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Performance of Biofloc With Different Carbon Sources on the Growth of Catfish (*Pangasius* sp.)

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ABSTRACT

The purpose of this study was to determine differences in carbon sources on the growth of catfish (*Pangasius* sp). The research design used was a completely randomized design (CRD) with 3 treatments and 3 replications. The treatments used were tapioca flour, corn starch, and wheat flour with a dose of 2 g/l carbon source water, 0.01 ml/l probiotics, and 3 g/l salts. The research variables observed were the growth pattern of catfish (*Pangasius* sp), the number of floc volumes, and water quality. The results showed that the performance of bioflocs with different carbon sources resulted in different daily growth patterns of catfish in each treatment, where the highest daily growth pattern was in the 60th-day tapioca flour treatment reaching 1.96%/day, corn starch treatment 1.57 %/day, and wheat flour treatment 1.74%/day. The results of water quality measurements for each treatment were still in the optimal range for the life and growth of catfish. Ammonia reduction in tapioca flour treatment was 0.57 mg/l, corn starch treatment was 0.36 mg/l, while in wheat flour treatment there was no reduction in ammonia due to low temperature at the end of the study so it interfered with bacterial metabolism in assimilating nitrogen can still be tolerated by catfish (*Pangasius* sp).

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1. Introduction

Catfish (*Pangasius* sp) is one of the important fishery commodities in Indonesia (Meilisza, 2009). Catfish culture should be carried out effectively and appropriately, to increase the amount of production (Sutama et al., 2016). Catfish require feed with protein content reaching 28-30% and a feeding rate of 2-5% per day, but only 25% is converted into biomass and the rest is disposed of in the form of feces and urine waste which can reduce the quality of aquaculture water (Savitri et al., 2015). Decreased water quality due to increased ammonia can interfere with the growth rate of fish, degeneration of liver tissue, hyperplasia of the gills, and death (Yasin et al., 2021).

Biofloc technology is one of the aquaculture technologies, which can improve the water quality of the maintenance media by heterotrophic bacteria with the addition of a carbon source (Runa et al., 2019). Heterotrophic bacteria will utilize nitrogen in organic and inorganic forms under conditions of balanced C and N in water, so that it will form floc biomass and can reduce the concentration of N (De Schryver et al., 2008)

Increasing the C/N ratio in water can be done by increasing carbohydrates and reducing protein in the feed so that it will stimulate the growth of heterotrophic bacteria (Azim et al., 2007). Increasing the C/N ratio can also be done by adding a carbohydrate source in water (Avnimelech, 2007).

The selection of carbon sources needs to consider several factors, namely the digestibility of carbohydrates by bacteria, protein content, and the price of the carbon source used (Ekasari, 2009) Carbon sources added to water can be sugar, starch, alcohol, and fiber (Chamberlain et al., 2001). In addition, wheat flour, corn flour, tapioca flour, and sorghum can also be used as carbon sources (Ekasari et al., 2010).

2. Material and methods

This research activity was carried out from May to July 2022, at the Aquaponics Laboratory, Faculty of Animal Science and Fisheries, Nusa Cendana University, Kupang.

2.1 Material

The tools used in this study were aquariums, aeration equipment, scoops, cone tubes, blowers, scales, rulers, cameras, and water quality measuring instruments, namely pH meters, DO meters, and thermometers. The materials used were catfish seed (*Pangasius* sp) size 2.5-2.9 grams, water, carbon sources in the form of tapioca flour, corn starch and wheat flour, probiotic probiotics, feed, and salt.

2.2 Method

The research design used was a Completely Randomized Design (CRD) consisting of 3 treatments and 3 replications. The treatment applied in this study was the difference in the carbon sources used, namely tapioca flour, cornstarch flour, and wheat flour. The flour used in each treatment is 20% of the feed composition. The following is a table of feed composition used.

Tabel 1. Composition of fish feed in 3 treatments.

Materials	Composition (weight)
Tapioca or Cornstartch or Wheat	100 g
Fish meal	120 g
Blood meal	100 g
Soybean meal	200 g
Bran	250 g
Vitamin mix	50 g
Broth	80 g

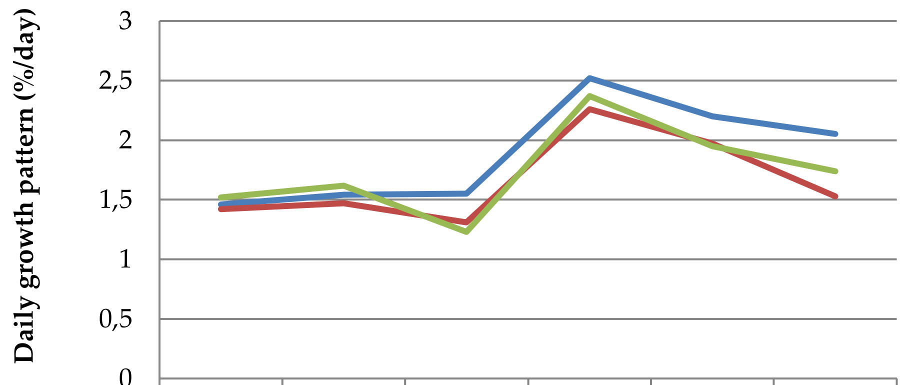
2.3 Analysis Data

The data obtained from the results of the research will be analyzed statistically using analysis of variance (ANOVA). If the results of the research show result that have a significant or highly significant (F count > F table) of 0.05, then proceed with the Tukey test.

3. Results and Discussion

3.1 Daily Growth

The daily growth pattern of catfish can be seen in the figure 1.



	H-10	H-20	H-30	H40	H-50	H-60
tapioca	1,46	1,54	1,55	2,52	2,2	2,05
cornstrach	1,42	1,47	1,31	2,26	1,97	1,53
wheat	1,52	1,62	1,23	2,37	1,95	1,74

Figure 1. Catfish daily growth.

Based on Figure 1, the daily growth pattern of catfish fluctuated (up and down) at the time of sampling. The daily growth pattern of catfish in all treatments experienced a significant increase from day 10 to day 40 of catfish rearing. This is due to bioflocs that have been well formed, and supported by optimal water quality on the day of rearing so that bioflocs can be used by fish as protein feed. According to Avnimelech, (2007) bioflocs are formed from various microorganisms such as phytoplankton, microbes, periphyton, and protozoa, which can be used as a food source for fish. Biofloc also contains protein (amino acids), vitamins, unsaturated fatty acids, and minerals that are beneficial for fish (Najdegerami et al., 2016). This is in line with research conducted by Wang et al., (2015) which stated that the crude protein content in biofloc reached 31.38% and was effectively utilized by carp as feed. The daily growth of catfish based on Figure 1 shows a decrease in the daily growth pattern on the 50th and 60th days. The decrease in the daily growth rate of catfish (*Pangasius* sp) was caused by the difference in the carbon source provided, this is following the statement of Wijaya et al., (2016) which stated that the difference in biofloc added to each treatment would produce different microorganisms that make up the biofloc both from diversity and quantity so that the resulting daily growth rate is different. The decrease in the daily growth rate of catfish was also caused by the low water temperature at the end of the study. The water temperature at the end of the study ranged from 22.03-22.76 °C. According to Kelabora, (2010), temperature changes can interfere with fish growth due to disturbances in the fish's digestive system. Furthermore, Wangni et al., (2019) stated that low temperatures affect the appetite of fish to be low, and the digestive process in fish becomes slow, which results in slow fish growth.

The figure 1 shows that the daily growth rate in treatment A (tapioca flour) was higher, followed by treatment C (wheat flour) and treatment B (cornstarch flour). This is because the number of carbohydrates that make up these three types of carbon sources is different. In addition, the reaction speed of tapioca flour and wheat flour is used by bacteria more quickly, compared to corn starch flour, because it takes longer to break down and use and has a lumpy and sticky texture when mixed with water (Erlangga et al., 2021).

3.2 Floc volume

The average floc volume during the study period can be seen in the table 2.

Table 2. Floc volume.

Treatment	Floc volume (ml/l)					
	H-10	H-20	H-30	H-40	H-50	H-60
Tapioca flour	18.33	36.33	48.33	58.33	65	63.33
Cornstrach flour	16.66	31.66	45	48.33	61.66	60
Wheat flour	15	25	46,66	50	63.33	61.66

Based on table 1, the volume of floc in each treatment increased until the end of the study. The increase in the volume of the flock was caused by the addition of a carbon source and the addition of artificial feed into the water so that heterotrophic bacteria were used to form flocks, which resulted in an increase in the total volume of the floc during the rearing period. The increase in the number of floc volumes increased until the 50th day and slightly decreased on the 60th day. The decrease in floc volume on day 60 was caused by a decrease in temperature at the end of the study, thus disrupting the metabolism of bacteria in forming flocs. A good floc volume range according to Khanjani & Sharifinia, (2020) is in the range of 50 ml/l.

This study used a commercial probiotic, namely probio7 which contains the bacterium *Bacillus subtilis* which is one of the bacteria capable of forming flocs. This is following the statement of Aiyushirota, (2009), bacteria capable of forming bioflocs are *Bacillus subtilis, Bacillus cereus, flavobacterium, Zooglea ramigera, Pseudomonas alcaligenes, tetrad,* and *tricoda.* Furthermore, Feroza et al., (2021) stated that the addition of probiotics in the rearing media, can increase the number of bacterial populations, so that nutrition and flock volume increase. The formation of bioflocs needs to pay attention to several factors, namely strong agitation, minimal water change close to zero, and an increase in the C/N ratio.

3.3 Water Quality

Water quality has an important role in increasing fish farming production because good water quality affects the success of aquaculture activities (Azhari & Tomasoa, 2018). The results of water quality measurements during the maintenance period of catfish (*Pangasius* sp) can be seen in table 3.

Table 3. Water quality. (*SNI: 01 – 6483.1, (2000).

Parameter	Treatment			*
	Tapioca	cornstratch	wheat	
Temperature (°C)	23.13-28.96	22.76-28.8	23.03-28.9	27-30
DO (mg/l)	5.26-7.6	5.33-7.76	5.3-7.26	> 5
pH	8.06-8.76	8.1-8.76	8.03-8.7	6.5-8.5

One of the water quality parameters that have an important role in aquaculture activities is temperature. Based on the results of the analysis of variance ANOVA, the difference in carbon sources has no effect on water temperature with a sig value of > 0.05 (0.14 > 0.05).

The water temperature during the maintenance period ranged from 23–28 °C. Water temperature affects floc formation in a certain range (Runa et al., 2019). In addition, water temperature also has a relationship with fish growth. Warm water temperatures will increase the growth rate of fish, because it increases the activity of digestive enzymes, thereby accelerating the digestion of nutrients and faster fish growth (Ridwantara et al., 2019). At the end of the study, the water temperature decreased to 22.76 °C due to cloudy and rainy weather towards the end of the study. Catfish can still tolerate low temperatures, but low temperatures will affect appetite, metabolic processes, and fish growth rates (Wangni et al., 2019).

Dissolved oxygen (DO) during the catfish rearing period in all treatments, ranged from 5-7 mg/l. Based on the results of the analysis of variance ANOVA, the difference in the carbon source provided did not affect dissolved oxygen with a sig value > 0.05 (0.86 > 0.05). During the maintenance period, dissolved oxygen was always in the normal range due to the availability of aeration in each treatment. Dissolved oxygen during the maintenance period decreased until the end of the study but was still at a safe limit for catfish rearing, namely > 5. The decrease in dissolved oxygen was thought to be due to the rate of dissolved oxygen consumption by fish and bacteria. The need for dissolved oxygen in the biofloc system will increase, because of the high heterotrophic bacteria in the water (Ekasari, 2009). Aeration stirring must be considered to support floc growth because dissolved oxygen plays an important role in the growth of heterotrophic bacteria (Avnimelech, 2007).

The pH value in each treatment showed results that were not different between treatments, with a range of 7-8.5, and was still in the optimal range for the life of catfish. Based on the results of the ANOVA analysis of variance, the effect of differences in carbon sources did not affect pH with a sig value > 0.05 (0.75 > 0.05). The optimum pH range supports bacterial activity in forming bioflocs (Luo et al., 2013). A pH value that is not by the life requirements of catfish can cause fish growth to be not optimal (Bokings et al., 2016). The increase in organic matter and the presence of bacterial activity in the water resulted in a decrease in the pH value, along with the length of maintenance time (Sukenda & Haris, 2006).

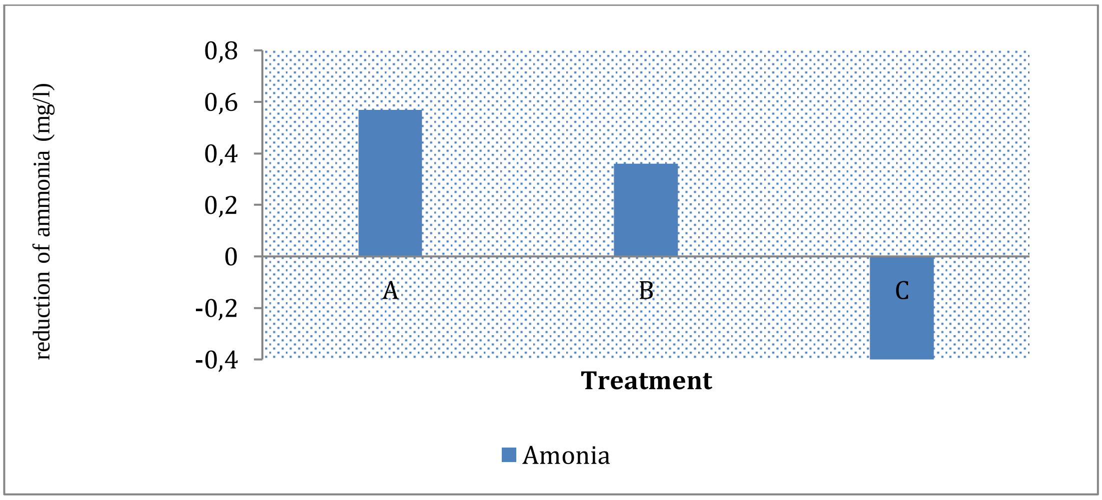


Figure 2. The reduction of ammonia

Based on Figure 2, the reduction of ammonia occurred in the treatment of tapioca flour (A), and treatment of corn starch flour (B), with a decrease in ammonia of 0.57 mg/l (A) and 0.36 mg/l (B), while in the treatment of wheat flour (C) the ammonia content increased at the end of the study, which indicated that there was no reduction in ammonia in the treatment of wheat flour. Ammonia reduction in the treatment of tapioca flour and corn starch treatment showed that the increase in C/N in water with the addition of a carbon source was able to reduce the concentration of ammonia in water. Ammonia reduction occurs because heterotrophic bacteria utilize ammonia to form proteinaceous biomass. Heterotrophic bacteria can utilize organic and inorganic nitrogen, to improve water quality (Ekasari, 2009). Research conducted by Azim et al., (2007) showed that the C/N ratio in the rearing medium reached 10:1 so that the biofloc microorganisms were able to assimilate 0.2 g nitrogen/m2/day nitrogen. Furthermore, research conducted by Wang et al., (2015), showed that the ammonia content in carp culture was reduced at a C/N ratio greater than 15:1. Assimilation of nitrogenous waste by heterotrophic bacteria in biofloc systems provided with a carbon source can produce nutritious feed that can increase the growth of organisms (Crab et al., 2012).

The increase in ammonia in the treatment of wheat flour was caused by the low temperature towards the end of the study, which affected the bacterial activity which became slower (Wahyuningsih & Gitarama, 2020). The reduction of ammonia in the treatment of tapioca flour and corn starch showed a breakdown of nitrogen waste by bacteria, while the increase in ammonia levels in the treatment of wheat flour was thought to be due to the absence of reshuffle by bacteria, this is by the opinion of Apriani et al., (2016) which stated that in Under conditions of low nitrite and high nitrate, bacteria do not remodel nitrogenous waste, while under conditions of low nitrite and nitrate with the addition of a carbon source, bacteria will remodel inorganic nitrogen.

4. Conclusion

The addition of a carbon source of tapioca flour, corn starch flour, and wheat flour can increase the daily growth of catfish because biofloc contains protein that is beneficial for fish. The amount of floc volume increased during the maintenance period and was still in the optimal range. In addition, the addition of carbon sources does not affect the quality of aquaculture water, but the quality of aquaculture water is still in the optimum range for the growth of catfish. Ammonia values in the treatment of tapioca flour and corn starch were reduced by 0.57 mg/l, and 0.36 mg/l, while in treatment C there was no reduction in ammonia, due to the low temperature at the end of the maintenance and the effect on bacterial activity.

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