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Supplementation of *Moringa* (*Moringa oleifera*) Leaf Meal on Growth Performance of Bileh Fish (*Rasbora* sp.)

Suplementasi Tepung Daun Kelor (*Moringa oleifera*) Terhadap Performa Pertumbuhan Ikan Bileh (*Rasbora* sp.)

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Abstract

Bileh fish *(Rasbora sp.)* is one type of Acehnese freshwater fish that is very popular with the public because it has a delicious and savory taste. The main objective in conducting this study was to determine the effect of using *Moringa* (*Moringa oleifera*) leaf flour as a supplement to commercial feed on the growth of bileh fish (*Rasbora* sp.). This study used a completely randomized design consisting of four treatments and three replications each. The doses of moringa flour used as the test treatment consisted of; P0 (control) = 0% moringa flour, P1 = 20% moringa flour, P2 = 30% moringa flour, P3 = 40% moringa flour. The parameters observed were proximate test, absolute weight growth, specific growth rate, absolute length growth, survival rate, feed efficiency and water quality consisting of temperature and pH. The results of analysis of variance (ANOVA) showed that the dosing of moringa flour in feed had a significant effect on absolute weight growth, absolute length growth and specific growth rate, but had no significant effect on the survival rate of bileh fish juvenile. The best dose of moringa leaf flour to increase the growth of bileh fish is the P3 treatment (moringa leaf flour) with an absolute weight growth value of 1.27 grams, absolute length growth of 5.93cm, and a survival rate in the P3 treatment of 98%.

Keywords: *Moringa oleifera, Supplementation, Feed, Growth, Rasbora sp.*

Abstrak

Ikan bileh *(Rasbora sp.)* merupakan salah satu jenis ikan air tawar khas Aceh yang sangat digemari oleh masyarakat karena memiliki rasa yang enak dan gurih. Tujuan utama dalam melakukan penelitian ini untuk mengetahui pengaruh penggunaan tepung daun kelor (*Moringa oleifera*) sebagai suplementasi pada pakan komersil terhadap pertumbuhan ikan bileh (*Rasbora* sp.). Penelitian ini menggunakan rancangan acak lengkap terdiri dari empat perlakuan dan masing-masing tiga kali ulangan. Dosis tepung daun kelor yang digunakan sebagai perlakuan uji terdiri dari; P0 (kontrol) = 0% tepung daun kelor, P1 = 20% tepung daun kelor, P2 = 30% tepung daun kelor, P3 = 40% tepung daun kelor. Parameter yang diamati adalah uji proksimat, pertumbuhan bobot mutlak, laju pertumbuhan spesifik, pertumbuhan panjang mutlak, tingkat kelangsungan hidup, efisiensi pakan dan kualitas air yang tediri dari suhu dan pH. Hasil analisis sidik ragam (ANOVA) menunjukkan bahwa pemberian dosis tepung daun kelor pada pakan berpengaruh nyata terhadap pertumbuhan bobot mutlak, pertumbuhan panjang mutlak dan laju pertumbuhan spesifik, namun tidak berpengaruh nyata terhadap tingkat kelangsungan hidup benih ikan bileh. Dosis tepung daun kelor terbaik untuk meningkatkan pertumbuhan ikan bileh adalah perlakuan P3 (tepung daun kelor) dengan nilai pertumbuhan bobot mutlak sebesar 1,27 gram, pertumbuhan panjang mutlak sebesar 5,93cm, dan tingkat kelangsungan hidup pada perlakuan P3 sebesar 98%.

Kata Kunci : *Moringa oleifera, Suplementasi, Pakan, Pertumbuhan, Rasbora sp.*

1. Introduction

Bileh fish (*Rasbora* sp.) is one type of freshwater fish found in several regions of Indonesia, especially in Aceh waters. In its habitat, it is found in rivers and lakes that have a small body shape (Zulfadhli, 2015). Bileh fish has the potential to be a profitable aquaculture commodity. The taste of bileh fish is very savory and much in demand by the public, so the market demand for bileh fish is very large**.**

Several farmers have conducted various bileh fish cultivation activities to meet the increasing market demand. However, it turns out that many problems arise in carrying out bileh fish cultivation activities, one of which is the growth of bileh fish, which is still relatively slow and has a low survival rate.

For this reason, it is necessary to carry out various cultivation activities to overcome the problems farmers face in

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dealing with the slow growth rate of bileh fish. One way to increase fish's growth and survival rate is to improve the quality of feed given according to the needs of bileh fish. According to Andri *et al*. (2021), feed is one of the most important factors in fish farming, which must have nutritional content that suits fish needs. The feed content contained in the feed can be made from various raw materials that are easy to find and do not contain excess chemicals.

Moringa leaves are natural raw materials that exist in nature and can be used as raw materials for fish feed. Moringa leaves have a complete nutritional content. Moringa leaf powder per 100 grams contains 27.1 grams of protein, 38.2 grams of carbohydrates, 2.3 grams of fat, 19.2 grams of fiber, 7.5% water content, and 205.0 calories and other important vitamins and minerals. It also contains 10 kinds of amino acids and omega 3, 6, and 9 (Krisnadi, 2015). Based on the results of research that has been done on the use of moringa leaves in feed to increase the growth of tilapia, it has a real effect up to a concentration of 20%. Buana Basir *et al*. (2018)

Based on the explanation above, it is necessary to research to improve the growth and survival of bileh fish by adding moringa leaf flour to commercial feed.

2. Materials and Methods

2.1. Time and Place

This research was conducted for 40 days, from September to November 2023. This research was conducted at the Aquaculture Hatchery of Teuku Umar University, West Aceh. The proximate test was conducted at the Agriculture Laboratory of Syiah Kuala University, Banda Aceh.

2.2. Tools and Materials

The tools used in this research are plastic jars measuring 25 liters, thermometers, DO meters, pH meters, digital scales, buckets, sieves, spray bottles, measuring cups, and stationery. The materials used were ikan bileh seeds (*Rasbora* sp.) with lengths ranging from 3.5-4 cm and weights of 0.19-0.26 g, moringa leaf flour, egg white, commercial feed, and water.

2.3. Trial Design

The experimental design used was a non-factorial, Completely Randomized Design (CRD) with four treatments and three replications. The treatments studied included commercial feed without moringa flour (P0), commercial feed with moringa flour at 20% /kg feed (P1), commercial feed with moringa flour at 30% /kg feed (P2), and commercial feed with moringa flour at 40% /kg feed (P3).

2.4. Water Quality Measurement

Temperature, pH, and DO measurements were taken in the morning at 08.00 WIB *in situ*.

2.5. Data Analysis

The data obtained were tabulated using Microsoft Excel and analyzed using SPSS 21.0, which includes Analysis of Variance (ANOVA). If there is a significant effect, it will be further tested using the Duncan test at the 95% confidence interval to see the differences between treatments. Meanwhile, water quality parameters were analyzed descriptively.

Weight growth can be calculated with the Effendie formula (2002) as follows:

$$Bm = Bt - Bo$$

Description:
Bm = Absolute weight growth (grams)
Bt = Final maintenance weight (gram)
Bo = Initial maintenance weight (gram)

The absolute length growth of fish can be calculated using the formula Jaya et al. (2013) as follows:

$$Pm = Pt - Po$$

Description:
Pm = Absolute length gain (cm)
Pt = Final average length (cm)
Po = Initial average length (cm)

Feed conversion ratio

$$FCR = \frac{F}{(Bt + D) - Bo}$$

Description:
FCR = Feed conversion ratio (g)
F = Total feed amount (g)
Bt = Total weight of fish at the end (g)
Bo = Total weight of fish at baseline (g)
D = Weight of dead fish during the study (g)

Calculation of fish-specific growth rate using the formula Mochtar et al. (2018) as follows:

$$LPS = \frac{Wt - Wo}{t} \times 100$$

Description:
LPS = Specific Growth Rate (%/day)
Wt = Final weight of fish (grams)
Wo = Final weight of fish (grams)
t = Time (days)

Fish survival can be calculated using the formula Mochtar et al. (2018), namely:

$$TKH = \frac{Nt}{No} \times 100$$

Description:
TKH = Survival Rate (%)
Nt = Number of fish at the end of rearing (fish)
No = Number of fish at the beginning of rearing (fish)

3. Results and Discussion

3.1. Results

Based on the results of the ANOVA test, adding moringa flour in commercial feed on the growth of bileh fish resulted in weight gain, length gain, and specific growth rate, which had a significant difference (P <0.05) for each treatment. In contrast, there was no significant difference (P>0.05) for each treatment for the feed conversion ratio and survival. The feed conversion ratio (Figure 3) showed the lowest result in P3 with a dose of 40% additional moringa flour with a value of 1.27 and the highest value in P0 without additional moringa flour with a value of 1.62. Specific growth rate (Figure 4) showed the highest result in P3 with a dose of 40% additional moringa flour with a value of 5.93 and the lowest result in P0 without additional moringa flour with a value of 4.23. The survival rate (Figure 5) showed the highest result in the treatment of a 40% dose of additional moringa flour, with a value of 98.3, and the lowest value was in the 0% dose, with a value of 85.0. The range of water quality (Table 2) includes temperature, PH, and DO levels (dissolved oxygen) for each treatment.

Table 1.
Water quality parameters during the rearing period

Parameters	Treatment			
	P0	P1	P2	P3
Temperature (°C)	25 - 30	25 - 30	25 - 30	25 - 30
pH	6,5 - 7,6	6,5 - 7,6	6,5 - 7,6	6,5 - 7,6
Do (mg/l)	4,3 - 6,7	4,3 - 6,7	4,3-6,7	4,3 - 6,79

Description: P0: Control/Treatment of 0% moringa flour; P1: Treatment of 20% moringa flour; P2: Treatment of 30% moringa flour; P3: 40% treatment with the addition of moringa flour as much as 40%.

Table 2.
Proximate test data of test feeds

Sample	Parameter (%)					
	Water	Ash	fat	Protein	Fiber	BETN
P0	10,15	4,44	4,12	27,41	2,47	51,41
P1	9,34	5,35	3,99	30,40	2,85	48,07
P2	10,87	3,64	3,48	30,97	2,63	48,42
P3	9,42	4,68	4,51	31,39	2,84	47,17

Source: Primary Data, 2023

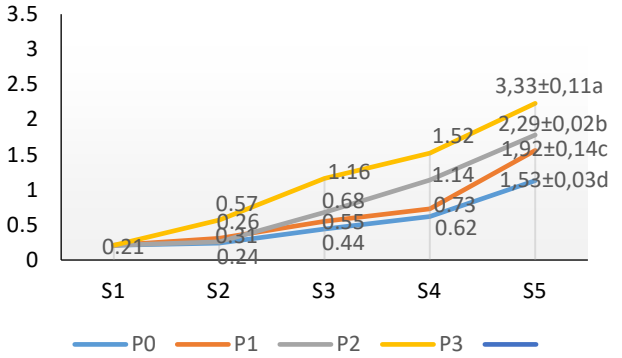

Figure. 1. Graph of average weight gain of bileh fish (*Rasbora* sp.).
Description: P0: control treatment/ 0% moringa flour; P1: 20% moringa flour; P2: 30% moringa flour; P3: 40% moringa flour.

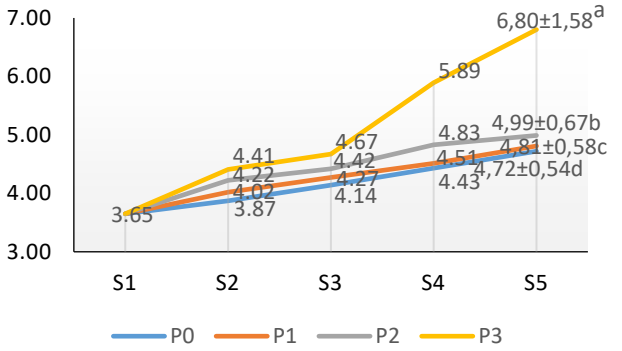

Figure. 2. Graph of mean length gain of bileh (*Rasbora* sp.).
Description: P0: control treatment/ 0% moringa flour; P1: 20% moringa flour; P2: 30% moringa flour; P3: 40% moringa flour.

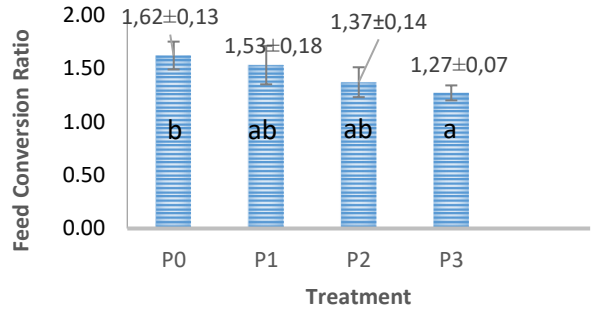

Figure. 3. Graph of feed conversion ratio (FCR) of bileh fish (Rasbora sp.).
Notes: The graph shows no significant difference; P0: control treatment/ 0% moringa flour; P1: 20% moringa flour treatment; P2: 30% moringa flour treatment; P3: 40% moringa flour treatment.

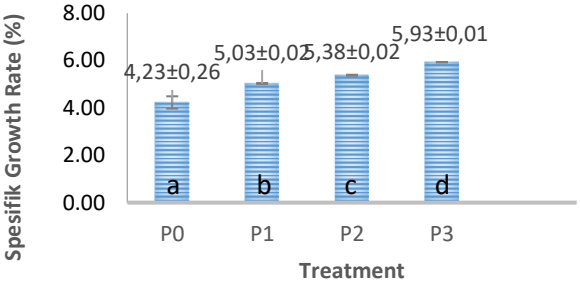

Figure. 3. Graph of specific growth rate (SGR) of bileh (Rasbora sp.).
Notes: The graph shows significant differences (P<0.05); P0: control treatment / 0% moringa flour; P1: 20% moringa flour treatment; P2: 30% moringa flour treatment; P3: 40% moringa flour treatment.

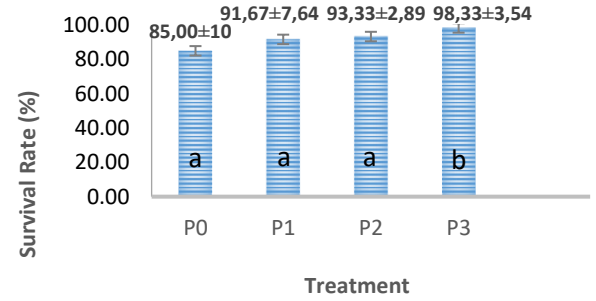

Figure. 3. Synthesis graph of billfish (*Rasbora* sp.).
Notes: The graph shows no significant difference; P0: control treatment/ 0% moringa flour; P1: 20% moringa flour treatment; P2: 30% moringa flour treatment; P3: 40% moringa flour treatment.

Discussion

Fish absolute weight growth refers to the additional weight of the fish each day during the rearing period. During the study, the absolute weight growth of fish ranged from 0.21-3.33 grams per day. The highest result was found in the P3 treatment, with an increase of 3.33 grams per day. The significant increase in fish weight growth in the P3 treatment is thought to be due to the protein content of the feed that reaches the fish growth needs. Protein nutrients in feed are converted into energy used to support optimal growth. Yulisman (2012) explains that protein, along with carbohydrates and fats, is one of the essential macronutrients for fish growth.

Besides protein, the high fat level in bileh fish feed is also expected to positively affect fish weight growth. This follows the statement of Nasution (2002), explaining that fat in the feed not only acts as a source of energy but also functions as an essential fat in the growth and defense system of the fish body. Palinggi *et al.* (2002) explain that the fat content is also easily absorbed by the fish body and acts as a carrier of vitamins, strengthening membrane resistance and increasing nutrient absorption.

Moreover, Akbar (2012) states that feed nutrition, genetic factors, and environmental situations influence fish's length and weight growth.

The absolute weight growth of fish, the lowest during the study, occurred in the control P0 treatment with an increase of only 0.21 grams per day. This was due to the absence of moringa flour in the feed and low protein levels, resulting in slower growth of fish body weight compared to treatments that received moringa flour. This agrees with Yuliyanto (2021). If the need for protein is not met in the diet, it can result in a significant decrease, such as stopping growth or losing body weight.

Fish body length gain is important in assessing fish growth during the study. The data documented in Figure 2 shows that incorporating Moringa leaf meal into the diet significantly impacted changes in fish body length ($P<0.05$).

The best increase in fish length growth occurred in the P3 treatment, with a value of (6.80 cm), compared to the control P0 treatment, which only reached a value of (4.72 cm). The significant increase in fish length growth in P3 is thought to be due to the high crude protein content, which reached 31.39%, compared to P0, which only reached 27.41%. In addition, the provision of moringa leaf meal in the appropriate amount can also positively affect the growth rate of fish length. Statistical tests (ANOVA) also showed that the P3 treatment gave the best results.

According to Webster (2002), the right level of feed protein in the P3 treatment according to the needs of bileh fish juvenile can consistently optimize energy use and increase fish length growth. Protein is an essential nutrient that is needed by the fish body. The availability of energy in the feed must be sufficient so that the protein is not only used for body metabolic activities but also for growth and other body functions. This statement is supported by Yulisman (2012), which reveals that fish growth is influenced by the level of protein contained in fish feed, both high and low levels of protein.

The feed conversion ratio value illustrates how efficient the fish is in utilizing the nutrients contained in the feed. The smaller the feed conversion ratio value, the more efficient the fish is in utilizing the nutrients contained in the feed. Observations and measurements of the feed conversion ratio are shown in Figure 3. The feed conversion ratio is within the range of 1.27 to 1.62. The results of the analysis of variance showed that the addition of moringa leaf meal to commercial feed had a significant impact on the feed conversion ratio of bileh (*Rasbora* sp.) ($P<0.05$). The highest feed conversion ratio was recorded in the commercial feed treatment without the addition of moringa flour (P0) at 1.62, while the lowest value was in the commercial feed treatment with the addition of moringa flour at 40% per kilogram of feed (P3) with a value of 1.27.

Susanti (2004) explains that the feed conversion ratio's low value indicates that the feed quality is good. The results of the feed conversion ratio in P3 show that by giving 1.27 feed, it can produce 1 kg of fish weight during the maintenance period.

It is thought that the improvement in feed quality that resulted in the best feed conversion ratio was due to the addition of moringa flour to the commercial feed. If the feed conversion ratio is low, the feed efficiency will be high, but conversely, if the feed conversion ratio is high, the feed efficiency will be low. The cause of the high feed conversion ratio in P3 is due to the ability of efficient digestion by fish on the feed, which results in accelerated growth (Mardhiana *et al*., 2017). According to research by Shofura *et al*. (2018), differences in nutrient absorption by individual fish will be seen in variations in feed conversion ratio values, both high and low. The improvement in feed quality that causes the feed conversion ratio to be the best is due to the addition of moringa flour in commercial feed.

Based on the data obtained, the daily growth rate of bileh fish during the experiment showed the highest value in the P3 treatment, which was around 5.93% per day, while the lowest value was recorded in the P0 (control) treatment, around 4.23% per day. Although there was no significant difference, the bileh fish fed with moringa leaf meal (P1, P2, and P3) performed better than those fed without moringa leaf meal (P0). This is thought to be because the content in moringa flour may have improved the quality of bileh fish feed as a feed additive. According to Yanuar (2017), moringa leaves contain important nutrients for the body, including carbohydrates, protein, fat, vitamins, and minerals. Nawir et al. (2015) explained that protein is a macronutrient that has an important role in determining feed quality and contributes greatly to growth because it is the main component of fish bodybuilding. Based on the results of the proximate test, the protein value in the P3 treatment was high at 31.39, while the value in the control P0 treatment was lower at 27.41. Hidayat *et al.* (2013) explained that if the feed is given nutritional content by the needs of fish, it can increase feed efficiency and fish growth.

The rearing of bile fish lasted for 40 days. Therefore, optimal growth was not yet apparent as the fish adapted to the new environment. The growth of bileh fish does not reach its maximum potential because most of the energy is used for survival and adjustment to the new environment. As mentioned by Budiharjo (2002), the growth of *Rasbora Lateristriata* during 10 weeks of maintenance is divided into three levels. In the early stage (level 1), fish growth is generally slow from the first to the fourth week. In the second stage (level 2), from the fourth week to the eighth week, the length of the fish increases, and the average growth of the fish is relatively fast. In the third stage (stage 3), from the eighth week to the tenth week, the overall average growth of the fish slows down.

The value of survival (survival) in bileh fish between treatments is not significantly different ($P>0.05$). The best survival value of bileh fish was found in P3, which amounted to 98.33%. This could be because the feed given in P3 has a nutritional quality superior to other treatments (P0, P1, and P2) for bileh fish. Therefore, bileh fish can utilize these nutritional sources to maintain their survival. Fish survival rate highly depends on several factors, including food, water, environment, and fish health conditions. In the research of Islama *et al.* (2020), it is stated that the fat contained in the feed is of great importance to the fish body. Apart from functioning as a source of energy, fat is also a source of essential fatty acids that must be provided in feed because the body cannot produce these essential fatty acids. Essential fatty acids are fat components the fish body requires to support life and growth. Its main function is as a precursor to the ingredients needed in the metabolic process of the fish body, as described by Adelina *et al.* (2012).

According to Agustono et al. (2009), the food that fish consume is converted into energy used for basic life purposes, such as maintaining metabolism, movement, breathing, spawning processes, environmental adjustments, and survival.

Water quality is a crucial factor that significantly affects fish growth. When water quality during rearing is well maintained, it can positively affect the survival and growth of bileh fish. This study measured water quality through temperature, pH, and dissolved oxygen (DO) levels. Changes in water temperature can affect the metabolic process of the fish body as well as its survival. The results of water quality measurements showed that the temperature values ranged from 25-31 ℃ in Table 2. It is estimated that the water temperature still meets the requirements for a suitable environment for the life of bileh fish. Erika et al. (2018) state that the optimal temperature range for fish life in tropical waters is between 28ºC

- and 32ºC. When the water temperature used for rearing bileh fish in this study is still within this range, it is likely to be an important factor that supports the survival and growth of bileh fish. However, a temperature mismatch in the rearing of bileh fish can affect the metabolism of the fish body and can even cause death. Siegers *et al.* (2019) stated that an increase in pond temperature will increase the rate of ammonium conversion to ammonia, which can harm farmed fish. If the temperature is not within the normal range required for fish life, it can decrease fish movement and appetite and even cause stress in fish, difficulty breathing, and death. Therefore, an ideal temperature for the living environment of bileh fish during this rearing period can accelerate the growth of bileh fish.

The range of water pH values observed in this study was between 6.5 and 7.6, which is still by conditions considered normal for bileh fish farming. Effendie (2002) stated that the best pH range for fish rearing is 6 to 8.5. Manunggal et al. (2018) explained that if a low pH occurs, the amount of oxygen dissolved in the water will decrease, resulting in decreased oxygen consumption by fish, increased respiratory activity, and decreased fish appetite. Siegers *et al*. (2019) stated that the ability of fish growth and reproduction is closely related to the pH value of water. Generally, fish can survive in a pH range of at least 4, but when the pH exceeds 11, the fish will experience death.

The results showed that the dissolved oxygen content ranged from 4.3 to 6.7 mg/l, which is still within the optimal range for bileh fish during the rearing period. According to Mulqan (2017), fish could survive at a dissolved oxygen content that exceeds 0.3 mg/l. Therefore, water quality during the rearing period of seurukan fish in the cultivation environment is optimal with various water quality test parameters such as temperature, pH, and dissolved oxygen, making it suitable for fish farming media.

4. Conclusion

Based on the research conducted, the conclusions obtained from this study are:

1. Adding moringa leaf meal to commercial feed can improve the growth of bileh (*Rasbora* sp.).
2. The addition of moringa flour in this commercial feed with the best results for growth and survival of bileh fish is found in the P3 treatment consisting of an absolute length growth value of 5.93cm, and the value of the survival rate of bileh fish in the P3 treatment is 98%.

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