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The Effect Giving of Probiotics in Water on Feed Efficiency and Water Quality for Aquaculture Tilapia (*Oreochromus niloticus*)

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Abstract:
This study aims to determine the effect of giving probiotics to water on the value of Feed Conversion Ratio (FCR), feed efficiency, and water quality of tilapia (Oreochromus niloticus) aquaculture. This is an experimental research with 4 treatments and 3 replications. The treatments tried were:

- *Treatment K: Without Probiotics,*
- *Treatment A: given probiotics at a dose of 1 ppm,*
- *Treatment B: given probiotics at a dose of 1.5 ppm, and*
- *Treatment D: given probiotics at a dose of 2 ppm*

The results showed that the water-given probiotics had an effect on the FCR value of the feed and the feed efficiency of tilapia, where the higher the dose of probiotics given, the smaller the FCR value, likewise with the value of feed efficiency, where the higher the dose of probiotics in tilapia rearing water, the higher the value of feed efficiency. The results of water quality measurements, such as temperature, pH, and ammonia, all of these water quality parameters still meet the requirements for the growth of tilapia.

Keywords: *Probiotics, FCR, feed efficiency, tilapia, water quality*

1. Introduction

Tilapia is a commodity that has very important economic value, and tilapia has several advantages, including being easily cultivated and liked by consumers (Kordi, 2015). Various additional ingredients are needed to maintain the survival and growth of tilapia, such as giving probiotics. According to Utama (2020), cultivating tilapia with the addition of probiotics can be a solution to maintain water quality because it contains nitrites to turn into nitrates so that they can be utilized and not poison the fish being cultivated.

Giving probiotics in the aquatic environment is expected to increase the immune response of fish against disease, improve the digestive system of fish, and improve water quality because it can change toxic compounds into non-toxic ones, such as ammonia and nitrite compounds through the nitrification process (Ghouse, 2015), increase survival and can increase the growth rate of fish so that it can support increased production (Suryaningrum, 2012). The use of probiotics in fish farming aims to maintain microbial balance and control pathogens in the digestive tract, water, and aquatic environment through biodegradation processes (Mansyur & Tangko, 2008).

The use of probiotics is an internal solution to produce optimal growth and feed efficiency, reduce production costs and ultimately reduce the environmental burden due to the accumulation of waste in waters (Iribarren *et al*., 2012). Irianto (2003) states that probiotics can regulate the microbial environment in the gut and inhibits pathogenic microorganisms in the intestine by releasing enzymes that help digest food. One of the bacteria that is believed to be able to increase the digestibility of fish is *Bacillus* sp.

According to Fuller (1987), probiotics are additional food (supplements) in the form of live microbial cells, which has a beneficial effect on the host animal that consumes it by balancing its intestinal microbial flora. Furthermore, Salminen *et al*. (1999) state that probiotics are all forms of microbial cell preparations (not necessarily live) or components of microbial cells that have beneficial effects on the health and life of the host. Based on this definition, Irianto

(2003) defines that probiotics are the supplementation of intact (not necessarily live) microbial cells or components of microbial cells in the feed or their living environment, which benefit the host.

Commercially, probiotics are currently being produced, especially those used for freshwater fish. However, because many species of fish are cultivated, and they have different eating habits as well as the ability to produce enzymes such as digestive enzymes protease, lipase, and amylase, it is necessary to conduct a study related to the effectiveness of these commercial probiotics (Setiawati *et al*., 2013). Nayak (2010) states that probiotics are used to increase aquaculture production, increase resistance to disease, and help in increased growth. Good growth is due to good maintenance of water environmental conditions. This is because the microbes from probiotics can help improve water conditions.

In addition to giving probiotics, the aspect of fish aquaculture plays a very important role in the quality of fish feed. Fish will grow if the feed nutrients that are digested and absorbed by the fish's body are greater than the amount needed to maintain their bodies (Lovell, 1989). This will happen if the supporting factors are in optimal conditions; it is different if the supporting factors, for example, the temperature is below the limit that can be tolerated by fish, then the food eaten is only used to defend itself to live, not to grow and develop.

2. Research Purposes

The purpose of this study was to determine the effect of giving probiotics to water on the value of Feed Conversion Ratio (FCR), feed efficiency, and water quality of tilapia aquaculture (*Oreochromus niloticus*).

3. Method

This is an experimental research using a completely randomized design with 4 treatments and 3 replications. The treatments tried were Treatment K: Without Probiotics; Treatment A: given probiotics at a dose of 1 ppm; Treatment B: given probiotics at a dose of 1.5 ppm of water and Treatment D: given probiotics at a dose of 2 ppm.

Water quality testing uses several test methods to obtain data. Tests were carried out in situ and ex-situ in the field. The procedure in this study was to use 12 basins with a size of 39 cm x 31 cm x 12 cm. The basin is cleaned first and brushed clean then the basin is dried in the sun. After the basin is dried, it is filled with clean water taken from the research site. Each basin is labeled according to what is specified, and each is given aeration.

The data collection technique used in this study is a data collection technique where researchers make direct observations of the object to be studied. The observations used in this research have been systematically planned. The data collected include: FCR data, feed efficiency, and water quality. The data analysis technique used in this study is the analysis of variance.

4. Results and Discussion

4.1. Feed Conversion Ratio (FCR)

Feed conversion ratio is the amount of feed needed to produce additional body weight. Feed conversion is used to determine the quality of feed given to fish growth. A low conversion ratio indicates that food can be utilized better in the body and the quality is better because the same amount of feed can gain higher body weight (Sulawesty *et al*., 2014) *in* Qolbiyah (2021). Barrows and Hardy (2001) explained that the value of the feed conversion ratio is influenced by food protein. Food protein that matches the nutritional needs of fish produces a more efficient feed. In addition, it is influenced by the amount of food given. If less food is given, there will be more efficient feeding.

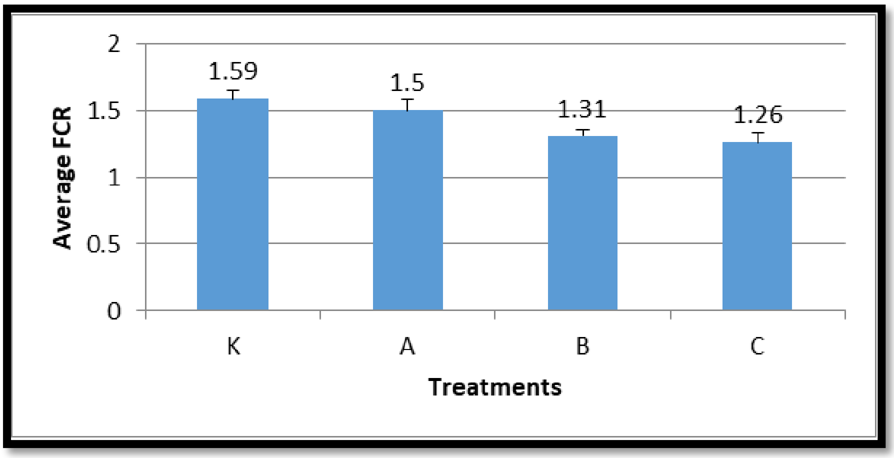

Figure 1: FCR Value of Tilapia Feed Given Probiotics

Figure 1 shows the FCR value of feed on rearing tilapia treated with probiotics in water showed the highest value in treatment K is 1.59, then followed by treatment A is 1.5, treatment B is 1.31, and the treatment with the lowest FCR value in treatment C with a value of 1.26. Thus, it can be said that the higher the dose of probiotics, the lower the value of FCR, which means that the feed is more efficiently used by tilapia. Irianto (2003) explained one of the factors that influence the success of probiotic products in increasing growth and feed efficiency in fish, namely the presence of probiotic bacteria in the digestive tract of fish.

These FCR results are still lower than the research conducted by Fitri (2022), who made observations for 42 days of rearing fish. Feed conversion range during rearing ranged from 1.32-1.78. However, the FCR value in this study is still higher than the results of research conducted by Ihsanudin *et al*. (2014), where the results of the feed conversion ratio (FCR) of larasati tilapia for 63 days of rearing obtained the best FCR value of 0.68. Kordi (2010) stated that tilapia has omnivorous characteristics (eating both plant and animal). Therefore, the cultivation business is very efficient, with low feed costs with a fairly good FCR value ranging from 0.8-1.6. The lower the value of the feed ratio, the better the quality of the feed given.

The results showed that the decrease in feed efficiency was thought to be due to the narrower space for fish movement with increasing stocking density, thereby affecting feed competition and the physiological conditions of fish (Fitri, 2022). Probiotics enter the intestines of fish and then help the digestive process so that digestion increases. The digestibility of feed increases, then the feed will be more efficiently used by fish because feed nutrients will be easily absorbed by the body, which in turn will increase protein retention due to the absorption of feed nutrients (Setiawati *et al*., 2013). Probiotics can act as immunostimulants, increase feed conversion ratios, has the ability to inhibit the growth of pathogenic bacteria, produce antibiotics, and improve water quality (Watson *et al*., 2008). Nayak (2010) states that from several studies conducted, probiotics are used to increase aquaculture production, Increases resistance to disease, and helps in increased growth.

The results of the Anova test show the sig. 0.001, which means that the treatment of probiotics in tilapia-rearing water has an effect because it is smaller than 0.005. The results of the next test, the results of the F test, showed the F-Count value was 16.129, while the F-Table value was at the 95% or 0.05 level, namely 4.26, and at the 99% level or 0.01, namely 8.02. Thus, it can be stated that the provision of treatment in the form of giving probiotics to water in tilapia culture has a very real effect because the F-count value is greater than the F-table, both at the level of 95% and 99%.

4.2. Feed Efficiency

Feed efficiency is obtained from the results of a comparison between body weight gain and the amount of feed spent during the rearing period. The value of feed efficiency is related to the growth rate because the higher the growth rate, the greater the body weight gain of the fish and the greater the value of feed efficiency (Setiawati *et al*., 2013). A feed is not only seen from the feed conversion value but it can also be seen from the value of feed efficiency. The value of feed efficiency is obtained from the results of a comparison between the body weight gain of the fish and the amount of feed consumed by the fish during the rearing period. The greater the feed efficiency value, the more efficient the fish are in utilizing the feed consumed for their growth (Iskandar & Elrifadah, 2015).

Barrows and Hardy (2001) stated that the value of the feed conversion ratio is influenced by feed protein. Feed protein that matches the nutritional needs of fish produces a more efficient feed. In addition, it is influenced by the amount of feed given; the less amount of feed given, the more efficient the feed. Giving different doses of probiotics can have a significant effect on feed efficiency. This shows that the use of feed and the role of probiotics is more efficient (Setiawati *et al*., 2013).

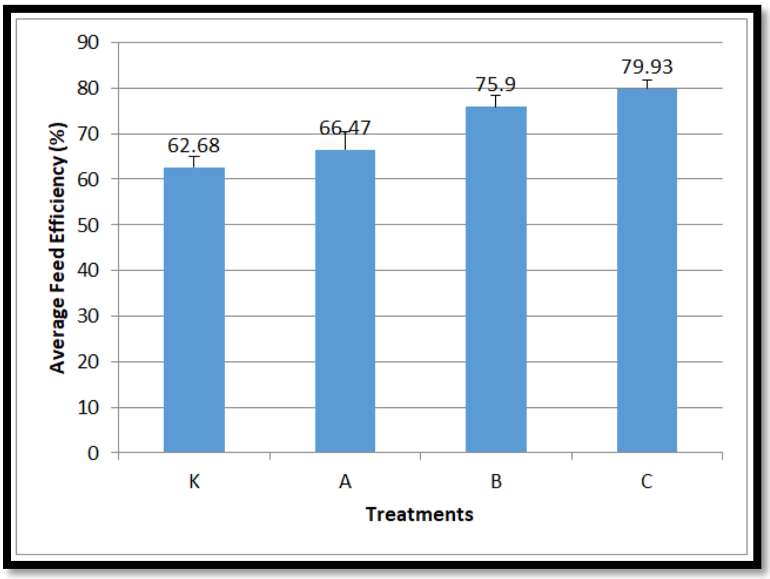

Figure 2: Efficiency Value of Tilapia Feed Given Probiotics

Figure 2 shows that the value of feed efficiency during the study was in the range of 62.68-79.93%, with the highest feed efficiency value obtained in treatment C, which is 79.93%, followed by treatment B, which is 75.9%, treatment A which is 66.47% and the lowest in the Control which is 62.68%. This means that the higher the dose of probiotics in tilapia-rearing water, the higher the value of feed efficiency.

However, the results of this study are still lower than the results of research conducted by Iskandar and Elrifadah (2015), who found that the efficiency value of the tested fish feed ranged from 89.65-90.26%. Djajasewaka (1986) in Santoso and Veroka (2011) states that the value of feed efficiency is inversely proportional to feed conversion and directly proportional to the increase in fish body weight, so the higher the feed efficiency value, the lower the feed conversion value so that fish are more efficient in utilizing the feed consumed for their growth.

The results of the ANOVA analysis show the sig. is 0.000, which is smaller than 0.005, and this means that the treatment of probiotics in tilapia aquaculture water has an influence on the efficiency value of fish feed utilization. Furthermore, after the T-Test was carried out, it showed that the F-count value was 24.995 and was greater than the F-Table value at the 95% confidence level or 0.05, which was 4.26 and at a confidence level of 99% or 0.01 is 8.02 which means that the treatment of probiotics in tilapia rearing water has a very significant effect on the efficiency value of fish feed.

4.3. Water Quality

Water quality is an important factor in aquaculture because it is not only a place for fish to live but also for all life existing in these waters. There are many ways to improve water quality. Good water quality can be maintained by giving probiotics to fish-rearing water (Khotimah *et al*., 2016). Management of water quality for aquaculture purposes is very important because water is a place for aquaculture organisms to live (Mulyanto, 1992 *in* Aquarista *et al*., 2012). Water quality is an important factor in fish farming, where water is a place for fish to live, which can determine the growth and life of fish.

Poor water quality can cause stunted growth and reduce the adaptability of fish, causing fish to die. Conversely, water conditions that are in accordance with the needs of fish will support their growth and survival. Water quality can be known by observing water quality parameters (Thaiin, 2016). According to Fitriah (2004), changing water conditions will cause stress for fish and physiological disturbances that can inhibit metabolic processes and result in decreased fish appetite.

4.3.1. Temperature (°C)

Temperature is a physical parameter of a body of water. Water temperature greatly influences the chemical and biological processes of water (Djunaedi, 2016). Temperature affects the life and growth of aquatic biota. High-temperature changes can kill cultivated biota due to changes in blood-carrying capacity (Kordi & Ghufron, 2009).

4.3.1.1. Water Temperature in the Morning (°C)

Figure 3 shows that the temperature of tilapia aquaculture water during the study for all treatments was in the range between 25.10 and 25.2°C. The results of this study are different from the results of research conducted by Ihsanudin *et al*. (2014), with the results of temperature measurements obtained at 26.8-28.30C, which is a good temperature range for the survival of tilapia.

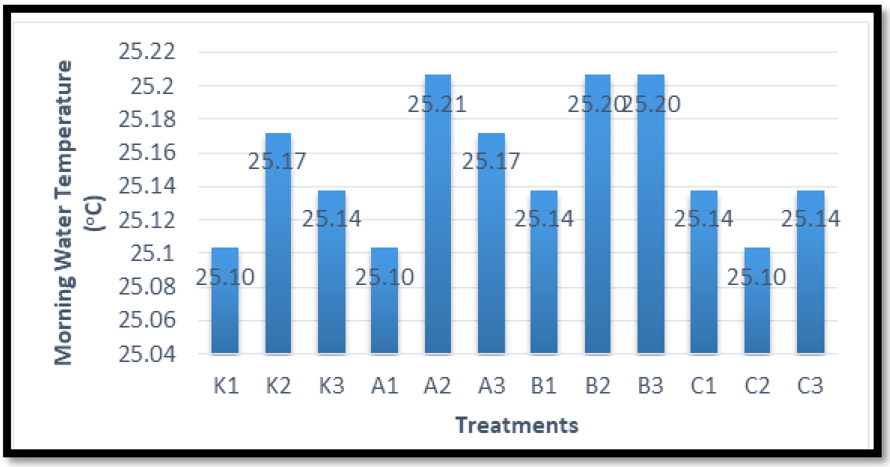

Figure 3: Fish Rearing Water Temperature in the Morning during the Study (°C)

The ideal temperature for tilapia to survive ranges from 14 to 38°C. The optimum temperature for the growth of tilapia ranges from 25 to 30°C (Amri & Khairuman, 2007). Thus, the temperature of tilapia aquaculture water during this study was still in the appropriate temperature range for tilapia aquaculture.

4.3.1.2. Water Temperature in the Afternoon (°C)

Figure 4 shows that the ideal temperature of tilapia aquaculture water in the afternoon ranges from 27.2-27.5°C. Rahardi (1996) in Iskandar and Elrifadah (2015) states that the ideal conditions for fish to live are in the range of 25-30°C with a temperature difference between day and night of no more than 5°C.

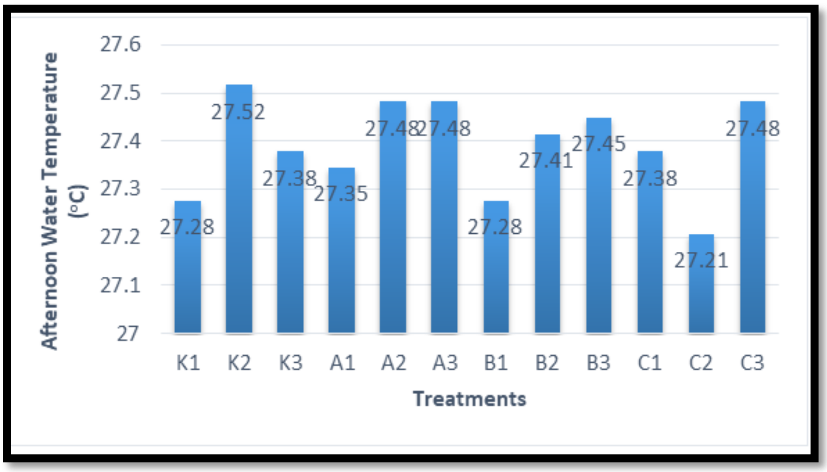

Figure 4: Fish Rearing Water Temperature in the Afternoon during the Study (°C)

4.3.2. pH

Power of Hydrogen (pH) is the negative logarithm of the hydrogen ion concentration. Pure water at 25 °C has a pH of 7, an acidic dead point at pH 4, while the base dead point is at pH 11 (Boyd, 1982) in Admawati (2014). The effect of pH generally causes stress in fish. The ability of water to withstand changes in pH is likely to be more important than the pH value itself in relation to the presence of carbonates, bicarbonate, and hydroxide. Water with low hardness has a low ability to withstand increased acidity (Boyd, 1982). At pH 8, free carbon dioxide and carbonic acid are no longer found. Only bicarbonate ions are present (Effendi, 2003). Daily pH fluctuations in the pond are influenced by the process of photosynthesis and the respiration of biota. In the afternoon, the pH value will increase due to the influence of the photosynthesis process. When the pH value is high, and the water temperature conditions are warm in the afternoon, ammonia will dominate these waters. The higher the pH value, the level of ammonia toxicity will increase (Hargreaves & Tucker, 2004).

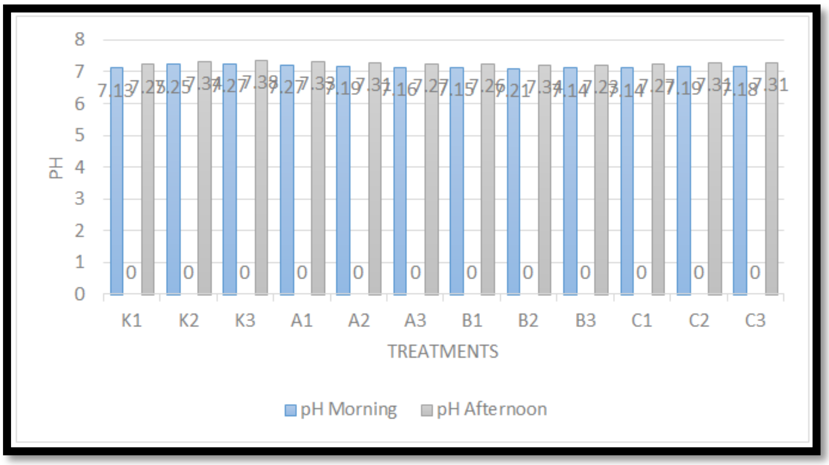

Figure 5: Fish Rearing Water pH during the Study

The pH values of tilapia aquaculture water during the study in the morning were in the range of 7.13-7.26, and in the afternoon were in the range of 7.23-7.38 (Figure 5). The value of this pH range is still relatively the same as the results of research conducted by Iskandar and Elrifadah (2015), namely the degree of water acidity (pH) during rearing ranges from 7.10 to 7.27.

According to Susanto (1999) in (Iskandar and Elrifadah (2015), in general, the pH, which is very suitable for all types of fish, ranges from 6.7 to 8.6. Thus the range of water pH during the rearing period of tilapia is still included in a good range for the survival of tilapia. The pH value in water has a significant influence on aquatic organisms, so it is often used as a guide to state whether water is good or bad. The growth of cultivated fish seeds will be optimal in the range of pH 7-8 (Kordi & Ghufron, 2009).

4.3.3. Ammonia (ppm)

Figure 6 shows that the highest ammonia content in water treated with probiotics during the study is obtained in treatment A, which is 0.0043 ppm, followed by treatment B, which is 0.0036 ppm, treatment K, which is 0.0031 ppm, and the lowest ammonia in treatment C is 0.0015 ppm. Thus, it can be stated that the higher the dose of probiotics given to the water media for tilapia cultivation, the lower the ammonia content will be.

The results of measuring the ammonia content in tilapia aquaculture in this study were almost the same as the ammonia content from a study conducted by Khotimah *et al*. (2016), who conducted research on *Pangasius djambal*, namely in the normal range ranging from 0.003-0.012 ppm.

In line with Fuller's opinion (1987 *in* Febriani and Rietje, 2008), probiotics in aquaculture have a role, among others, to regulate microbiological conditions in the water or sediment to improve the quality of fish-rearing water to increase the survival and growth of the fish. Probiotics themselves are additional food supplements in the form of live microbial cells, which have a beneficial effect on the host animal that consumes them by balancing the microbial flora (Khotimah *et al*., 2016).

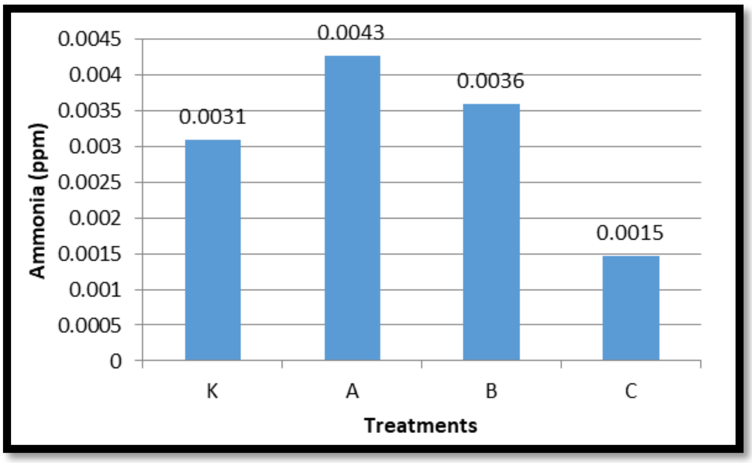

Figure 6: Fish Rearing Water Ammonia during Research

The results of the ANOVA test showed that if probiotics were given to the aquaculture water, it had a significance value of 0.450, which meant that the probiotic treatment had no effect on the value of ammonia in the water. The results of the F-test calculation show that the F-Table at a confidence level of 0.05 is 4.26 and a confidence level of 0.01 is 8.02 while the F-Count is 0.978, which means that the treatment of giving probiotics to tilapia aquaculture water does not significantly affect the value ammonia in water because the T-count value is smaller than the T-table value, both the confidence level is 0.05 and 0.01%. Beauty et al. (2012) added that probiotic bacteria would decompose useless and toxic organic materials and reduce the total levels of ammonia in the waters.

5. Conclusion

The results showed that the provision of probiotics affected the value of the Feed Conversion Ratio (FCR) of tilapia feed, namely, the higher the dose of probiotics given to tilapia culture water, the lower the FCR value. Likewise with the value of feed efficiency, namely, the higher the dose of probiotics in tilapia rearing water, the higher the value of feed efficiency, so that the fish more efficiently utilize the feed consumed for growth and survival. Based on the measurement results of water quality parameters such as temperature, pH, and ammonia, it can be stated that all of these water quality parameters still meet the requirements for the growth and survival of tilapia.

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