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EFFECT OF DIETARY PROBIOTIC SUPPLEMENTATION ON GROWTH PERFORMANCE, SURVIVAL RATE, AND CONDITION FACTOR OF RED NILE TILAPIA (*Oreochromis niloticus* L.)

Pengaruh Penambahan Probiotik Pada Pakan Terhadap Kinerja Pertumbuhan, Kelangsungan Hidup dan Faktor Kondisi Ikan Nila Merah (*Oreochromis niloticus* L.)

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ABSTRACT

Red Nile Tilapia (*Oreochromis niloticus* L.) is one of the important commodities in aquaculture, possessing high economic value and promising prospects for supporting the economy and food security. Various efforts have been made to increase fish production, one of which is through the use of feed additives. Probiotics have been widely used in aquaculture, either as a feed supplement or applied directly to the culture media. This study aims to compare the growth, survival rate, and condition factor of Red Nila Tilapia fed with probiotic-supplemented feed and those without probiotics. The study was conducted over 84 days using Red Nila Tilapia measuring 6.8 cm, stocked in earthen ponds at a density of 10 fish/m². The results showed that Red Nila Tilapia fed with probiotic-supplemented feed had a higher growth performance compared to those without probiotics. The average daily growth rate and survival rate of fish given probiotics were 2.06 g/day and 87%, respectively, whereas fish without probiotic supplementation had 1.70 g/day and 84%. Conversely, fish fed with probiotics exhibited a condition factor of 1.06, which was lower than the 1.69 recorded in fish without probiotics. The findings of this study indicate that probiotics can be used as a feed additive for Red Nile Tilapia, providing positive effects on growth, survival rate, and fish health.

Keywords: Aquaculture, Culture Performance, Feed Additive, Functional Feed

ABSTRAK

Ikan nila merah (*Oreochromis niloticus* L.) merupakan salah satu komoditas penting dalam akuakultur yang memiliki nilai ekonomis tinggi serta prospek yang menjanjikan dalam mendukung ekonomi dan ketahanan pangan. Berbagai upaya telah dilakukan untuk meningkatkan produksi ikan budidaya, salah satunya dengan penggunaan tambahan pakan.

Probiotik telah banyak digunakan dalam akuakultur, baik sebagai campuran pakan maupun diaplikasikan langsung pada media budidaya. Penelitian ini bertujuan untuk membandingkan pertumbuhan, tingkat kelangsungan hidup, dan faktor kondisi ikan nila merah yang diberi pakan dengan penambahan probiotik dan tanpa probiotik. Penelitian ini dilakukan selama 84 hari menggunakan ikan nila merah berukuran 6,8 cm, yang ditebar pada kolam tanah dengan kepadatan 10 ekor/m². Ikan nila merah yang diberi pakan dengan penambahan probiotik memiliki pertumbuhan yang lebih tinggi dibandingkan dengan ikan tanpa probiotik. Rata-rata pertumbuhan harian dan tingkat kelangsungan hidup ikan nila merah yang diberi probiotik masing-masing adalah 2,06 gram/hari dan 87%, sedangkan pada ikan tanpa penambahan probiotik masing-masing sebesar 1,70 gram/hari dan 84%. Sebaliknya, ikan nila merah yang diberi probiotik menunjukkan faktor kondisi sebesar 1,06, lebih rendah dibandingkan dengan ikan tanpa probiotik yang memiliki faktor kondisi 1,69. Hasil penelitian ini menunjukkan bahwa probiotik dapat digunakan sebagai bahan tambahan dalam pakan ikan nila merah dengan dampak positif untuk meningkatkan pertumbuhan, tingkat kelangsungan hidup, dan kesehatan ikan.

Kata Kunci: Akuakultur, Pakan Fungsional, Performa Budidaya, Tambahan Pakan

INTRODUCTION

Tilapia is one of the fish with high economic value and good nutritional content, making it a leading commodity in fisheries cultivation in Indonesia. Tilapia production in 2019 reached 1,317,559 tons and increased by 3.87% to 1,368,542 tons in 2023 (KKP, 2024). The high interest of farmers in tilapia is due to its various advantages, such as ease of maintenance in various media, simple production and breeding processes, the ability to be cultivated at high densities, good adaptation to extreme environments, relatively fast growth, and thick meat with a savory taste and high selling value (Rozal *et al.*, 2021; Putra *et al.*, 2022; Pane *et al.*, 2023; Thalib *et al.*, 2023; Liana *et al.*, 2024). The high market demand for tilapia encourages farmers to implement various strategies to increase their production. One of the main aspects in cultivation that needs to be considered is feed. According to Riswan *et al.*, (2020), feed is the component with the largest cost in tilapia cultivation, reaching 35–60% of the total production cost. Therefore, good feed management is the key to success in tilapia cultivation. The availability of sufficient and high-quality feed is very important to support optimal growth, because it functions as the main source of energy that allows fish to survive, develop, and achieve maximum growth (Mirna & Tahir, 2023; Hidayat *et al.*, 2024). In addition, the use of additional feed or feed additives can also be applied as a strategy to increase the efficiency of tilapia growth (Hutabarat *et al.*, 2024).

Imune-nutrition is a cultivation strategy that optimizes growth through the use of high-quality feed while improving the fish's immune system (Abadi *et al.*, 2023). The availability of high-quality feed is a major factor in supporting optimal growth, reducing the feed conversion ratio, and increasing the survival of tilapia. One way to achieve this is to increase the stimulation and digestibility of feed through optimization of fish digestive enzymes, which can be supported by the addition of feed additives such as probiotics (Riswan *et al.*, 2020; Hidayat *et al.*, 2024).

Probiotics are living microbes that are beneficial to fish by increasing the population of good microbes in the digestive tract, thereby supporting fish health and growth. In addition, probiotics also play a role in maintaining pond water quality, preventing and overcoming disease attacks, and increasing fish productivity so that they can be harvested faster (Ariwinata *et al.*, 2021; Pangaribuan *et al.*, 2022). Probiotics have been widely used in aquaculture activities because they have various positive impacts on fish and are generally applied through water and feed media. Kore *et al.*, (2022) reported that the use of probiotics with the mixing

method in feed gave better results compared to direct administration into the cultivation media or through the immersion method. The use of probiotics in fish feed has been shown to improve growth performance, including absolute length, absolute weight growth, and feed conversion ratio in snakehead fish (*Channa striata*) (Lestari *et al.*, 2022; Ibrahim *et al.*, 2023). Similar results were also found in the application of probiotics in Pearl catfish (*Clarias gariepinus*) feed, where the addition of probiotics did not have a negative impact on the fish, and even increased growth performance and feed efficiency (Rarassari *et al.*, 2021; Purba *et al.*, 2023). Linayati *et al.*, (2021) also reported that the addition of probiotics to feed can increase the growth of milkfish (*Chanos chanos*). In addition, probiotics can be applied symbiotically with other ingredients such as banana stems (*Musa paradisiaca*) (Akbarurrasyid *et al.*, 2021) and forest onion flour (*Eleutherine bulbosa*) (Indah *et al.*, 2022).

Probiotics have also been widely used in tilapia cultivation. Telaumbanua *et al.*, (2023) reported that the addition of probiotics containing microorganisms to the cultivation medium can provide various benefits, such as improving the quality of aquaculture water, increasing fish growth rates, suppressing pathogenicity, and reducing the feed conversion ratio. Other studies have shown that the administration of probiotics to the cultivation medium not only increases growth but also increases the survival of tilapia (Apriyan *et al.*, 2021; Mjenise *et al.*, 2024). Riswan *et al.*, (2020) also reported that the administration of probiotics in feed has a positive effect on the growth and survival of tilapia during the rearing stage. Tilapia seeds fed with additional papaya seed flour and probiotics showed better absolute weight and absolute length growth compared to fish without probiotic treatment (Hidayat *et al.*, 2024). However, the effect of probiotic use on the condition factors of red tilapia being cultivated is still widely reported in various ways. Therefore, this study was conducted to determine the effect of probiotic use on growth performance, survival rate, and condition factors of red tilapia (*Oreochromis niloticus* L.) cultivated in earthen ponds.

METHODS

Research Location

This research was conducted at the Fish Cultivation Laboratory, State Secondary Fisheries Business School (SUPM) Kotaagung, located on Jalan Pantai Harapan, Way Gelang, Kotaagung District, Tanggamus Regency, Lampung Province.

Tools and Materials

The tools used in this study include: (a) 2 units of 200 m² earthen ponds for fish maintenance; (b) feeding equipment, namely buckets and feed ladles; (c) scales for weighing fish, feed, fertilizer, and lime; (d) scoops and buckets for catching fish; (e) nets for sampling fish; (f) measuring cups and trays for mixing feed with probiotics. The materials used in this study include red tilapia seeds, floating pellet feed, granulated sugar, lime, organic fertilizer, and probiotics. The types of probiotics used contain several types of microorganisms, namely *Saccharomyces cerevisiae, Lactobacillus acidophilus, Bacillus subtilis, Aspergillus oryzae, Rhodopseudomonas, Actinomycetes*, and *Nitrobacter*.

Research Design

This study was conducted using two treatments, namely the addition of probiotics to fish feed and without the addition of probiotics (control). Each treatment used a 200 m² earthen pond. Before use, the pond was dried for 3 days, then limed using quicklime at a dose of 250 grams/m². Furthermore, the pond was fertilized using organic fertilizer at a dose of 500 grams/m². After that, the pond was filled with water to a height of 70 cm and left for 7 days before the seeds were spread. The red tilapia seeds used in this study had an average weight of 6.8 grams/tail. The seeds were spread with a density of 10 tails/m². During the study, the fish

were fed floating pellets with the following nutritional content: 31–33% protein, 3–5% fat, 4–6% crude fiber, 10–13% ash, and 11–13% water content. The feed was given three times a day (morning, afternoon, and evening) at a rate of 3–5% of the total weight of the fish, namely 5% in the first month, 4% in the second month, and 3% in the third month. In the treatment with feed added with probiotics, the feed was first mixed with a probiotic solution made by dissolving 10 ml of probiotics in 1 liter of water (according to the recommended dose on the product packaging). After that, 15 grams of granulated sugar was added to the solution and stirred until evenly mixed. This mixture was then sprayed onto 12.5 kg of fish feed, aerated, and ready to be given to the fish.

Observation and Data Analysis

This study was conducted for three months (12 weeks; 84 days). Observations of fish growth were carried out through sampling every two weeks. In each sampling, 50 fish from each treatment were weighed. The sampling data were used to determine the amount of feed to be given to the fish. In calculating feed requirements, the estimated fish mortality rate was set at 2.5% in each sampling. Data analysis was performed using Microsoft Excel. The data analyzed in this study included initial body weight (IBW), initial body length (IBL), final body weight (FBW), final body length (FBL), average daily growth (ADG), condition factor (CF), and survival rate (SR). SR is the percentage of fish that are still alive from the number at the beginning to the end of the study. ADG is the average weight gain rate of fish per day during the study period. CF is a parameter used to assess the health, fitness, or suitability of the body shape of fish based on the relationship between their weight and body length. ADG calculations were performed at each sampling, while CF and SR calculations were only performed at the end of the study. The calculation of these parameters uses the following formula (Karnain *et al.,* 2023; Talib *et al.,* 2023; Gaitian *et al.,* 2024):

Survival rate (SR, %) = (number of fish alive at the end / number of fish at the beginning of the study) × 100
Condition factor (CF) = (FBW / total length^3) × 100
Average daily growth (ADG, g/day) = (FBW – IBW)/duration of feeding
The units used for weight are grams (g), while for length are centimeters (cm).

RESULTS

In this study, red tilapia fed with probiotics showed better growth compared to red tilapia fed without probiotics. The final weight of red tilapia fed with probiotics was higher than that without probiotics, which were 182.1 grams and 151.5 grams, respectively. In addition, the final length of red tilapia fed with probiotics was also greater, which was 25.6 cm, compared to fish not fed with probiotics, which only reached 20.8 cm (Table 1). The average daily growth (ADG) of red tilapia fed with probiotics showed a better growth trend compared to fish without probiotics (Figure 1). Red tilapia fed with probiotics had a daily growth of 2.06 grams/day at the end of the study period, while fish not fed with probiotics only reached 1.70 grams/day (Table 1). This shows that the average daily growth of fish fed with probiotics was 21.2% higher than fish without probiotics.

Table 1. Performance of Red Tilapia Fish During 84 Days of Research

Parameter	Without Probiotics	With Probiotic
Initial body weight (IBW; gram)	6.80	6.80
Initial body length (IBL; cm)	9.20	9.20
Final body weight (FBW; gram)	151.5	182.1
Final body length (FBL; cm)	20.8	25.6

Average daily growth (ADG; gram/day)	1.70	2.06
Survival rate (SR; %)	84.0	87.0
Condition factor (CF)	1.69	1.09

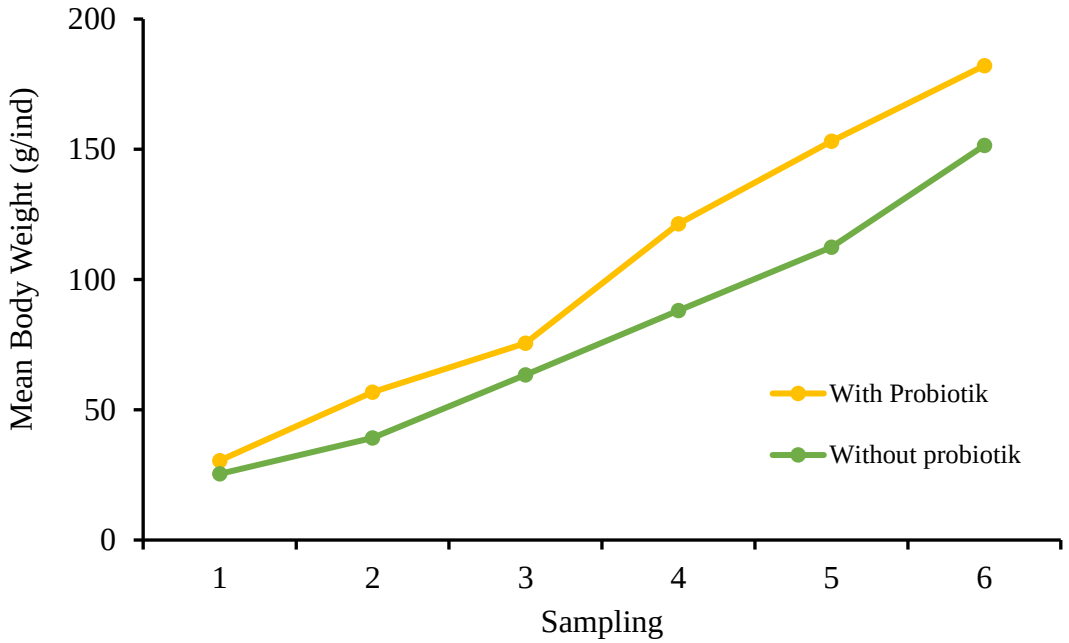

Figure 1. Average Fish Weight Graph for Each Sampling

Red tilapia treated with probiotics in this study showed a higher survival rate compared to fish without probiotics. Red tilapia fed with probiotics had a survival rate of 87%, an increase of 3% compared to fish without probiotics which only reached 84%. In addition, the results of the study showed that red tilapia fed with added probiotics had a condition factor of 1.09, which was lower than tilapia without probiotics, which had a condition factor of 1.69.

DISCUSSION

Fish growth is the process of increasing body size and weight over time as a result of feed consumption and metabolic efficiency in converting nutrients into body tissue. This growth is influenced by various factors, such as feed quality and quantity, water temperature, stocking density, genetics, and aquatic environmental conditions. Optimal growth indicates that maintenance conditions, feed management, and the environment support efficient fish development. The use of probiotics in red tilapia feed in this study affected growth, as indicated by differences in weight, length, and average daily growth. The average daily growth of fish given probiotics reached 2.06 grams/day, higher than fish without probiotics which only reached 1.70 grams/day. These results are in line with research by Agustina *et al.*, (2020), which showed that the addition of probiotics to feed had a significant effect on absolute growth and feed conversion ratio. Fish given probiotics had a higher average absolute growth and lower feed conversion value compared to fish without probiotics (control). Other studies have also shown that the addition of various doses of probiotics in artificial feed has a significant effect on the absolute growth and daily growth rate of tilapia seeds (Lestari *et al.*, 2024). The positive effect of probiotics was also found in tilapia cultivated with a biofloc system. Tilapia in the biofloc system given probiotics showed higher absolute growth values, survival, immune responses, and total number of intestinal bacteria compared to fish not given probiotics (Thalib *et al.*, 2023). Permatasari *et al.*, (2023) also reported that the addition of probiotics to feed significantly affected the specific growth rate of Sultana tilapia. The average specific growth

with the addition of 35 ml of probiotics/100 grams of feed reached 0.036 grams/day, higher than that of fish in the control group without probiotics, which only reached 0.030 grams/day. This increase in growth is thought to be because probiotics help the digestion and absorption of feed nutrients in fish, thus supporting better growth. The bacteria contained in probiotics through the fermentation process are able to hydrolyze proteins into simpler compounds, so that they are more easily absorbed by the fish's body and accelerate growth (Hutabarat *et al.*, 2024).

Fish survival rate (SR) is often used as an indicator of success in fish farming because it reflects the extent to which fish are able to survive the environmental conditions, feed, and treatment given. A high SR indicates that the maintenance conditions support fish survival, while a low SR may indicate problems such as stress, disease, poor water quality, or feed incompatibility. The addition of probiotics to the feed of red tilapia fish cultivated in earthen ponds has been shown to have a positive effect on fish survival. Red tilapia fed with added probiotics had a survival rate of 87%, higher than fish without probiotics which only reached 84%. Similar results were also reported by Baedlowi & Aminin (2021), where fish fed without added probiotics had a survival rate of 75%, while fish fed with probiotics reached 90%. Other studies have also shown that feeding with added probiotics can significantly increase tilapia survival. The survival rate of tilapia with the addition of probiotics reached 96.67–100%, while without probiotics it was only 63.33% (Armin *et al.*, 2024). Meanwhile, red tilapia cultivated with feed mixed with probiotics at a dose of 7–11 ml/100 g of feed showed a fairly high survival rate, namely 78–88% (Harmilia *et al.*, 2020). The high survival rate of red tilapia in earthen ponds is thought to be due to good cultivation environmental conditions and the role of probiotics in increasing fish immunity. The survival of tilapia is greatly influenced by the quality and quantity of feed and supportive environmental conditions. Providing adequate feed and an optimal environment can increase the survival rate of tilapia (Sartika *et al.*, 2022). According to Pangaribuan *et al.*, (2022), probiotics in pellets can function as immunostimulants. In addition, the use of probiotic bacteria has also been shown to have a significant effect on the survival of tilapia seeds during the transportation process, because it can maintain water quality and maintain the health of fish seeds (Marda *et al.*, 2022). Probiotic bacteria in feed can reach the digestive tract of tilapia seeds, help balance the intestinal microbiota, thereby increasing the efficiency of nutrient absorption and reducing the risk of pathogen infection in the digestive tract (Hasan *et al.*, 2023).

Condition Factor (CF) is a parameter used to assess the health, fitness, and body condition of fish based on the relationship between their weight and body length. CF reflects the ability of fish to accumulate energy reserves and is influenced by various factors, such as feed quality, environment, stress levels, and fish health. Condition factors are often used to evaluate feed effectiveness, environmental influences on fish growth, and overall fish welfare. Generally, the ideal fish condition factor is around 1 or slightly higher, depending on gender and other specific conditions (Salmadinah et al., 2017). In this study, red tilapia treated with probiotics showed lower condition factor values compared to fish fed without probiotics, namely 1.09 and 1.69, respectively. These results indicate that fish cultivated with the addition of probiotics have better condition factors compared to fish without probiotics. According to Karnain *et al.*, (2023), bacteria in the digestive tract of fish originating from probiotics can produce digestive enzymes such as protease and amylase, dominate the intestinal microbiota, suppress the growth of pathogenic bacteria, and help fish utilize good bacteria to support their growth and health. Furthermore, Rahmanu *et al.*, (2021) stated that condition factors are important indicators of growth that reflect fish health based on their physical capacity to survive and reproduce. In addition, fish condition factors also reflect their welfare and response to the environment, including the feed given, which plays an important role in influencing the growth, productivity, and resistance of tilapia to stress and disease (Gaitian *et al.*, 2024).

CONCLUSION

Red tilapia fed with probiotics showed higher growth and survival rates compared to fish fed without probiotics. In addition, probiotics added to red tilapia feed tended to decrease condition factors. This suggests that probiotics can be used as feed additives to improve growth, survival rates, and fish health. Further research is needed to determine the effect of probiotics added to feed on the composition of bacteria in the fish digestive tract.

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