

Effect of turmeric probiotics on the survival rate and growth of domesticated endemic betta fish (*Betta dennisyongi*)

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Abstract. The endemic betta fish (*Betta dennisyongi*) was a species of freshwater ornamental fish native to Indonesia which has been successfully domesticated but it has low survival rate and growth. One way to increase the survival rate and growth of farmed fish is by administering turmeric probiotics. This study aims to analyze the best dosage of turmeric probiotics to increase the survival rate and growth of domesticated betta fish. This research was carried out experimentally. The treatments were control, turmeric probiotic 1.5 mL 100 grams feed, turmeric probiotic 3 mL 100 grams feed, turmeric probiotic 4.5 mL 100 grams feed. The parameters tested during the research were survival rate, daily growth rate, and feed conversion ratio and water quality. The analysis of variance test on the data was analyzed using the SPSS 25.0 program with a 95% confidence interval. Treatments that are significantly different will be further tested using the Duncan test to determine the best treatment. The results of the study showed that giving turmeric probiotics for survival rate gave results that had a significant effect ($P < 0.05$) but had no significant effect ($P > 0.05$) on the growth of betta fish. The use of turmeric probiotics 3 mL 100 grams feed can increase weight gain, length gain and survival rate of domesticated betta fish.

1 Introduction

Implementing large-scale social restrictions and social distancing in Indonesia has forced workers to work from home [1]. The implementation of work-from-home by the Indonesian government has not only produced positive impacts but also negative impacts. One of the negative impacts of working from home is that many employees experience boredom and stress due to restrictions on activities ranging from work to worship, all of which are carried out at home [2]. Employees have new hobbies, such as keeping ornamental fish to reduce boredom and stress. One type of ornamental fish that is excellent for keeping is the ornamental betta fish [3]. Betta fish is an option to keep because this type of ornamental fish does not require significant capital in maintenance or cultivation [4][5]. One type of ornamental betta fish most sought after is the one endemic to the western and southern regions of Aceh Province, which has the local name jielabu and the Latin name *Betta dennisyongi* [6].

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During the COVID-19 pandemic, the jielabu betta fish (*Betta dennisyongi*) is one of the most popular ornamental betta fish. So far, they are still caught in the wild to meet the demand for jielabu betta fish (*Betta dennisyongi*). The ongoing arrests have been deeply disturbing. This fishing can make this fish increasingly rare in nature and can damage the environment where this fish lives. One way to reduce catching in the heart is to domesticate the jielabu betta fish (*Betta dennisyongi*). Fish domestication is the taming/ adaptation of fish from wildlife to cultivation environments over different periods. Domestication can take years to decades [7]. The obstacles in domesticating fish are that the difficulty of adaptation for fish/ water animals is more serious than that of land/ terrestrial animals and slow growth [8]. One solution to resolve obstacles in domestication is by administering turmeric probiotics.

Turmeric probiotics are probiotics that have been combined with herbal plants. The advantage of this turmeric probiotic is increasing the production performance and health status of farmed fish [9]. This is because turmeric contains curcumin compounds, which help increase fish appetite and maintain fish health. Several previous studies have proven that giving turmeric probiotics to farmed fish can improve production performance, for example, in tilapia [10], catfish [11], freshwater pomfret [12], local snakehead fish [9]. Based on the explanation above, turmeric probiotics have never been tested for the endemic jielabu betta fish (*Betta dennisyongi*). Therefore, research needs to be carried out to evaluate the use of herbal probiotics on the production performance and color quality of the endemic betta fish (*Betta dennisyongi*).

2 Material and Methods

2.1 Time and place

The research was conducted from March 1 to July 31, 2023, at the Integrated Fisheries Laboratory, Faculty of Fisheries and Marine Sciences, Teuku Umar University. Laboratory analysis was carried out at the Integrated Mathematics and Natural Sciences Laboratory, Teuku Umar University, and the Laboratory of the Faculty of Veterinary Medicine, Syiah Kuala University.

2.2 Tools and materials

The tools used in this research include a fiber box for fish keeping, a blender, an aerator, a digital scale, a pH meter, a thermometer, a DO meter, a ruler, and a measuring pipette. The ingredients include Betta fish seeds (*Betta dennisyongi*), turmeric, banana stems, fine bran, sugar, yeast, label paper, commercial feed, and EM4 probiotics.

2.3 Experimental design

This research was carried out using experimental methods. The experimental design was completely randomized, with four treatments and three replications. The research design can be seen in the Table below. The dosage for this study was taken from a combination of research conducted previously [10].

Table 1. Turmeric probiotic treatment design

No	Code	Information
1	P0	Treatment without adding turmeric probiotics to feed (control)
2	P1	Treatment dose is 1.5 ml of turmeric probiotics 100 grams of feed
3	P2	Treatment dose is 3 ml of turmeric probiotics 100 grams of feed
4	P3	Treatment dose is 4.5 ml of turmeric probiotics 100 grams of feed

2.4 Research procedure

2.4.1 Preparation of rearing containers and maintenance of test animals

The containers are 12 fiber boxes measuring 50 x 30 x 40 cm³. The fiber box is cleaned with soap and disinfected with potassium permanganate at 15 mg L⁻¹. After that, the fiber box is soaked for three days. After three days, the fiber box is rinsed and left to dry. After the disinfection process, the fiber box is filled with 40 L of water.

The Betta fish (*Betta dennisyongi*) used measures 2-3 cm. Before being stocked in the rearing media, Betta fish (*Betta dennisyongi*) are acclimatized first. Fish rearing is carried out for 60 days. They fed fish using the ad satiation method (according to fish consumption/needs). The feeding frequency is three times daily, namely at 08.00, 12.00 and 16.00 WIB. During maintenance, siphoning and water changes of 10-20% are carried out every ten days.

2.4.2 The process of making turmeric probiotics

According to [10], the process of making turmeric probiotics is by putting 5 liters of clean/sterile water into a container, then adding 500 grams of fine turmeric, 125 grams of chopped banana stems, 25 grams of granulated sugar, 500 grams of fine bran, 200 ml EM4 and 15 grams of yeast. After that, all the ingredients are combined and mixed well. The mixing results are then put into a jerry can/container and closed tightly. Place these materials in a room not exposed to the sun and leave for ± 14 days. Every 2-3 days, the lid of the jerry can/ container is opened for a few minutes to release the fermentation gas. After ± 14 days, this turmeric probiotic is filtered using a filter. Signs of a successful probiotic are that it produces a tape. According to [12], sufficient sugar solution is given during maintenance to keep microorganisms alive.

2.4.3 Feed enrichment process

The commercial feed used is commercial feed, namely Prima Feed 500, with a minimum protein content of 39%, 5% fat, 4% crude fiber, 11% ash, and 10% water. The feed enrichment process is carried out using the spray method. The feed is sprayed with turmeric probiotics according to the treatment. Namely, 1.5 ml, 3 ml, and 4.5 ml for every 100 grams of feed, add egg white as much as 10% of the weight of the feed for all treatment. Then, the feed is air-dried for ± 5 minutes. Then the feed can be given to Betta fish (*Betta dennisyongi*).

2.4.4 Research Test Parameters

a. Weight Gain (WG)

Weight gain was calculated using the following formula [13]:

$$WG = W_t - W_o$$

Remarks: WG = Weight gain (g), W_t = average body weight of fish at the end of the experiment (g), W_o = average body weight of fish at the start of the experiment (g)

b. Length Gain (LG)

Length gain was calculated using the following formula [13]:

$$LG = L_t - L_o$$

Remarks: LG = length gain (cm), Lt = average body length of fish at the end of the experiment (cm), Lo = average body length of fish at the start of the experiment (cm)

c. Daily Growth Rate (DGR)

The daily growth rate was calculated using the following formula [14]:

$$DGR = \frac{(W_t - W_0)}{t}$$

Remarks: DGR= daily growth rate (g day⁻¹), Wt = average body weight of fish at the end of the experiment (g), W0 = average body weight of fish at the start of the experiment (g), t = duration of the feeding experiment (day)

d. Feed conversion ratio (FCR)

The feed conversion ratio was calculated using the following formula [15]:

$$FCR = \frac{KP}{\Delta W}$$

Remarks: FCR=Feed conversion ratio, KP= Total amount of feed consumption (g), ΔW= Weight gain (g)

e. Survival Rate (SR)

The survival rate was calculated using the following formula [16]:

$$SR = \frac{N_t}{N_0} \times 100 \%$$

Remarks: SR = Survival rate (%), Nt = Total of fish at the end of the experiment, No = Total of fish at the start of the experiment

f. Water Quality Parameters

Water quality parameters measured include temperature, pH, and dissolved oxygen. temperature, pH and DO measurements were carried out every 10 days after fish sampling.

3 Result and Discussion

The results of the analysis of variance and Duncan's further tests showed that the addition of turmeric probiotics to feed had a significant effect ($P < 0.05$) on length increase, weight gain, and survival rate but had no significant impact ($P > 0.05$) on the daily growth rate, and ratio conversion feed. The values for length gain, weight gain, survival rate, daily growth rate, and feed conversion ratio can be seen in the table 2 below. Proximate test results showed that feed supplemented with turmeric probiotics had a higher protein content than the control. The comparative test results can be seen in Table 3 below. Water quality measurements show that water quality during maintenance is still within normal limits. The results of the water quality test can be seen in Table 4.

Table 2. Production performance of betta fish (*Betta dennisyongi*) given turmeric probiotics

Perlakuan	Parameter					
	WG (cm)	LG (gram)	SR (%)	DGR (%)	FCR	Glukose
P0	0,26 ±	0,10 ±	86,67 ±	0,39 ±	1,22 ±	95,3 ±
	0,15 ^a	0,05 ^a	2,88 ^a	0,01 ^a	0,10 ^a	31,65 ^a

P1	0,49 ± 0,06 ^b	0,22 ± 0,04 ^b	90 ± 5 ^{ab}	0,60 ± 0,03 ^a	1,08 ± 0,09 ^a	61,3 ± 24,44 ^a
P2	0,22 ± 0,05 ^a	0,14 ± 0,01 ^a	96,67 ± 5,77 ^b	0,53 ± 0,02 ^a	1,18 ± 0,01 ^a	62,0 ± 26,90 ^a
P3	0,28 ± 0,07 ^a	0,15 ± 0,05 ^{ab}	96,67 ± 2,88 ^b	0,51 ± 0,14 ^a	1,18 ± 0,16 ^a	79,7 ± 12,34 ^a

Note: Different superscript letters in the same column show significantly different (P <0.05).

Table 3. Results of proximate tests on feed added with turmeric probiotics

Treatment	Water content (%)	Ash level (%)	Fat (%)	Protein (%)	Crude fiber (%)	Carbohydrate (%)
P0	9,93	5,71	5,88	32,42	2,99	43,07
P1	8,22	3,54	5,84	34,47	3,13	44,82
P2	6,61	3,40	5,65	36,62	3,29	44,42
P3	6,26	4,69	4,22	37,12	3,59	44,11
Turmeric Probiotic	52,81	2,19	6,86	15,27	5,24	17,63

Table 4. Water quality parameters during maintenance

Water Quality Parameters	Treatment			
	P0	P1	P2	P3
pH	7,5- 8,4	7,4-8,5	7,5-8,4	7,3-8,5
DO (mg/L)	5,20-5,72	5,06-5,68	5,04-5,58	5,25-5,61
Temperature (°C)	30,1-30,4	30,2-30,9	30,6-30,9	30,4-30,8

The results of this study show that giving turmeric probiotics influences the growth in weight and length of betta fish. The best weight and length growth values for betta fish were found in the treatment dose of 1.5 ml of turmeric probiotic 100 grams feed (P1). The weight growth value of P1 is 0.49 ± 0.06 cm, and the length growth value of P2 is 0.22 ± 0.04 grams. The effect of giving turmeric probiotics in this study on weight and length growth is in line with the opinion of [17], which states that the compounds contained in turmeric can increase metabolism and the performance of the digestive system. Turmeric also contains the compound curcumin, which has the function of increasing the absorption of food substances, which is done by stimulating the walls of the gallbladder to release bile into the small intestine, thereby improving digestion [18];[19]. Turmeric also contains vitamin C [20];[21], which functions as a catalyst that can speed up reactions in the body so that it can absorb and utilize it for growth [22]. Apart from that, the probiotic content in the treatment also helps increase food absorption in the fish's intestines. This is thought to be due to the probiotic content of beneficial bacteria to suppress pathogenic bacteria [23]. Proximate results also showed that the administration of turmeric probiotics increased crude protein compared to controls. This is because fermentation is changing complex substances into simpler ones by enzymes produced by microbes. This process will reduce and even eliminate harmful substances such as antitrypsin in feed ingredients by microbes. The fermentation process will also degrade complex materials into amino acids so that microbes can use these amino acids to reproduce [24,25]. Increasing the number of microbial colonies during fermentation can indirectly increase crude protein content because microbes are a source of single-cell protein [26].

The survival rate results also showed that the administration of turmeric probiotics influenced the survival rate of betta fish. The best survival rate value was found in treating 3 ml of turmeric probiotic 100 grams feed (P2). This is because turmeric contains active compounds, namely curcumin and flavonoids. Curcumin and flavonoids play a role in keeping fish healthy. Fish in healthy conditions and with good water quality will have a high survival rate [27];[22]. Apart from that, adding probiotics can increase beneficial microbes, which have a protective function, namely the ability of microbes to inhibit pathogenic microbes in the fish's body [28]. The microbes in probiotics also produce substances that are not harmful to fish but destroy pathogenic microbes that disrupt the digestive system [12].

The results of the parameters of daily growth rate, and feed conversion ratio did not show results that were not significantly different compared to the control. However, adding turmeric probiotics to fish feed made the daily growth rate, and feed conversion ratio higher than the control. This is thought to be because the addition of probiotics to fish feed creates a synergy of probiotics working in the digestive tract and increases the digestibility of the meal, thus stimulating fish growth [9]. The results of this study are similar to research conducted by [29]. Adding probiotic bacteria to *Poecilopsis gracilis* fish resulted in a tendency for daily growth rates to be slightly higher than controls. Research showed that adding probiotic bacteria can affect the fish's digestive tract. Microba function to increase fish digestibility of feed to stimulate fish growth [30][31][32]. Adding probiotics to fish feed can create a synergistic composition of probiotics working in the digestive tract and increase the digestibility of the feed, thus stimulating the growth of local snakehead fish [5], according to [33], where the addition of probiotics can reduce the feed conversion ratio value. However, in the research, the feed conversion ratio value was not significantly different from the control, but the value was higher than the control. According to [34], this occurs because there are still very few probiotic bacteria that reach the fish's digestive tract and have not reproduced very much, so time is needed to affect the fish's digestive process.

The water quality measured during the research was still within the limits betta fish can tolerate. Temperature parameters during the study ranged from 30.1-30.9 °C. According to [35], Betta fish prefer a warm water climate to other tropical fish, namely in the 25 -30°C. The pH parameters during the research were in the range of 7.4-8.5. According to [36], Betta fish can live in water that has a pH range of 7.9 -8. DO parameters are still in the normal range, namely >5 mg/L. According to [37], Betta fish are able to live in water with dissolved oxygen of 3 mg/L because Betta fish are labyrinth fish, which are able to take oxygen directly from the air.

4 Conclusion

Different doses of turmeric probiotics gave different responses to survival rate parameters but gave the same response to growth parameters. A dose of 3 mL turmeric probiotic 100 grams of feed is the best dose to increase the survival rate of betta fish (*Betta dennisyongi*).

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