tolerance for freshwater fish is >3-5 mg L-1[10]. DO is not only used by fish but is also needed by deep water microbes to form flocs [11]. DO or dissolved oxygen also plays an important role in the cultivation of biofloc and biofloc systems in the process of decomposition of organic matter by probiotic bacteria, so that organic matter in the media is reduced.

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Based on the results of the T-test analysis showed that the range of TDS obtained in the rearing medium ranged from 284.50 ± 163.25 – 488.17 ± 420.59 mg L-1. Treatment of P1 or biofloc ranged from 416±233.50 - 488.17 ±420.59 mg L-1 and P2 or biofloc ranged from 284.50±163.25 – 328.67±301.31 mg L-1. The difference in TDS in biofloc ponds is thought to be due to differences in nutrients obtained in full from fish feces containing nitrogen. Plants need nitrogen as a natural fertilizer for growth and development. The results of the T-test analysis, Total Dissolved Solid (TDS) on days 0, 7, 14, 21, 28, 35, and 42 were not significantly different in treatment P1 and P2 (P<0.05). Based on the water quality standards in PP No 82 of 2001 (class II), the concentration of TDS obtained during maintenance is appropriate and safe for fish farming activities, which is less than 1000 mg L-1.

Based on the results of the T-test analysis in table 4.4. showed that the range of BOD obtained in the rearing medium ranged from 0.48 ± 0.12 – 0.68 ± 40.25 mg L-1. Treatment of P1 or biofloc ranged from 0.48 ± 0.12 – 0.68 ± 40.25 mg L-1 and P2 or biofloc ranged from 0.50±0 – 0.68 ± 0.23 mg L-1. The results of the T-test analysis showed that the Biochemical Oxygen Demand (BOD) on days 0, 7, 14, 21, 28, 35, and 42 were not significantly different between treatments P1 and P2 (P<0.05). BOD during maintenance ranged from 0.48±0.12 mg L-1 – 0.68±0.25 mg L-1. According to [12], the BOD value can be influenced by temperature, plankton density, the presence of microbes, and the type of organic matter content. BOD values in natural waters ranged from 0.5 to 7.0 mg L-1. The low BOD value during this study was presumably because the microbes in probiotics and plants could utilize organic matter as a source of nutrition.

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Prior to the addition of swamp probiotics, bacteria were naturally present in the rearing pond with a population density of 2.48 and 2.75 Log CFU mL-1 at P1 and P2, respectively. Based on the T-test analysis, the total bacterial population was not significantly different on day 1 and day 42 with the highest concentration in P1. The bacterial population in all treatments ranged from 6.35±0.48-8.94±0.70 Log CFU mL-1. This concentration is still categorized as safe and non-pathogenic for cultured fish. According to [13] candidate probiotic bacteria from swamp sediment are pathogenic at concentrations of more than 8 Log CFU mL-1. The bacterial population on both treatments on the 42nd day was higher than on the 1st day. The high population is due to the addition of swamp bacteria (Bacillus sp. and Streptomyces sp.) into the maintenance medium and the addition of carbon sources every 7 days, where the molasses will be utilized by bacteria as nutrients for growth. The bacterial population on day 42 increased due to the addition of carbon sources (molasses) as nutrients for bacteria.

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Bernal [14] stated that the combination of Streptomyces sp. and Bacillus sp. can cause synergistic activity, bacteria give each other benefits that produce several extracellular enzymes (Bacillus sp.) and antibiotic compounds (Streptomyces sp.) that can increase survival, growth and increase fish resistance to disease. Bacillus sp. can produce antimicrobial compounds in the form of bacteriocins and antibiotics that can suppress the colonies of pathogenic bacteria [15]. Streptomyces sp. has the potential to control pathogenic bacteria by conducting competition, parasitism, or producing secondary metabolites [16] and is able to produce various biologically active compounds, such as antibacterial, antifungal, antiparasitic, and antiviral [17].

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T-test analysis showed that the volume of flocs in treatment P1 and P2 were not significantly different on days 0,7,14, 28,35, and 42 (P<0,05). According to [18], the more aquaculture waste in the media used by heterotrophic bacteria, the higher the floc formed. The formed floc can provide nutrients such as proteins, amino acids, lipids, and fatty acids in various microbial forms [19][20][21]. Biofloc is a good source of vitamins, and minerals, especially phosphorus and microbial protein as an additional source of nutrition for fish and plants.

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The results of the T-test analysis showed that the survival of snakehead fish was not significantly different in the P2 and P1 treatments (P<0.05). Maintenance using biofloc technology and aquaponics gave SR or survival of 100±0.00%. The maintenance of snakehead fish using biofloc technology was 99.78±0.38%. It showed that the treatment of biofloqua and biofloc can maintain water quality in optimal conditions. The use of probiotics in aquaculture can balance the microbial population and can control pathogens in the digestive tract, water, and aquatic environment through the biodegradation process [22].

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Table 1. Feed Efficiency and Growth of Fish for 42 days

Treatment	Feed efficiency (%)	Growth of Total Weight (g)	Growth of Total Length (cm)
P1	179 ± 31,66	7,39 ± 1,51	2,61 ± 0,42
P2	147 ± 36,10	6,10 ± 1,44	2,27 ± 0,27

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Based on the results of the study showed that the efficiency value of P1 (179%) was significantly higher than P2 (147%). This is presumably because in the biofloc or P2 treatment the temperature in the rearing media was relatively higher which could affect the fish's appetite but remained in the optimal temperature range so that growth remained good. Bacteria enter the digestive tract through respiration at mealtimes and snakehead fish can take advantage of the floc formed in the maintenance medium with optimal temperature. So that the bacteria in P1 can work in the digestive tract and increase digestibility. High digestibility can increase nutrient absorption so that if the nutritional needs of fish are met, the fish will grow well and increase the value of feed efficiency.

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Figure 1. Biofloqua pond and Biofloc pond for rearing striped snakehead fish

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The growth of water spinach plants during maintenance is very good where at the beginning of maintenance the initial height of plants was 7-8 cm, after 7 days after planting on biofloqua media the height of plants becomes 15-19 cm and after 21 days the height of the plant reaches 35.60-46.73 cm. The growth of the water spinach plants was good, as in the study [23], the height of the kale plants at 9 days old was 16 cm after planting, and at 18 days was 47.24 cm.

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please make a discussion along with the results (can be a graph or table to show the absolute weight and length of the fish)

4. Conclusion

The application of biofloc technology or aquaponics with biofloc and floating systems on snakehead fish (*Channa striata*) culture media can produce water quality in the maintenance media that can be tolerated by snakehead fish, namely pH 6.1-7.7, dissolved oxygen 4.45-5.95 mg L-1, TDS 284.50-488.17 mg L^{-1}, BOD 0.48-0.68 mg L-1, feed efficiency 179%, fish survival 100%. So that the integration of biofloqua technology can be used as a simple cultivation system by producing good fish and vegetables productivity.

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Acknowledgment

We are grateful to the University of Sriwijaya for funding the research under Competitive Grant in 2021 and 2022.

References

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Biofloc-Aquaponic Floating System Technology for Striped Snakehead Fish (*Channa striata*) Rearing

M Wijayanti[1], M Fitrani, N Fuadi, D Jubaedah, M Amin

Aquaculture Study Program, Department of Fisheries, Faculty of Agriculture, Universitas Sriwijaya, Indralaya, Ogan Ilir, South Sumatra, Indonesia

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The research was carried out at the Aquaculture and Experimental Pond, Fisheries Basic Laboratory, Aquaculture Study Program, and Microbiology-Biochemical-Fishery Products Laboratory, Fishery Products Technology Study Program, Department of Fisheries, Faculty of Agriculture, Sriwijaya University.

This study used a Completely Randomized Design (CRD) consisting of 2 treatments and 3 replications. The treatments were: P1 = Maintenance of 100 ind.m^{-3} using a floating biofloc-aquaponics (biofloqua) system and P2 = Maintenance of 100 ind.m^{-3} using a biofloc system.

Figure 1. Biofloqua (Biofloc-Aquaponic) pond (A) and Biofloc pond for rearing striped snakehead fish (B)

The maintenance container used is a round tarpaulin pond with a diameter of 2 m, a height of 1 m, and a water level of 0.5 m. At the top of the pond is given a rope and wire that has been attached to a cup containing charcoal and water spinach (Figure 1). The function of the wire itself is as a reinforcement to keep it in position when exposed to rain and wind. It was given aeration of 5 points in each pond. Molasses and swamp probiotics were poured into the media as a starter of 10 mL m^{-3}, with a bacterial density of 10^5 CFU mL^{-1}. Fish stocking and acclimatization for 10 days. Fish were given commercial feed 40% protein 3 times a day at satiation. The maintenance of snakehead fish was carried out for 42 days after treatment and every week a sampling of the weight and length of fish was carried out. Molasse was added as much as 100 mL.m^{-3} every week.

Water spinach seeds were sown in rockwool for 14 days in a humid room without sunlight. After the roots and some leaves appeared on the rockwool growing media, they were then stocked into aquaponics containers. Stocking was done on aquaponic media after three days of stocking fish in the rearing pond. Water spinach plants were harvested after 21 days.

The parameters in this study included survival, absolute weight growth of fish, growth of the absolute length of fish, feed efficiency, growth of absolute weight of water spinach, growth of the absolute length of water spinach, volume of floc, and water quality of snakehead fish rearing (pH, TDS, BOD, and DO). Data on water quality, floc volume, survival, growth, and feed efficiency were analyzed by T-test.

3. Results and Discussion

The pH value at P1 or biofloqua pond ranged from 6.1–7.7 while the pH value at P2 or biofloc pond ranged from 6.0–7.7. The pH value obtained showed that the pH of the rearing media was still within the tolerance range for the maintenance, survival, and growth of snakehead fish. Snakehead fish as a swamp fishery commodity tends to have an acidic to neutral pH 4-7 [8]. The application of the cultivation of biofloc and biofloqua systems that utilize the activity of bacteria and other aquatic microbes in forming flocs is proven to be able to maintain the pH value of the water within the tolerance of snakehead fish culture during the study. The activity of bacteria in breaking down organic materials can form organic acids which affect the decrease in pH value. The increase in pH value is due to a decrease in bacterial activity so that the organic acids produced are low. It has an impact on increasing the pH in the maintenance medium [9].

The range of DO or dissolved oxygen in the rearing media ranged from 4.45±0.10 - 5.95±0.36 mg L^{-1}. Treatment of P1 or biofloqua ranged from 4.45±0.10 - 5.90±0.12 mg L^{-1} and P2 or biofloc ranged from 5.25±0 - 5.95±0.17 mg L^{-1}. The difference in DO levels or dissolved oxygen is thought to be caused by photosynthesis and respiration of fish and microbes in the water that differs between biofloqua and biofloc ponds, but the dissolved oxygen tolerance for freshwater fish is more than 3-5 mg L^{-1}[10]. DO is not only used by fish but is also needed by deep water microbes to form flocs [11]. DO also plays an important role in the cultivation of biofloqua and biofloc systems in the process of decomposition of organic matter by probiotic bacteria, so that organic matter in the media is reduced.

The range of TDS obtained in the rearing medium ranged from 223 - 479 mg L^{-1}. Treatment of P1 or biofloqua ranged from 386.25 – 479.75 mg L^{-1} and P2 or biofloc ranged from 223 – 244 mg L^{-1}. The difference in TDS in biofloc ponds is thought to be due to differences in nutrients obtained in full from fish feces containing nitrogen. Plants need nitrogen as a natural fertilizer for growth and development. The results of the T-test analysis (Table 1), Total Dissolved Solid (TDS) on days 0, 7, 14, 21, 28, 35, and 42 were not significantly different in treatment P1 and P2 ($P<0.05$). Based on the water quality standards in PP No 82 of 2001 (class II), the concentration of TDS obtained during maintenance is appropriate and safe for fish farming activities, which is less than 1000 mg L^{-1}.

Table 1. TDS value in rearing media of striped snakehead for 42 days (mg.L^{-1})

Rearing days	Treatment	
	P1 (Biofloqua)	P2 (Biofloc)
0	386.25±73.25	231.50±9.00
7	377.50±86.50	241.75±5.75
14	474.50±58.00	223.25±7.75
21	366.75±53.75	234.00±3.75
28	383.75±60.25	244.50±13.00
35	479.75±60.75	242.25±10.75
42	389.00±33.50	237.50±6.00

The range of BOD obtained in the rearing medium ranged from 0.48 ± 0.12 – 0.68 ± 40.25 mg L^{-1}. Treatment of P1 or biofloc ranged from 0.48 ± 0.12 – 0.68 ± 40.25 mg L^{-1} and P2 or biofloc ranged from 0.50±0 – 0.68 ± 0.23 mg L^{-1}. The results of the T-test analysis (Table 2) showed that the Biochemical Oxygen Demand (BOD) on days 0, 7, 14, 21, 28, 35, and 42 were not significantly different between treatments P1 and P2 ($P<0.05$). BOD during maintenance ranged from 0.48±0.12 mg L^{-1} – 0.68±0.25 mg L^{-1}.

Table 2. BOD value in rearing media of striped snakehead for 42 days (mg.L^{-1})

Treatment	Rearing days						
	0	7	14	21	28	35	42
P1	0.63±0.38	0.53±0.15	0.55±0.17	0.48±0.12	0.68±0.25	0.68±0.21	0.48±0.15
P2	0.67±0.15	0.50±0.0	0.62±0.12	0.62±0.15	0.65±0.20	0.55±0.20	0.68±0.23

According to [12], the BOD value can be influenced by temperature, plankton density, the presence of microbes, and the type of organic matter content. BOD values in natural waters ranged from 0.5 to 7.0 mg L^{-1}. The low BOD value during this study was presumably because the microbes in probiotics and plants could utilize organic matter as a source of nutrition.

Bernal [14] stated that the combination of *Streptomyces* sp. and *Bacillus* sp. cause synergistic activity, bacteria give each other benefits that produce several extracellular enzymes (*Bacillus* sp.) and antibiotic compounds (*Streptomyces* sp.) that can increase survival, growth and increase fish resistance to disease. *Bacillus* sp. can produce natural antimicrobial compounds that can suppress the colonies of pathogenic bacteria [15]. *Streptomyces* sp. has the potential to control pathogenic bacteria by conducting competition, parasitism, or producing secondary metabolites [16] and can produce various biologically active compounds, such as antibacterial, antifungal, antiparasitic, and antiviral [17].

T-test analysis showed that the volume of flocs in treatment P1 and P2 were significantly different on days 14, 28,35, and 42 (P<0,05), it is showed at Table 3.

Table 3. Floc volume in rearing media of striped snakehead for 42 days

Rearing days	Floc volume (ml.L^{-1})	
	P1	P2
0	0.13 ± 0.06	0.05 ± 0.05
7	0.40 ± 0.00	1.10 ± 0.50
14	0.87 ± 0.15	16.00 ± 2.00
21	2.37 ± 0.65	21.50 ± 1.50
28	4.77 ± 0.25	28.00 ± 3.00
35	3.00 ± 0.50	19.00 ± 5.00
42	6.00 ± 0.50	23.00 ± 5.00

According to [18], the more aquaculture waste in the media used by heterotrophic bacteria, the higher floc formed. The formed floc can provide nutrients such as proteins, amino acids, lipids, and fatty acids in various microbial forms [19]. Biofloc is a good source of vitamins, and minerals, especially phosphorus and microbial protein as an additional source of nutrition for fish and plants [20].

The results of the T-test analysis showed that the survival of snakehead fish was not significantly different in the P2 and P1 treatments (P<0.05). Maintenance using biofloc technology and aquaponics gave SR or survival of 100±0.00%. The maintenance of snakehead fish using biofloc technology was 99.78±0.38%. It showed that the treatment of biofloqua and biofloc can maintain water quality in optimal conditions. The use of probiotics in aquaculture can balance the microbial population and can control pathogens in the digestive tract, water, and aquatic environment through the biodegradation process [21].

Table 4. Feed Efficiency and Growth of Fish for 42 days

Treatment	Feed efficiency (%)	Growth of Total Weight (g)	Growth of Total Length (cm)
P1	179 ± 31.66	7.39 ± 1.51	2.61 ± 0.42
P2	147 ± 36.10	6.10 ± 1.44	2.27 ± 0.27

Based on the results of the study showed that the feed efficiency value of P1 (179%) was not significant with P2 (147%) (Table 4). Bacteria enter the digestive tract through respiration at mealtimes. Snakehead fish can take advantage of the floc formed in the optimal environment. So that the bacteria in P1 and P2 can work in the digestive tract and increase digestibility. Although the feed efficiency average of fishes in P1 and P2 was not significant, in biofloqua system gave better performance than the biofloc system. High digestibility can increase nutrient absorption so that if the nutritional needs of fish are met, the fish will grow well and increase the value of feed efficiency [22].

The growth of water spinach plants was good. At the beginning of maintenance, the initial height of plants was 7-8 cm. At 7 days after planting on biofloqua media, the size of plants became 15-19 cm. At 21 days after planting, the height of the plant reaches 35.60-46.73 cm. The size of the water spinach plants at

9 days old after planting was 16 cm, and at 18 days after planting was 47.24 cm [23]. The water spinach plant development in aquaponics systems can be impacted by the availability of sufficient nutrients in the form of nitrates and phosphates that will be absorbed by the plants in the aquaponics system [24].

4. Conclusion

The application of biofloc technology or aquaponics with biofloc and floating systems on snakehead fish (*Channa striata*) culture media can produce water quality in the maintenance media that can be tolerated by snakehead fish, namely pH 6.1-7.7, dissolved oxygen 4.45-5.95 mg L^{-1}, TDS 284.50-488.17 mg L^{-1}, BOD 0.48-0.68 mg L^{-1}, feed efficiency 179%, and fish survival 100%. The integration of biofloqua technology can be used as a simple cultivation system by producing good fish and vegetables productivity.

Acknowledgment
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References

[1] Muslim 2006 Pros. Forum Perairan Umum Indonesia IV (Balai Riset Perikanan Perairan Umum Palembang) p 7-11
[2] Wijayanti M, Amin M, Tanbiyaskur T, Jubaedah D, Jaya K, Ziyad MA, Marsi M 2021 *Journal of Aquaculture and Fish Health* **10** 258
[3] Puspita EV dan Sari RP 2018 *Aquasains Jurnal Ilmu Perikanan dan Sumberdaya Perairan* **6** 563
[4] Wijayanti M, Jubaedah D, Yulistya O, Tanbiyaskur T and Sasanti AD 2020 *AACL Bioflux* **13** 1064
[5] Pinho SM, David LH, Garcia F, Portella MC, Keesman KJ 2022 *Ecological Indicators* **141** 109092.
[6] Pinho SM, Lima JP, David LH, Oliveira MS, Goddek S, Carneiro DJ, Keesman KJ, Portella MC 2021 *Aquaculture* **543** 736932
[7] Wijayanti M, Jubaedah D, Suhada JA, Yuliani S, Saraswati N, Syaifudin M, Widjajanti H 2018 *Proc. Int. Conf. E3S Web of Conf.* vol 68 (EDP Sciences) p 01023
[8] Jubaedah D, Kamal MM, Muchsin I, Hariyadi S. 2015 J. *Manusia dan Lingkungan* **22** 12-21.
[9] Khanjani MH and Sharifinia M 2020 *Reviews in aquaculture* **12** 1836
[10] Bich TT, Tri DQ, Yi-Ching C, Khoa HD 2020 *Aquacultural Engineering* **89** 102057
[11] Liu H, Li H, Wei H, Zhu X, Han D, Jin J, Yang Y, Xie S 2019 *Aquaculture* **506** 256
[12] Crossman J, Bussi G, Whitehead PG, Butterfield D, Lannergård E, Futter MN 2021 Water 13 723.
[13] Khotimah H 2019 Uji Patogenisitas Bakteri Kandidat Probiotik Asal Sedimen Rawa Skripsi Universitas Sriwijaya
[14] Bernal MG, Marrero RM, Campa-Córdova ÁI, Mazón-Suástegui JM 2017 *Aquaculture international* **259** 27
[15] Santos RA, Oliva-Teles A, Pousão-Ferreira P, Jerusik R, Saavedra MJ, Enes P, Serra CR 2021 *Marine Biotechnology* **23** 276.
[16] Liang Q, Liu G, Guo Z, Wang Y, Xu Z, Ren Y, Zhang Q, Cui M, Zhao X, Xu D *2022 Fish & Shellfish Immunology* **127** 375
[17] Al-Ansari M, Alkubaisi N, Vijayaragavan P, Murugan K 2019 *Journal of infection and public health* **12** 861
[18] Pekkoh J, Chaichana C, Thurakit T, Phinyo K, Lomakool S, Ruangrit K, Duangjan K, Suwannarach N, Kumla J, Cheirsilp B, Srinuanpan S 2022 *Bioresource Technology* **359** 127469.
[19] Sontakke R, Tiwari VK, Kurcheti P, Asanaru Majeedkutty BR, Ande MP, Haridas H 2021 *Aquaculture Research* **52** 3460
[20] Baidya S 2020 Biofloc Technology and its Application for Sustainable Aquaculture in Northeast India. In *Fish Nutrition and Its Relevance to Human Health* CRC Press **11** 289
[21] Hlordzi V, Kuebutornye FK, Afriyie G, Abarike ED, Lu Y, Chi S, Anokyewaa MA 2020 *Aquaculture Reports* **18** 100503.
[22] Hodar AR, Vasava RJ, Mahavadiya DR, Joshi NH 2020 *J. Exp. Zool. India* **23** 13

[23] Adimihardja SA, Sunardi O, Mulyaningsih Y 2013 *Jurnal Pertanian* **4** 33
Hasan Z, Andriani Y, Dhahiyat Y, Sahidin A, Rubiansyah MR 2018 *Jurn*

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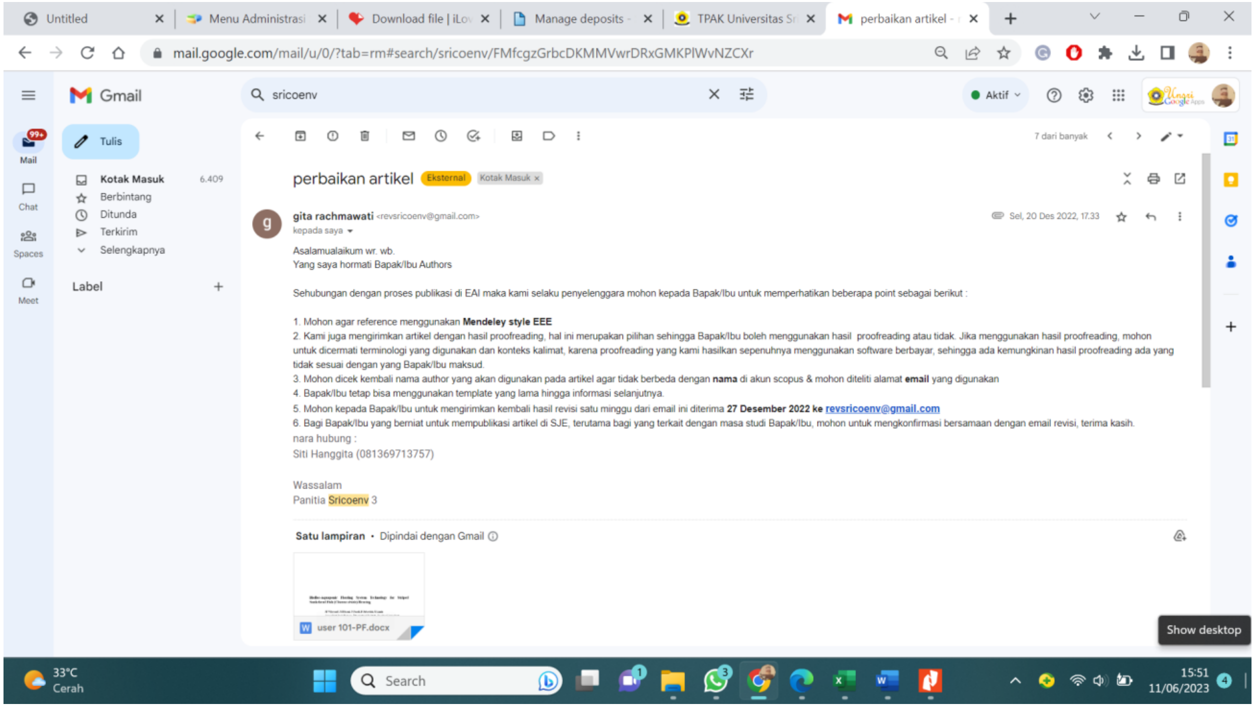
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Biofloc-Aquaponic Floating System Technology for Striped Snakehead Fish (*Channa striata*) Rearing

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Abstract. With the application of biofloqua technology (biofloc-aquaponic), the addition of swamp bacteria can increase fish growth, and have an impact on the survival, feed efficiency, and productivity of cultured fish as well as being environmentally-friendly. This study aims to determine the effectiveness of the application of biofloc technology and floating aquaponics in increasing the productivity of snakehead fish culture using swamp probiotics. This study used a completely randomized design with three replication and two treatments of snakehead fish rearing using an aquaponic biofloc floating system and a biofloc only system. Striped snakehead fish were stocked in a pond with a density of 100 fish.m-3 and added molasses every week. The results of this study indicate that the aquaponic biofloc system with probiotics from swamps can maintain the water quality of the rearing media, increase the efficiency of fish feed, fish growth, and fish survival. The integration of biofloc and aquaponics technology with swamp probiotic starter can be used as an integrated aquaculture system with continuous vegetable production.

Summary. In the application of Biofloqua technology (Biofloc-Aquaponic), the addition of marsh bacteria can increase fish growth and affect survival, feeding efficiency and productivity of farmed fish, and also be environmentally friendly. The objective of this study is to determine the effectiveness of using Biofloc technology and floating aquaponics in increasing snakehead fish culture productivity using marsh probiotics. This study used a completely randomized design with three replicates and two treatments for rearing snakeheads using a floating aquaponics system with Biofloc and a system with Biofloc only. Striped snakehead fish were kept in a pond with a density of 100 fish.m-3 and molasses was added every week. The results of this study show that the aquaponic Biofloc system with probiotics from marshes can maintain the water quality of the rearing medium, increase the efficiency of fish feed, fish growth and survival rate. The integration of Biofloc and aquaponics technology with probiotic swamp starter can be used as an integrated aquaculture system with continuous vegetable production.

1. Introduction

Striped snakehead fish (*Channa striata*) is a species of freshwater fish native to Indonesia that has been successfully domesticated and cultivated. Snakehead fish is one of several types of swamp fish that is quite popular among the people, especially in South Sumatra, especially in the city of Palembang [1]. Snakehead fish farming has been developed to increase production and meet high market demand. One way to increase the production of snakehead fish cultivation is by applying aquaculture technology.

The striped snakehead fish (Channa striata) is a freshwater fish species native to Indonesia that has been successfully domesticated and bred. The snakehead fish is one of several marsh fish species that is popular in South Sumatra, especially in the city of Palembang [1]. Snakehead fish farming was developed to increase production and meet the high market demand. One way to increase the production of snakehead fish is to apply aquaculture technology.

The application of biofloc and aquaponics technology for snakehead fish cultivation is the right solution to increase production to meet high market demand, especially in South Sumatra. The application of biofloc and aquaponics technology has shown good results for other fish commodities such as catfish. According to the research of [2], catfish rearing using the biofloqua system showed growth better and a survival performance of 96% with FCR < 1.00.

The application of Biofloc and aquaponics technology for snakehead fish farming is the right solution to increase production and meet the high market demand, especially in South Sumatra. The application of biofloc and aquaponics technology has shown good results in other fish species such as catfish. According to the research conducted by [2], the rearing of catfish using the Biofloqua system showed better growth and survival rate of 96% with FCR of < 1.00.

The combination of biofloc and aquaponics with the addition of swamp bacteria will assist in maintaining water quality in fish farming to optimize stocking density in aquaculture as well as research on optimizing the distribution density of catfish with biofloc and Nitrobacter systems which support the highest specific growth rate and the lowest FCR [3], as in the laboratory scale snakehead biofloc in a biofloc study with a swamp probiotic starter [4].

The combination of Biofloc and aquaponics with the addition of marsh bacteria will help in maintaining water quality in fish farming to optimize stocking density in aquaculture, as well as in research to optimize distribution density of catfish with Biofloc and Nitrobacter systems that support the highest specific growth rate and lowest FCR [3], as with the snakehead Biofloc at laboratory scale in a Biofloc study with a probiotic marsh starter [4].

The combination of biofloc and aquaponics can provide benefits that can guarantee business sustainability because it is profitable and environmentally friendly [5][6]. However, there are also drawbacks to the combination of cultivation technology between biofloc and aquaponics still often require additional water pumps in the aquaponics system. The biofloc methods could be combined with the floating system aquaponics for removing the water pumps. The swamp probiotic is *Bacillus* sp. and *Streptomyces* sp. The isolations were selected from swamp sediments in the Lebung Karangan, Ogan Ilir Regency, South Sumatra [7]. *Bacillus* sp. and *Streptomyces* sp. are used as probiotic bacteria in aquaculture that can improve feed efficiency, survival, and growth of snakehead fish while maintaining water quality [4]. This study aims to determine the effectiveness of the application of biofloc technology and floating aquaponics in increasing the productivity of snakehead fish culture using swamp probiotics.

The combination of biofloc and aquaponics can provide advantages that ensure the sustainability of the enterprise, as it is profitable and environmentally friendly [5][6]. However, there are also disadvantages in combining cultivation techniques between biofloc and aquaponics, which often still require additional water pumps in the aquaponics system. The biofloc method could be combined with the floating system aquaponics to remove the water pumps. The swamp probiotics are Bacillus sp. and Streptomyces sp. The isolates were selected from swamp sediments in Lebung Karangan, Ogan Ilir Regency, South Sumatra [7]. Bacillus sp. and Streptomyces sp. are used as probiotic bacteria in aquaculture that can improve feed efficiency, survival and growth of snakehead fish while maintaining water quality [4]. The objective of this study is to determine the efficacy of using Biofloc technology and floating aquaponics in increasing snakehead fish culture productivity using marsh probiotics.

2. Materials and methods

The research was carried out at the Aquaculture and Experimental Pond, Fisheries Basic Laboratory, Aquaculture Study Program, and Microbiology-Biochemical-Fishery Products Laboratory, Fishery Products Technology Study Program, Department of Fisheries, Faculty of Agriculture, Sriwijaya University.

The study was conducted in the Aquaculture and Experimental Pond, Fisheries Fundamentals Laboratory, Aquaculture Study Program, and the Microbiology-Biochemistry-Fishery Products Laboratory, Fishery Products Technology Study Program, Department of Fisheries, Faculty of Agriculture, College of Sriwijaya.

This study used a Completely Randomized Design (CRD) consisting of 2 treatments and 3 replications. The treatments were: P1 = Maintenance of 100 ind.m^{-3} using a floating biofloc-aquaponics (biofloqua) system and P2 = Maintenance of 100 ind.m^{-3} using a biofloc system.

Figure 1. Biofloqua (Biofloc-Aquaponic) pond (A) and Biofloc pond for rearing striped snakehead fish (B)

The maintenance container used is a round tarpaulin pond with a diameter of 2 m, a height of 1 m, and a water level of 0.5 m. At the top of the pond is given a rope and wire that has been attached to a cup containing charcoal and water spinach (Figure 1). The function of the wire itself is as a reinforcement to keep it in position when exposed to rain and wind. It was given aeration of 5 points in each pond. Molasses and swamp probiotics were poured into the media as a starter of 10 mL m^{-3}, with a bacterial density of 10^5 CFU mL^{-1}. Fish stocking and acclimatization for 10 days. Fish were given commercial feed 40% protein 3 times a day at satiation. The maintenance of snakehead fish was carried out for 42 days after treatment and every week a sampling of the weight and length of fish was carried out. Molasse was added as much as 100 $mL.m^{-3}$ every week.

The maintenance vessel used is a circular planted pond with a diameter of 2 m, a height of 1 m, and a water level of 0.5 m. A rope and wire are attached to the top of the pond, which is attached to a cup of charcoal and water spinach (Figure 1). The wire itself has the function of reinforcement, keeping it in position when exposed to rain and wind. In each pond, it was aerated with 5 points. Molasses and marsh probiotics were added to the medium as starters of 10 mL m-3 with a bacterial density of 105 CFU mL-1. Fish stocking and acclimation for 10 days. Fish were fed a commercial 40% protein diet three times daily for satiation. Snakehead fish were maintained for 42 days after treatment, and fish weight and length were measured each week. Molasses was added every week in an amount of 100 mL.m-3.

Water spinach seeds were sown in rockwool for 14 days in a humid room without sunlight. After the roots and some leaves appeared on the rockwool growing media, they were then stocked into aquaponics containers. Stocking was done on aquaponic media after three days of stocking fish in the rearing pond. Water spinach plants were harvested after 21 days.

The seeds of water spinach were sown in rock wool in a humid room without sunlight for 14 days. After the roots and some leaves appeared on the rockwool substrate, they were planted in aquaponics containers. Aquaponic media was stocked after three days of fish stocking in the nursery pond. Water spinach plants were harvested after 21 days.

The parameters in this study included survival, absolute weight growth of fish, growth of the absolute length of fish, feed efficiency, growth of absolute weight of water spinach, growth of the absolute length of water spinach, volume of floc, and water quality of snakehead fish rearing (pH, TDS, BOD, and DO). Data on water quality, floc volume, survival, growth, and feed efficiency were analyzed by T-test.

Parameters in this study included survival rate, absolute weight gain of fish, absolute length gain of fish, feed efficiency, absolute weight gain of water spinach, absolute length gain of water spinach, flake volume, and water quality in rearing snakeheads (pH, TDS, BOD, and DO). Data on water quality, flake volume, survival, growth, and feeding efficiency were analyzed by T-test.

3. Results and Discussion

The pH value at P1 or biofloqua pond ranged from 6.1–7.7 while the pH value at P2 or biofloc pond ranged from 6.0–7.7. The pH value obtained showed that the pH of the rearing media was still within the tolerance range for the maintenance, survival, and growth of snakehead fish. Snakehead fish as a swamp fishery commodity tends to have an acidic to neutral pH 4-7 [8]. The application of the cultivation of biofloc and biofloqua systems that utilize the activity of bacteria and other aquatic microbes in forming flocs is proven to be able to maintain the pH value of the water within the tolerance of snakehead fish culture during the study. The activity of bacteria in breaking down organic materials can form organic acids which affect the decrease in pH value. The increase in pH value is due to a decrease in bacterial activity so that the organic acids produced are low. It has an impact on increasing the pH in the maintenance medium [9].

The pH in pond P1 or Biofloqua was between 6.1and 7.7, while the pH in pond P2 or Biofloc was between 6.0and 7.7. The determined pH indicated that the pH of the rearing medium was still within the tolerance range for the maintenance, survival and growth of snakehead fish. Snakeheads as a marsh fishery product usually have an acidic to neutral pH of 4-7 [8]. Culturing Biofloc and Biofloqua systems, which utilize the activity of bacteria and other aquatic microbes in the formation of flocs, have been shown to maintain water pH within the tolerance level of snakehead culture. The activity of bacteria in breaking down organic materials can form organic acids that cause the pH to decrease. The increase in pH is due to a decrease in bacterial activity, so the organic acids produced are low. This has an impact on the increase of pH in the maintenance medium [9].

The range of DO or dissolved oxygen in the rearing media ranged from 4.45±0.10 - 5.95±0.36 mg L^{-1}. Treatment of P1 or biofloqua ranged from 4.45±0.10 - 5.90±0.12 mg L^{-1} and P2 or biofloc ranged from 5.25±0 - 5.95±0.17 mg L^{-1}. The difference in DO levels or dissolved oxygen is thought to be caused by photosynthesis and respiration of fish and microbes in the water that differs between biofloqua and biofloc ponds, but the dissolved oxygen tolerance for freshwater fish is more than 3-5 mg L^{-1}[10]. DO is not only used by fish but is also needed by deep water microbes to form flocs [11]. DO also plays an important role in the cultivation of biofloqua and biofloc systems in the process of decomposition of organic matter by probiotic bacteria, so that organic matter in the media is reduced.

The range of DO or dissolved oxygen in the rearing media ranged from 4.45±0.10 - 5.95±0.36 mg L-1. P1 or Biofloqua treatment ranged from 4.45±0.10 - 5.90±0.12 mg L-1 and P2 or Biofloc ranged from 5.25±0 - 5.95±0.17 mg L-1. It is believed that the difference between DO and dissolved oxygen is caused by photosynthesis and respiration of fish and microbes in the water, which differ between Biofloqua and Biofloc ponds, but the tolerance for dissolved oxygen is more than 3-5 mg L-1for freshwater fish [10]. DO is not only used by fish, but also needed by deep water microbes to form flocs [11]. DO also plays an important role in the cultivation of Biofloqua and Biofloc systems in the process of decomposition of organic material by probiotic bacteria, so that organic material in the medium is reduced.

The range of TDS obtained in the rearing medium ranged from 284.50 ± 163.25 – 488.17 ± 420.59 mg L^{-1}. Treatment of P1 or biofloqua ranged from 416±233.50 - 488.17 ±420.59 mg L^{-1} and P2 or biofloc ranged from 284.50±163.25 – 328.67±301.31 mg L^{-1}. The difference in TDS in biofloc ponds is thought to be due to differences in nutrients obtained in full from fish feces containing nitrogen. Plants need nitrogen as a natural fertilizer for growth and development. The results of the T-test analysis (Table 1), Total Dissolved Solid (TDS) on days 0, 7, 14, 21, 28, 35, and 42 were not significantly different in treatment P1 and P2 ($P<0.05$). Based on the water quality standards in PP No 82 of 2001 (class II), the concentration of TDS obtained during maintenance is appropriate and safe for fish farming activities, which is less than 1000 mg L^{-1}.

The TDS value of the rearing medium ranged from 284.50±163.25 to 488.17±420.59 mg L-1. Treatment with P1 or Biofloqua ranged from 416±233.50 - 488.17±420.59 mg L-1 and P2 or Biofloc ranged from 284.50±163.25 - 328.67±301.31 mg L-1. The difference in TDS in Biofloc ponds is believed to be due to differences in nutrients derived entirely from nitrogenous fish excreta. Plants require nitrogen as a natural fertilizer for their growth and development. The results of the T-test analysis (Table 1) show that total dissolved solids (TDS) were not significantly different between treatments P1 and P2 on days 0, 7, 14, 21, 28, 35, and 42 ($P<0.05$). Based on the water quality standards in PP No. 82 of 2001 (Class II), the TDS concentration of less than 1000 mg L-1 achieved during maintenance is suitable and safe for fish culture.

Table 1. TDS value in rearing media of striped snakehead for 42 days

Rearing days	Treatment	
	P1 (Biofloqua)	P2 (Biofloc)
0	474.33±338.48	306.50±260.43
7	488.17±420.59	328.67±301.31
14	416.00±233.50	294.00±245.57
21	438.17±269.74	294.00±250.97
28	452.00±265.36	314.00±242.15
35	452.00±244.50	319.33±267.89
42	418.50±139.54	284.50±163.25

The range of BOD obtained in the rearing medium ranged from 0.48 ± 0.12 – 0.68 ± 40.25 mg L^{-1}. Treatment of P1 or biofloc ranged from 0.48 ± 0.12 – 0.68 ± 40.25 mg L^{-1} and P2 or biofloc ranged from

0.50±0 – 0.68 ± 0.23 mg L^{-1}. The results of the T-test analysis (Table 2) showed that the Biochemical Oxygen Demand (BOD) on days 0, 7, 14, 21, 28, 35, and 42 were not significantly different between treatments P1 and P2 ($P<0.05$). BOD during maintenance ranged from 0.48±0.12 mg L^{-1} – 0.68±0.25 mg L^{-1}.

Table 2. BOD value in rearing media of striped snakehead for 42 days

Treatment	Rearing days						
	0	7	14	21	28	35	42
P1	0.63±0.38	0.53±0.15	0.55±0.17	0.48±0.12	0.68±0.25	0.68±0.21	0.48±0.15
P2	0.67±0.15	0.50±0.0	0.62±0.12	0.62±0.15	0.65±0.20	0.55±0.20	0.68±0.23

According to [12], the BOD value can be influenced by temperature, plankton density, the presence of microbes, and the type of organic matter content. BOD values in natural waters ranged from 0.5 to 7.0 mg L^{-1}. The low BOD value during this study was presumably because the microbes in probiotics and plants could utilize organic matter as a source of nutrition.
According to [12], the value of BOD can be influenced by temperature, plankton density, the presence of microbes, and the type of organic matter content. BOD Values in natural waters range from 0.5 to 7.0 mg L-1. The low BOD value in this study is probably due to the fact that microbes in probiotics and plants can use organic matter as a food source.

Bernal [14] stated that the combination of *Streptomyces* sp. and *Bacillus* sp. cause synergistic activity, bacteria give each other benefits that produce several extracellular enzymes (*Bacillus* sp.) and antibiotic compounds (*Streptomyces* sp.) that can increase survival, growth and increase fish resistance to disease. *Bacillus* sp. can produce natural antimicrobial compounds that can suppress the colonies of pathogenic bacteria [15]. *Streptomyces* sp. has the potential to control pathogenic bacteria by conducting competition, parasitism, or producing secondary metabolites [16] and can produce various biologically active compounds, such as antibacterial, antifungal, antiparasitic, and antiviral [17].
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T-test analysis showed that the volume of flocs in treatment P1 and P2 were significantly different on days 14, 28,35, and 42 (P<0,05), it is showed at Table 3.

Table 3. Floc volume in rearing media of striped snakehead for 42 days

Rearing days	Floc volume (ml.L^{-1})	
	P1	P2
0	0.13 ± 0.06	0.05 ± 0.05
7	0.40 ± 0.00	1.10 ± 0.50
14	0.87 ± 0.15	16.00 ± 2.00
21	2.37 ± 0.65	21.50 ± 1.50
28	4.77 ± 0.25	28.00 ± 3.00
35	3.00 ± 0.50	19.00 ± 5.00

42	6.00 ± 0.50	23.00 ± 5.00

According to [18], the more aquaculture waste in the media used by heterotrophic bacteria, the higher floc formed. The formed floc can provide nutrients such as proteins, amino acids, lipids, and fatty acids in various microbial forms [19]. Biofloc is a good source of vitamins, and minerals, especially phosphorus and microbial protein as an additional source of nutrition for fish and plants [20].

According to [18], the more aquaculture waste is contained in the medium used by the heterotrophic bacteria, the more flocs are formed. The floc formed can provide nutrients such as proteins, amino acids, lipids and fatty acids in various microbial forms [19]. Biofloc is a good source of vitamins and minerals, especially phosphorus and microbial protein as an additional food source for fish and plants [20].

The results of the T-test analysis showed that the survival of snakehead fish was not significantly different in the P2 and P1 treatments ($P<0.05$). Maintenance using biofloc technology and aquaponics gave SR or survival of 100±0.00%. The maintenance of snakehead fish using biofloc technology was 99.78±0.38%. It showed that the treatment of biofloqua and biofloc can maintain water quality in optimal conditions. The use of probiotics in aquaculture can balance the microbial population and can control pathogens in the digestive tract, water, and aquatic environment through the biodegradation process [21].

The results of T-test analysis showed that the survival rate of snakehead fish was not significantly different between P2 and P1 treatments ($P < 0.05$). Maintaining with Biofloc technology and aquaponics resulted in SR or a survival rate of 100±0.00%. The maintenance of snakehead fish with Biofloc technology was 99.78±0.38%. It showed that Biofloqua and Biofloc treatment can maintain water quality under optimal conditions. The use of probiotics in aquaculture can keep the microbial population in balance and control pathogens in the digestive tract, water and aquatic environment through the biodegradation process [21].

Table 4. Feed Efficiency and Growth of Fish for 42 days

Treatment	Feed efficiency (%)	Growth of Total Weight (g)	Growth of Total Length (cm)
P1	179 ± 31.66	7.39 ± 1.51	2.61 ± 0.42
P2	147 ± 36.10	6.10 ± 1.44	2.27 ± 0.27

Based on the results of the study showed that the feed efficiency value of P1 (179%) was not significant with P2 (147%) (Table 4). Bacteria enter the digestive tract through respiration at mealtimes. Snakehead fish can take advantage of the floc formed in the optimal environment. So that the bacteria in P1 and P2 can work in the digestive tract and increase digestibility. Although the feed efficiency average of fishes in P1 and P2 was not significant, in biofloqua system gave better performance than the biofloc system. High digestibility can increase nutrient absorption so that if the nutritional needs of fish are met, the fish will grow well and increase the value of feed efficiency [22].

The results of the study show that the feeding efficiency of P1 (179%) is not significantly comparable to that of P2 (147%) (Table 4). The bacteria enter the digestive tract through respiration during meals. Snakeheads may benefit from flocculation in the optimal environment. Thus, the bacteria in P1 and P2 can act in the digestive tract and increase digestibility. Although the average feeding efficiency of fish in P1 and P2 was not significant, the Biofloqua system showed better performance than the Biofloc system. High digestibility can increase nutrient uptake, so when the nutrient requirement of the fish is met, the fish grow well and the value of feeding efficiency increases [22].

The growth of water spinach plants was good. At the beginning of maintenance, the initial height of plants was 7-8 cm. At 7 days after planting on biofloqua media, the size of plants became 15-19 cm. At 21 days after planting, the height of the plant reaches 35.60-46.73 cm. The size of the water spinach plants at

9 days old after planting was 16 cm, and at 18 days after planting was 47.24 cm [23]. The water spinach plant development in aquaponics systems can be impacted by the availability of sufficient nutrients in the form of nitrates and phosphates that will be absorbed by the plants in the aquaponics system [24].

The growth of water spinach plants was good. At the beginning of care, the initial height of the plants was 7-8 cm. 7 days after planting on Biofloqua media, the size of the plants was 15-19 cm. 21 days after planting the height of the plants reached 35.60-46.73 cm. The height of water spinach plants at the age of 9 days after planting was 16 cm and 18 days after planting was 47.24 cm [23]. The development of water spinach plants in aquaponic systems may be influenced by the availability of sufficient nutrients in the form of nitrates and phosphates, which are taken up by the plants in the aquaponic system [24].

4. Conclusion

The application of biofloc technology or aquaponics with biofloc and floating systems on snakehead fish (*Channa striata*) culture media can produce water quality in the maintenance media that can be tolerated by snakehead fish, namely pH 6.1-7.7, dissolved oxygen 4.45-5.95 mg L^{-1}, TDS 284.50-488.17 mg L^{-1}, BOD 0.48-0.68 mg L^{-1}, feed efficiency 179%, and fish survival 100%. The integration of biofloqua technology can be used as a simple cultivation system by producing good fish and vegetables productivity. Application of Biofloc technology or aquaponics with Biofloc and floating systems on culture media for snakehead fish (Channa striata) can produce water quality in maintenance media that can be tolerated by snakehead fish, namely pH 6.1-7.7, dissolved oxygen 4.45-5.95 mg L-1, TDS 284.50-488.17 mg L-1, BOD 0.48-0.68 mg L-1, feed efficiency 179% and fish survival 100%. The integration of Biofloqua technology can be used as a simple farming system that produces good fish and vegetable productivity.

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References

[24] Muslim 2006 Pros. Forum Perairan Umum Indonesia IV (Balai Riset Perikanan Perairan Umum Palembang) p 7-11
[25] Wijayanti M, Amin M, Tanbiyaskur T, Jubaedah D, Jaya K, Ziyad MA, Marsi M 2021 *Journal of Aquaculture and Fish Health* **10** 258
[26] Puspita EV dan Sari RP 2018 *Aquasains Jurnal Ilmu Perikanan dan Sumberdaya Perairan* **6** 563
[27] Wijayanti M, Jubaedah D, Yulistya O, Tanbiyaskur T and Sasanti AD 2020 *AACL Bioflux* **13** 1064
[28] Pinho SM, David LH, Garcia F, Portella MC, Keesman KJ 2022 *Ecological Indicators* **141** 109092.
[29] Pinho SM, Lima JP, David LH, Oliveira MS, Goddek S, Carneiro DJ, Keesman KJ, Portella MC 2021 *Aquaculture* **543** 736932
[30] Wijayanti M, Jubaedah D, Suhada JA, Yuliani S, Saraswati N, Syaifudin M, Widjajanti H 2018 *Proc. Int. Conf. E3S Web of Conf.* vol 68 (EDP Sciences) p 01023
[31] Jubaedah D, Kamal MM, Muchsin I, Hariyadi S. 2015 J. *Manusia dan Lingkungan* **22** 12-21.
[32] Khanjani MH and Sharifinia M 2020 *Reviews in aquaculture* **12** 1836
[33] Bich TT, Tri DQ, Yi-Ching C, Khoa HD 2020 *Aquacultural Engineering* **89** 102057
[34] Liu H, Li H, Wei H, Zhu X, Han D, Jin J, Yang Y, Xie S 2019 *Aquaculture* **506** 256
[35] Crossman J, Bussi G, Whitehead PG, Butterfield D, Lannergård E, Futter MN 2021 Water 13 723.
[36] Khotimah H 2019 Uji Patogenisitas Bakteri Kandidat Probiotik Asal Sedimen Rawa Skripsi Universitas Sriwijaya
[37] Bernal MG, Marrero RM, Campa-Córdova ÁI, Mazón-Suástegui JM 2017 *Aquaculture international* **259** 27

[38] Santos RA, Oliva-Teles A, Pousão-Ferreira P, Jerusik R, Saavedra MJ, Enes P, Serra CR 2021 *Marine Biotechnology* **23** 276.
[39] Liang Q, Liu G, Guo Z, Wang Y, Xu Z, Ren Y, Zhang Q, Cui M, Zhao X, Xu D *2022 Fish & Shellfish Immunology* **127** 375
[40] Al-Ansari M, Alkubaisi N, Vijayaragavan P, Murugan K 2019 *Journal of infection and public health* **12** 861
[41] Pekkoh J, Chaichana C, Thurakit T, Phinyo K, Lomakool S, Ruangrit K, Duangjan K, Suwannarach N, Kumla J, Cheirsilp B, Srinuanpan S 2022 *Bioresource Technology* **359** 127469.
[42] Sontakke R, Tiwari VK, Kurcheti P, Asanaru Majeedkutty BR, Ande MP, Haridas H 2021 *Aquaculture Research* **52** 3460
[43] Baidya S 2020 Biofloc Technology and its Application for Sustainable Aquaculture in Northeast India. In *Fish Nutrition and Its Relevance to Human Health* CRC Press **11** 289
[44] Hlordzi V, Kuebutornye FK, Afriyie G, Abarike ED, Lu Y, Chi S, Anokyewaa MA 2020 *Aquaculture Reports* **18** 100503.
[45] Hodar AR, Vasava RJ, Mahavadiya DR, Joshi NH 2020 *J. Exp. Zool. India* **23** 13
[46] Adimihardja SA, Sunardi O, Mulyaningsih Y 2013 *Jurnal Pertanian* **4** 33
Hasan Z, Andriani Y, Dhahiyat Y, Sahidin A, Rubiansyah MR 2018 *Jurnal Iktiologi Indonesia* **1**

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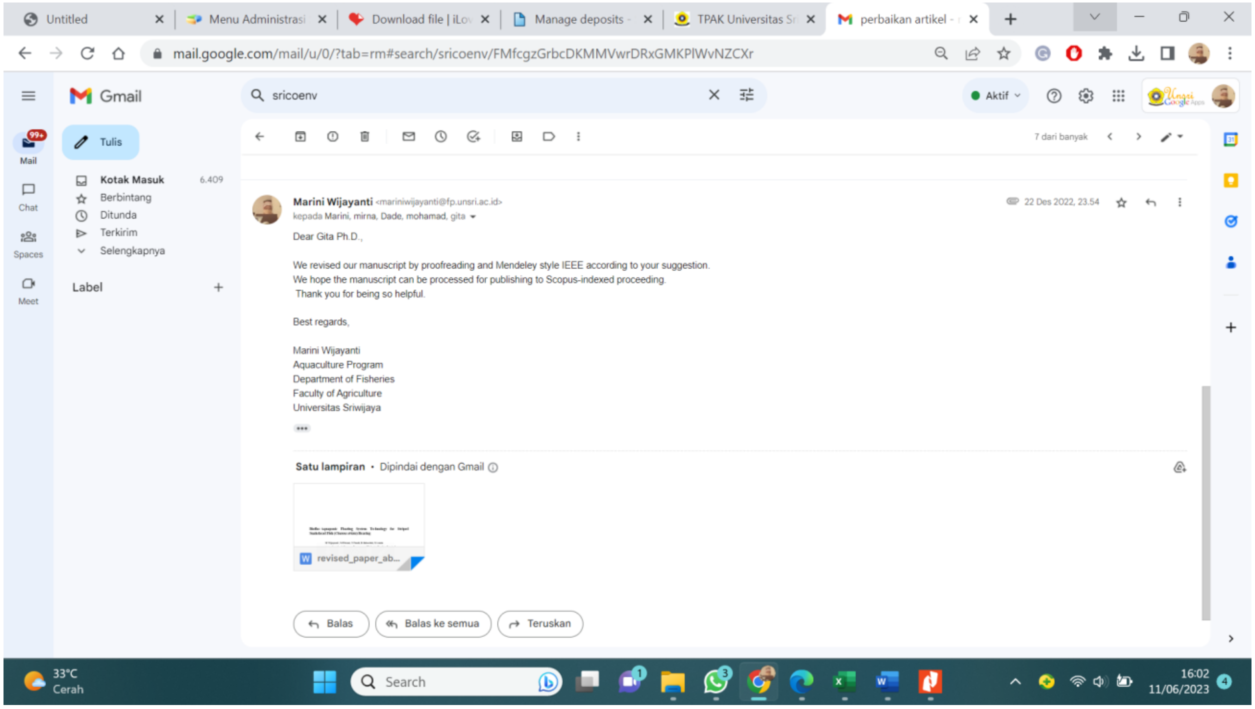

Biofloc-Aquaponic Floating System Technology for Striped Snakehead Fish (*Channa striata*) Rearing

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Abstract. In the application of Biofloqua technology (Biofloc-Aquaponic), the addition of swamp bacteria can increase fish growth and affect survival, feeding efficiency and productivity of farmed fish, and also be environmentally friendly. The objective of this study is to determine the effectiveness of using Biofloc technology and floating aquaponics in increasing striped snakehead fish culture productivity using swamp probiotics. This study used a completely randomized design with three replicates and two treatments for rearing snakeheads using a floating aquaponics system with Biofloc and a system with Biofloc only. Striped snakehead fish were kept in a pond with a density of 100 fish m^{-3} and molasses were added every week. The results of this study show that the aquaponic Biofloc system with probiotics from swamp can maintain the water quality of the rearing medium, increase the efficiency of fish feed, fish growth and survival rate. The integration of Biofloc and aquaponics technology with probiotic swamp starter can be used as an integrated aquaculture system with continuous vegetable production.

1. Introduction

The striped snakehead fish (*Channa striata*) is a freshwater fish species native to Indonesia that has been successfully domesticated and bred. The snakehead fish is one of several swamp fish species that is popular in South Sumatra, especially in the city of Palembang [1]. Snakehead fish farming was developed to increase production and meet the high market demand. One way to increase the production of snakehead fish is to apply aquaculture technology.

The application of Biofloc and aquaponics technology for snakehead fish farming is the right solution to increase production and meet the high market demand, especially in South Sumatra. The application of biofloc and aquaponics technology has shown good results in other fish species such as catfish. According to the research conducted by [2], the rearing of catfish using the Biofloqua system showed better growth and survival rate of 96% with FCR of < 1.00.

The combination of Biofloc and aquaponics with the addition of swamp bacteria will help in maintaining water quality in fish farming to optimize stocking density in aquaculture, as well as in research to optimize distribution density of catfish with Biofloc and Nitrobacter systems that support the highest specific growth rate and lowest FCR[3], as with the snakehead Biofloc at laboratory scale in a Biofloc study with a probiotic swamp starter [4].

The combination of biofloc and aquaponics can provide advantages that ensure the sustainability of the enterprise, as it is profitable and environmentally friendly [5][6][7]. However, there are also disadvantages in combining cultivation techniques between biofloc and aquaponics, which often still require additional water pumps in the aquaponics system. The biofloc method could be combined with the floating system aquaponics to remove the water pumps. The swamp probiotics are *Bacillus* sp. and *Streptomyces* sp. The isolates were selected from swamp sediments in Lebung Karangan, Ogan Ilir Regency, South Sumatra [8]. *Bacillus* sp. and *Streptomyces* sp. are used as probiotic bacteria in aquaculture that can improve feed efficiency, survival and growth of snakehead fish while maintaining water quality[4]. The objective of this study is to determine the efficacy of using Biofloc technology and floating aquaponics in increasing snakehead fish culture productivity using swamp probiotics.

2. Materials and methods

The study was conducted in the Aquaculture and Experimental Pond, Fisheries Fundamentals Laboratory, Aquaculture Study Program, and the Microbiology-Biochemistry-Fishery Products Laboratory, Fishery Products Technology Study Program, Department of Fisheries, Faculty of Agriculture, University of Sriwijaya.

This study used a Completely Randomized Design (CRD) consisting of 2 treatments and 3 replications. The treatments were: P1 = Maintenance of 100 ind.m^{-3} using a floating biofloc-aquaponics (biofloqua) system and P2 = Maintenance of 100 ind.m^{-3} using a biofloc system.

Figure 1. Biofloqua (Biofloc-Aquaponic) pond (A) and Biofloc pond for rearing striped snakehead fish (B)

The maintenance vessel used is a circular planted pond with a diameter of 2 m, a height of 1 m, and a water level of 0.5 m. A rope and wire are attached to the top of the pond, which is attached to a cup of charcoal and water spinach (Figure 1). The wire itself has the function of reinforcement, keeping it in position when exposed to rain and wind. In each pond, it was aerated with 5 points. Molasses and swamp probiotics were added to the medium as starters of 10 mL m^{-3} with a bacterial density of 10^5 CFU mL^{-1}. Fish stocking and acclimation for 10 days. Fish were fed a commercial 40% protein diet three times daily for satiation. Snakehead fish were maintained for 42 days after treatment, and fish weight and length were measured each week. Molasses was added every week in an amount of 100 $mL.m^{-3}$.

The seeds of water spinach were sown in rock wool in a humid room without sunlight for 14 days. After the roots and some leaves appeared on the rockwool substrate, they were planted in aquaponics containers. Aquaponic media was stocked after three days of fish stocking in the nursery pond. Water spinach plants were harvested after 21 days.

Parameters in this study included survival rate, absolute weight gain of fish, absolute length gain of fish, feed efficiency, absolute weight gain of water spinach, absolute length gain of water spinach, floc volume, and water quality in rearing snakeheads (pH, TDS, BOD, and DO). Data on water quality, floc volume, survival, growth, and feeding efficiency were analyzed by T-test.

3. Results and Discussion

The pH in pond P1 or Biofloqua was between 6.1and 7.7, while the pH in pond P2 or Biofloc was between 6.0 and 7.7. The determined pH indicated that the pH of the rearing medium was still within the tolerance range for the maintenance, survival and growth of snakehead fish. Snakeheads as a swamp fishery product usually have an acidic to neutral pH of 4-7 [9]. Culturing Biofloc and Biofloqua systems, which utilize the activity of bacteria and other aquatic microbes in the formation of flocs, have been shown to maintain water pH within the tolerance level of snakehead culture. The activity of bacteria in breaking down organic materials can form organic acids that cause the pH to decrease. The increase in pH is due to a decrease in bacterial activity, so the organic acids produced are low. This has an impact on the increase of pH in the maintenance medium [10].

The range of DO or dissolved oxygen in the rearing media ranged from 4.45±0.10 - 5.95±0.36 mg L-^{1}. P1 or Biofloqua treatment ranged from 4.45±0.10 - 5.90±0.12 mg L^{-1} and P2 or Biofloc ranged from 5.25±0 - 5.95±0.17 mg L^{-1}. It is believed that the difference between DO and dissolved oxygen is caused by photosynthesis and respiration of fish and microbes in the water, which differ between Biofloqua and Biofloc ponds, but the tolerance for dissolved oxygen is more than 3-5 mg $L^{-1}$for freshwater fish [11]. DO is not only used by fish, but also needed by deep water microbes to form flocs [12]. DO also plays an important role in the cultivation of Biofloqua and Biofloc systems in the process of decomposition of organic material by probiotic bacteria, so that organic material in the medium is reduced.

The TDS value of the rearing medium ranged from 284.50±163.25 to 488.17±420.59 mg L^{-1}. Treatment with P1 or Biofloqua ranged from 416±233.50 - 488.17±420.59 mg L^{-1} and P2 or Biofloc ranged from 284.50±163.25 - 328.67±301.31 mg L^{-1}. The difference in TDS in Biofloc ponds is believed to be due to differences in nutrients derived entirely from nitrogenous fish excreta. Plants require nitrogen as a natural fertilizer for their growth and development. The results of the T-test analysis (Table 1) show that total dissolved solids (TDS) were not significantly different between treatments P1 and P2 on days 0, 7, 14, 21, 28, 35, and 42 ($P<0.05$). Based on the water quality standards in PP No. 82 of 2001 (Class II), the TDS concentration of less than 1000 mg L^{-1} achieved during maintenance is suitable and safe for fish culture.The pH value at P1 or biofloqua pond ranged from 6.1–7.7 while the pH value at P2 or biofloc pond ranged from 6.0–7.7.

The range of DO or dissolved oxygen in the rearing media ranged from 4.45±0.10 - 5.95±0.36 mg L^{-1}. Treatment of P1 or biofloqua ranged from 4.45±0.10 - 5.90±0.12 mg L^{-1} and P2 or biofloc ranged from 5.25±0 - 5.95±0.17 mg L^{-1}. The difference in DO levels or dissolved oxygen is thought to be caused by photosynthesis and respiration of fish and microbes in the water that differs between biofloqua and biofloc ponds, but the dissolved oxygen tolerance for freshwater fish is more than 3-5 mg L^{-1} [11]. DO is not only used by fish but is also needed by deep water microbes to form flocs [12]. DO also plays an important role in the cultivation of biofloqua and biofloc systems in the process of decomposition of organic matter by probiotic bacteria, so that organic matter in the media is reduced.

The range of TDS obtained in the rearing medium ranged from 223 - 479 mg L^{-1}. Treatment of P1 or biofloqua ranged from 386.25 – 479.75 mg L^{-1} and P2 or biofloc ranged from 223 – 244 mg L^{-1}. The difference in TDS in biofloc ponds is thought to be due to differences in nutrients obtained in full from fish feces containing nitrogen. Plants need nitrogen as a natural fertilizer for growth and development. The results of the T-test analysis (Table 1), Total Dissolved Solid (TDS) on days 0, 7, 14, 21, 28, 35, and 42 were not significantly different in treatment P1 and P2 ($P<0.05$). Based on the water quality standards in PP No 82 of 2001 (class II), the concentration of TDS obtained during maintenance is appropriate and safe for fish farming activities, which is less than 1000 mg L^{-1}.

Table 1. TDS value in rearing media of striped snakehead for 42 days (mg.L^{-1})

Rearing days	Treatment	
	P1 (Biofloqua)	P2 (Biofloc)
0	386.25+73.25	231.50±9.00
7	377.50±86.50	241.75±5.75
14	474.50±58.00	223.25±7.75
21	366.75±53.75	234.00±3.75
28	383.75±60.25	244.50±13.00
35	479.75±60.75	242.25±10.75
42	389.00±33.50	237.50±6.00

The range of BOD obtained in the rearing medium ranged from 0.48 ± 0.12 – 0.68 ± 40.25 mg L^{-1}. Treatment of P1 or biofloc ranged from 0.48 ± 0.12 – 0.68 ± 40.25 mg L^{-1} and P2 or biofloc ranged from 0.50±0 – 0.68 ± 0.23 mg L^{-1}. The results of the T-test analysis (Table 2) showed that the Biochemical Oxygen Demand (BOD) on days 0, 7, 14, 21, 28, 35, and 42 were not significantly different between treatments P1 and P2 ($P<0.05$). BOD during maintenance ranged from 0.48±0.12 mg L^{-1} – 0.68±0.25 mg L^{-1}.

Table 2. BOD value in rearing media of striped snakehead for 42 days (mg.L^{-1})

Treatment	Rearing days						
	0	7	14	21	28	35	42
P1	0.63±0.38	0.53±0.15	0.55±0.17	0.48±0.12	0.68±0.25	0.68±0.21	0.48±0.15
P2	0.67±0.15	0.50±0.0	0.62±0.12	0.62±0.15	0.65±0.20	0.55±0.20	0.68±0.23

According to [13], the BOD value can be influenced by temperature, plankton density, the presence of microbes, and the type of organic matter content. BOD values in natural waters ranged from 0.5 to 7.0 mg L^{-1}. The low BOD value during this study is probably due to the fact that the microbes in probiotics and plants can use organic matter as a source of nutrition.

Bernal et al [14] stated that the combination of *Streptomyces* sp. and *Bacillus* sp. has a synergistic effect, i.e., the bacteria give benefits to each other by producing various extracellular enzymes (*Bacillus* sp.) and antibiotic compounds (*Streptomyces* sp.) that can increase fish survival, growth, and resistance to disease. *Bacillus* sp. can produce natural antimicrobial compounds that can suppress colonies of pathogenic bacteria [15]. *Streptomyces* sp. has the potential to control pathogenic bacteria through competition, parasitism, or production of secondary metabolites [16] and can produce various biologically active compounds, such as antibacterial, antifungal, antiparasitic, and antiviral [17].

T-test analysis showed that the volume of flocs in treatment P1 and P2 were significantly different on days 14, 28,35, and 42 ($P<0,05$), it is showed at Table 3.

Table 3. Floc volume in rearing media of striped snakehead for 42 days

Rearing days	Floc volume ($ml.L^{-1}$) P1	Floc volume ($ml.L^{-1}$) P2
0	0.13 ± 0.06	0.05 ± 0.05
7	0.40 ± 0.00	1.10 ± 0.50
14	0.87 ± 0.15	16.00 ± 2.00
21	2.37 ± 0.65	21.50 ± 1.50
28	4.77 ± 0.25	28.00 ± 3.00
35	3.00 ± 0.50	19.00 ± 5.00
42	6.00 ± 0.50	23.00 ± 5.00

According to [18], the more aquaculture waste is contained in the medium used by the heterotrophic bacteria, the more flocs are formed. The floc formed can provide nutrients such as proteins, amino acids, lipids and fatty acids in various microbial forms [19]. Biofloc is a good source of vitamins and minerals, especially phosphorus and microbial protein as an additional food source for fish and plants [20].

The results of T-test analysis showed that the survival rate of snakehead fish was not significantly different between P2 and P1 treatments ($P < 0.05$). Maintaining with Biofloc technology and aquaponics resulted in SR or a survival rate of 100±0.00%. The maintenance of snakehead fish with Biofloc technology was 99.78±0.38%. It showed that Biofloqua and Biofloc treatment can maintain water quality under optimal conditions. The use of probiotics in aquaculture can keep the microbial population in balance and control pathogens in the digestive tract [21], water and aquatic environment through the biodegradation process [22].

Table 4. Feed Efficiency and Growth of Fish for 42 days

Treatment	Feed efficiency (%)	Growth of Total Weight (g)	Growth of Total Length (cm)
P1	179 ± 31.66	7.39 ± 1.51	2.61 ± 0.42
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The results of the study show that the feeding efficiency of P1 (179%) is not significantly comparable to that of P2 (147%) (Table 4). The bacteria enter the digestive tract through respiration during meals. Snakeheads may benefit from flocculation in the optimal environment. Thus, the bacteria in P1 and P2 can act in the digestive tract and increase digestibility. Although the average feeding efficiency of fish in P1 and P2 was not significant, the Biofloqua system showed better performance than the Biofloc system. High digestibility can increase nutrient uptake, so when the nutrient requirement of the fish is met, the fish grow well and the value of feeding efficiency increases [23].

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4. Conclusion

Application of Biofloc technology or aquaponics with Biofloc and floating systems on culture media for snakehead fish (Channa striata) can produce water quality in maintenance media that can be tolerated by snakehead fish, pH 6.1-7.7, dissolved oxygen 4.45-5.95 mg L^{-1}, TDS 284.50-488.17 mg L^{-1}, BOD 0.48-0.68 mg L^{-1}, feed efficiency 179%, and fish survival 100%. The integration of biofloqua technology can be used as a simple cultivation system by producing fish and vegetables.

Acknowledgment
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References

[1] M. Muslim, "Potensi, peluang dan tantangan budidaya ikan gabus (*Channa striata*) di propinsi Sumatera Selatan," *Pros. Semin. Nas. Forum Perair. Umum Indones. IV*, no. May, pp. 7–12, 2006.

[2] M. Wijayanti *et al.*, "Aquaponic Biofloc Technology by Swamp Bacteria Probiotic for Clarias Catfish Rearing," *J. Aquac. Fish Heal.*, vol. 10, no. 3, p. 258, 2021, doi: 10.20473/jafh.v10i3.23549.

[3] E. V. Puspita and R. P. Sari, "Effect of different stocking density to growth rate of catfish (*Clarias gariepinus*, burch) cultured in biofloc and nitrobacter media," *Aquasains*, vol. 6, no. 2, p. 583, 2018, doi: 10.23960/aqs.v6i2.p583-588.

[4] M. Wijayanti, D. Jubaedah, O. Yulistya, Tanbiyaskur, and A. D. Sasanti, "Optimization of striped snakehead fish (*Channa striata*) culture using swamp microbial combination and nitrification bacteria," *AACL Bioflux*, vol. 13, no. 2, 2020.

[5] S. M. Pinho, L. H. David, F. Garcia, M. C. Portella, and K. J. Keesman, "Sustainability assessment of FLOCponics compared to stand-alone hydroponic and biofloc systems using emergy synthesis," *Ecol. Indic.*, vol. 141, no. June, 2022, doi: 10.1016/j.ecolind.2022.109092.

[6] S. M. Pinho *et al.*, "Decoupled FLOCponics systems as an alternative approach to reduce the protein level of tilapia juveniles' diet in integrated agri-aquaculture production," *Aquaculture*, vol. 543, no. April, 2021, doi: 10.1016/j.aquaculture.2021.736932.

[7] S. M. Pinho *et al.*, "FLOCponics: The integration of biofloc technology with plant production," *Rev. Aquac.*, vol. 14, no. 2, pp. 647–675, 2022, doi: 10.1111/raq.12617.

[8] M. Wijayanti *et al.*, "DNA Barcoding of Swamp Sediment Bacterial Isolates for Swamp Aquaculture Probiotic," *E3S Web Conf.*, vol. 68, p. 01023, 2018, doi: 10.1051/e3sconf/20186801023.

[9] D. Jubaedah, M. M. Kamal, I. Muchsin, and S. Hariyadi, "Water Quality Characteristics and Estimation of Ecobiological Risk of Herbicide in Lubuk Lampam Floodplain, South Sumatera," *J. Mns. dan Lingkung.*, vol. 22, no. 1, pp. 12–21, 2015.

[10] M. H. Khanjani and M. Sharifinia, "Biofloc technology as a promising tool to improve aquaculture production," *Rev. Aquac.*, vol. 12, no. 3, pp. 1836–1850, 2020, doi: 10.1111/raq.12412.

[11] T. T. N. Bich, D. Q. Tri, C. Yi-Ching, and H. D. Khoa, "Productivity and economic viability of snakehead *Channa striata* culture using an aquaponics approach," *Aquac. Eng.*, vol. 89, no. January, p. 102057, 2020, doi: 10.1016/j.aquaeng.2020.102057.

[12] H. Liu *et al.*, "Biofloc formation improves water quality and fish yield in a freshwater pond aquaculture system," *Aquaculture*, vol. 506, pp. 256–269, 2019, doi: 10.1016/j.aquaculture.2019.03.031.

[13] J. Crossman, G. Bussi, P. G. Whitehead, D. Butterfield, E. Lannergård, and M. N. Futter, "A new, catchment-scale integrated water quality model of phosphorus, dissolved oxygen, biochemical oxygen demand and phytoplankton: Inca-phosphorus ecology (peco)," *Water (Switzerland)*, vol. 13, no. 5, 2021, doi: 10.3390/w13050723.

[14] M. G. Bernal, R. M. Marrero, Á. I. Campa-Córdova, and J. M. Mazón-Suástegui, "Probiotic effect of *Streptomyces* strains alone or in combination with *Bacillus* and *Lactobacillus* in juveniles of the white shrimp Litopenaeus vannamei," *Aquac. Int.*, vol. 25, no. 2, pp. 927–939, 2017, doi: 10.1007/s10499-016-0085-y.

[15] R. A. Santos *et al.*, "Isolation and Characterization of Fish-Gut *Bacillus* spp. as Source of Natural Antimicrobial Compounds to Fight Aquaculture Bacterial Diseases," *Mar. Biotechnol.*, vol. 23, no. 2, pp. 276–293, 2021, doi: 10.1007/s10126-021-10022-x.

[16] Q. Liang *et al.*, "Application of potential probiotic strain *Streptomyces* sp. SH5 on anti-*Aeromonas* infection in zebrafish larvae," *Fish Shellfish Immunol.*, vol. 127, no. June, pp. 375–385, 2022, doi: 10.1016/j.fsi.2022.06.049.

[17] M. Al-Ansari, N. Alkubaisi, P. Vijayaragavan, and K. Murugan, "Antimicrobial potential of S*treptomyces* sp. to the Gram positive and Gram negative pathogens," *J. Infect. Public Health*, vol. 12, no. 6, pp. 861–866, 2019, doi: 10.1016/j.jiph.2019.05.016.

[18] J. Pekkoh *et al.*, "Dual-bioaugmentation strategy to enhance the formation of algal-bacteria symbiosis biofloc in aquaculture wastewater supplemented with agricultural wastes as an alternative nutrient sources and biomass support materials," *Bioresour. Technol.*, vol. 359, no. 3, p. 127469, 2022, doi: 10.1016/j.biortech.2022.127469.

[19] R. Sontakke, V. K. Tiwari, P. Kurcheti, B. R. Asanaru Majeedkutty, M. P. Ande, and H. Haridas, “Yam-based biofloc system improves the growth, digestive enzyme activity, bacterial community structure and nutritional content in milkfish (*Chanos chanos*),” *Aquac. Res.*, vol. 52, no. 7, pp. 3460–3474, 2021, doi: 10.1111/are.15190.

[20] A. M. Aboseif *et al.*, “Influence of dietary C: N: P ratios on Nile tilapia *Oreochromis niloticus* growth performance and formation of water biotic communities within a biofloc system containment,” *Aquac. Reports*, vol. 24, no. April, p. 101136, 2022, doi: 10.1016/j.aqrep.2022.101136.

[21] A. D. Diwan, S. N. Harke, Gopalkrishna, and A. N. Panche, “Aquaculture industry prospective from gut microbiome of fish and shellfish: An overview,” *J. Anim. Physiol. Anim. Nutr. (Berl).*, vol. 106, no. 2, pp. 441–469, 2022, doi: 10.1111/jpn.13619.

[22] V. Hlordzi *et al.*, “The use of Bacillus species in maintenance of water quality in aquaculture: A review,” *Aquac. Reports*, vol. 18, p. 100503, 2020, doi: 10.1016/j.aqrep.2020.100503.

[23] A. R. Hodar, R. Vasava, N. H. Joshi, and D. R. Mahavadiya, “Fish meal and fish oil replacement for alternative sources: a review,” *J. Exp. Zool. India*, vol. 23, no. January, pp. 13–21, 2020, [Online]. Available: https://www.thepharmajournal.com/archives/2021/vol10issue9/PartI/10-8-322-305.pdf.

[24] S. A. Adimihardja, O. Sunardi, and Y. Mulyaningsih, “Pengaruh tingkat pemberian zpt gibberellin (Ga3) terhadap pertumbuhan vegetatif tanaman kangkung air (I*pomea aquatica* forsk l.) Pada sistem hidroponik floating …,” *J. Pertan.*, vol. 4, no. April, pp. 33–47, 2017, [Online]. Available: https://unida.ac.id/ojs/jp/article/view/546.

[25] Z. Hasan, Y. Andriani, Y. Dhahiyat, A. Sahidin, and M. R. Rubiansyah, “Pertumbuhan tiga jenis ikan dan kangkung darat (*Ipomoea reptans* Poir) yang dipelihara dengan sistem akuaponik,” *J. Iktiologi Indones.*, vol. 17, no. 2, p. 175, 2018, doi: 10.32491/jii.v17i2.357.

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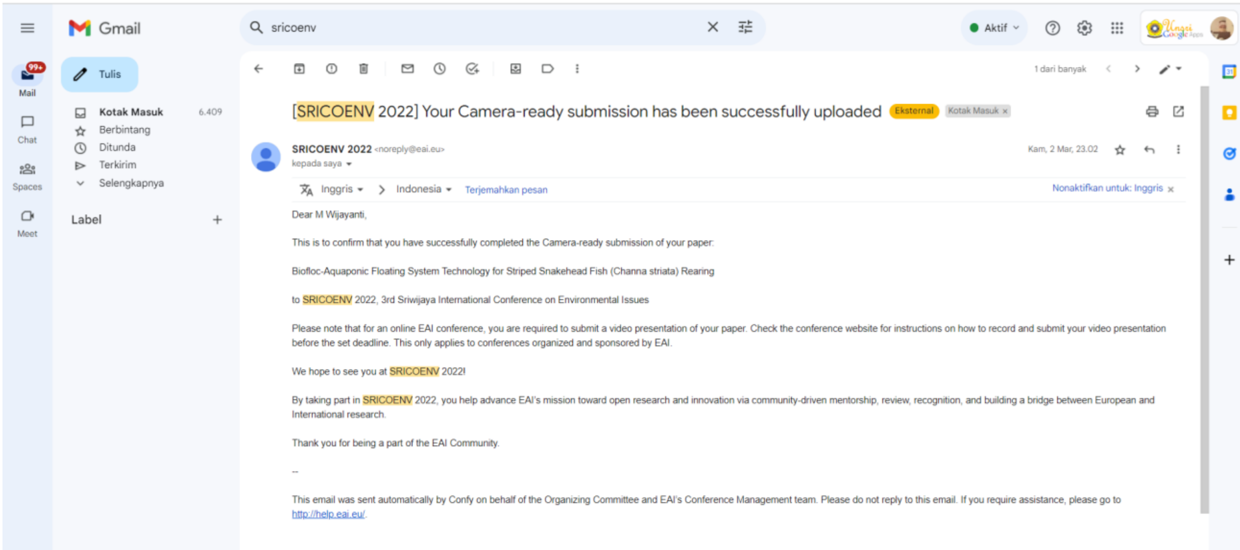

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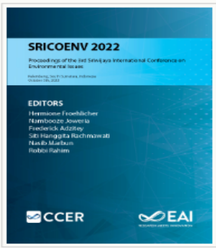

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