BIOEDUSCIENCE
ISSN: 2614-1558
http://journal.uhamka.ac.id/index.php/bioeduscience

The Effect of Adding Silk Worms (*Tubifex tubifex*) Feed on the Growth of Jelawat Fish (*Leptobabus hoevenii* [Bleeke, 1851])

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Abstract

Background: This study aims to determine the effect of Jelawat (*Leptobarbus hoevenii*) fish growth given additional feed silkworm and pellets. **Method:** This study used a Complete Randomized Design (RAL) with four treatments and five repetitions. *L. hoevenii* was kept for 28 days in a container box with the same quality and quantity of water. Analysis of variance (ANOVA) was carried out on the measurement results and continued with the Least Significant Difference (BNT) test. **Result:** Each experimental group influences the growth of *L. hoevenii*. The results of the ANOVA test showed a significant value (P<0.05), so it was continued with the Least Significant Difference test. The research results of experimental group B showed substantial results (P<0.05), which were marked with the notation (*). **Conclusion:** The addition of *T. tubifex* feed can influence the growth of *L. hoevenii,* and the best treatment to produce good fish growth in this study is found in the B treatment given feed (Pellets 25% + *T. tubifex* 75%), resulting in the highest growth with body weight growth (1.02 g), body length (24.6 mm), and body thickness (2.84) mm.

Keywords: Growth; Jelawat Fish; Silk Worm

Article history
Received: April 04 2024
Accepted: August 25 2024
Published: August 30 2024

Publishe's Note:
BIOEDUSCIENCE stays neutral with regad to jurisdictional claims in published maps and institutional affiliations.

Citation: Ginting, N.A.B., Ruyani, A., Defianti, A., Palindungan, D., & Hidayat, T. (2024). The Effect of Adding Silk Worms (*Tubifex tubifex*) Feed on the Growth of Jelawat Fish (*Leptobabus hoevenii* [Bleeke, 1851]). *BIOEDUSCIENCE, 8*(2), 258-266. doi: 10.22236/jbes/14706

Introduction

Law No. 9 of 1985 concerning fisheries states that fisheries development manages fish resources through pre-production, production, and marketing optimally for the Indonesian people's prosperity (Agus, 2018). Indonesia is a maritime country with a large water area, and it can be seen that Indonesia is flanked by the Indian Ocean and the Pacific Ocean so that fishery resources in sea waters and on land can be managed optimally, one of which is by cultivating fish (Sari et al., 2021). Excessive fishing can lead to a decrease in the fish population, which is one of the problems in managing existing water areas. Signs of excessive fishery can be seen in the activities of fishermen to catch fish, and the results always decrease in some regions of Indonesia (Agus, 2018).

Jelawat fish (*Leptobarbus hoevenii*) is a freshwater fish native to Indonesia in Sumatra and Kalimantan Island waters. The advantage of *L. hoevenii* is that it has a high economic value as a fish for consumption. Even the jelawat fish is favored by several countries, including Brunei and Malaysia, so the jelawat fish can be used as a potential commodity and encourage the interest of the Indonesian people to develop it (Iskandar et al., 2015). Jelawat fish is superior in Riau Province, precisely in Kampar Regency. Jelawat fish has many nutrients, including 66.3% water, 19.7% protein, 13.2% fat, 1.17% ash content, and other components of 0.63% (Nasution et al., 2015). *L. hoevenii* has a body length of about

41 cm and weighs about 10 kg. Several regions in Indonesia call *L. hoevenii* bundung fish, jelejer fish, kumpai jelawat, and fatty fish (Zulkifli, 2018).

The cultivation of *L. hoevenii* is less effective because it is still seasonal, and the results of the seed catch also still depend on nature. Hence, the sustainability of *L. hoevenii* cultivation activities is still not guaranteed (Aryani, 2017). Fishing carried out seasonally and continuously will cause limitations in the number of fish populations used as fishing objects (Sinaga & Dimenta, 2022). Other obstacles encountered during fish farming are poor feed quality and disease infections (Ojwala et al., 2018). The growth of *L. hoevenii* is highly dependent on the feed given. Lack of protein content in the feed can slow the growth of *L. hoevenii* (Ari et al., 2023).

The types of feed are divided into two parts: artificial feed, often called pellets, and natural feed. Daily live feed for fish must also be designed so that fish can grow well (Sunarno & Syamsunarno, 2015). Several studies have combined artificial feed with natural feed. The results show that combining artificial feed with natural feed can support the growth and survival of fish (Sunarno & Syamsunarno, 2017), so it is not uncommon for fish farmers to prefer to combine artificial fish feed with natural fish feed. One of the natural feeds that can be combined with artificial feed is *T. tubifex*.

T. tubifex is a natural feed used by fish farmers, especially in cultivating fish larvae and seeds. The silkworm is very small, so fish larvae and seeds can quickly devour it (Rihi, 2019). The use of *T. tubifex* as fish feed has been carried out by previous researchers, such as in catfish cultivation (Mullah et al., 2020), snakehead fish cultivation (Wulandari et al., 2023), and snakehead fish cultivation (Juliantara et al., 2020). Therefore, researchers tried to combine *T. tubifex* with pellets as an alternative feed for *L. hoevenii* to determine the growth of *L. hoevenii*. This study aimed to assess the effect of *T. tubifex* feed on the growth rate of *L. hoevenii* and the best feed dose for the growth of *L. hoevenii* seeds.

Metode

This study used a Completely Randomized Design (CRD) with four treatment groups with different feed combinations in each group namely, the first treatment group, symbolized by A, was given 100% pellet feed, the second treatment group, symbolized by B, was given 25% pellet feed + 75% *T. tubifex*, the third treatment group symbolized by C was given 50% pellet feed + 50% *T. tubifex*, and the fourth treatment group symbolized by D was given 75% pellet feed + 25% *T. tubifex*.

Tools and Materials

The tools used in this study were an Armada Aquarium Pump brand aerator, a 48.4x31x26 cm Ezy Box brand container box, an Analyzer brand do meter, a Vernier Caliper brand caliper, a Butterfly brand ruler, a Digital Atc brand pH meter, TDS brand Tds-3 Tds/Temp, and a fishing net. The materials used in this study were *L. hoevenii*, *T. tubifex*, pellets (PF 1000), ketapang leaves, fish salt, and methylene blue. Pictures of *L. hoevenii*, *T. tubifex* feed, and pellet feed (PF 1000) can be seen in Figure 1, Figure 2, and Figure 3.

Figure 1. Jelawat Fish (*L. hoevenii*)

Figure 2. Changing Silka (*T. tubifex*)

Figure 3. Pellets (PF 1000)

Time and Place of Research

This research was conducted in September-October 2023 for 28 days at the Ruyani Life Sciences Learning Resource (SBIH) (Ruyani et al., 2018) in Bengkulu City. The number of *L. hoevenii* kept was 20, and they were obtained in the Talang Kering area of Bengkulu City. *T. tubifex*, used as additional feed for *L. hoevenii* was obtained in the Bentiring area of Bengkulu City.

Fish Maintenance Process

The *L. hoevenii* seeds used in this study were fish seeds with an average individual of around 4g/tail, an average individual length of around 30 mm/tail, and an average individual body thickness of around 10 mm/tail. *L. hoevenii* was kept for 28 days and fed twice daily at 08.00 WIB and 16.00 WIB, with a feed dose of 3% of the fish's body weight. Every two days, the fish container is cleaned by removing ±1/4 of the water along with fish waste and replacing it with clean water; the aim is to keep the fish environment clean. After cleaning the container, the fish container is given two tablespoons of fish salt and three drops of methylene blue. Adding fish salt and methylene blue aims to prevent the fish from stress, and ketapang leaves are given so that the fish are protected from bacterial diseases (Ramadhani et al., 2023).

Data Analysis

Data analysis in this study was the analysis of variances (ANOVA) test followed by the most negligible significant difference (LSD) test because there was an important statement. The measurement parameters in this study were the Specific Growth Rate (SGR) or specific growth rate (Weight, length, and width of fish), Survival Rate (SR), Feed Conversion Ratio (FCR), and water quality (temperature, DO, TDS, and pH).

Specific Growth Rate (SGR)

Specific Growth Rate or fish growth rate during maintenance can be calculated using the following formula (Muchlisin et al., 2016).

$$SGR = \frac{In\ Wt - In\ Wo}{\Delta t}$$

Description:
SGR = Specific Growth Rate or specific growth rate (%)
Wt = Fish weight at the end of maintenance (g)
Wo = Fish weight at the beginning of maintenance (g)
Δt = Maintenance period (days)

Survival Rate (SR)

Survival Rate (SR) can also be called survival. SR can be calculated using the following formula (Harahap et al., 2019).

$$SR = \frac{nt}{no}\ x\ 100\%$$

Description:
SR = Survival Rate or survival (%)
Nt = number of fish at the end of the study (tail)
No = Number of fish at the beginning of the study (tail)

Food Conversion Ratio (FCR)

Food Conversion Ratio (FCR) can also be called the feed conversion ratio and can be calculated using the following formula (Harahap et al., 2019).

$$FCR = \frac{F}{(Wt + D) - Wo}$$

Description:
FCR = Food Conversion Ratio or feed conversion
F = Total amount of feed given (g)
Wt = Total Weight of fish at the end of the study (g)
Wo = Total Weight of fish at the beginning of the study (g)
D = Weight of fish that died during the study (g)

Results

The results of the observation of *L. hoevenii* weight growth can be seen in Table 1.

Table 1. Data on the results of *L. hoevenii* weight growth

Treatment Group	N	P1 ($\bar{x}$±SD)	P2 ($\bar{x}$±SD)	P3 ($\bar{x}$±SD)	P3-P1 (%)
A (Pelet 100%)	5	4,34±0,42	4,62±0,46	4,84±0,41^{b}	0,5 (11,52)
B (Pelet 25%+ *T. tubifex* 75%)	5	4,16±0,24	4,74±0,19	5,18±0,20^{c}	1,02* (24,51)
C(Pelet 50% +*T. tubifex* 50%)	5	4,12±0,13	4,44±0,23	4,66±0,21^{ab}	0,54 (13,10)
D (Pelet 75%+*T. tubifex* 25%)	5	4,10±0,23	4,26±0,27	4,44±0,30^{a}	0,34 (8,29)

Description: N = Repeat, P1 = 1st measurement (September 28, 2023), P2 = 2nd measurement (October 12, 2023), P3 = 3rd measurement (October 26, 2023), $\bar{x}$ = Average, SD = Standard Deviation, Number notation followed by the same letter indicates no significant difference at a significance level of 0.05%, Notation * shows very substantial growth.

The results of observations in Table 1 can be seen more clearly in Figure 4 below:

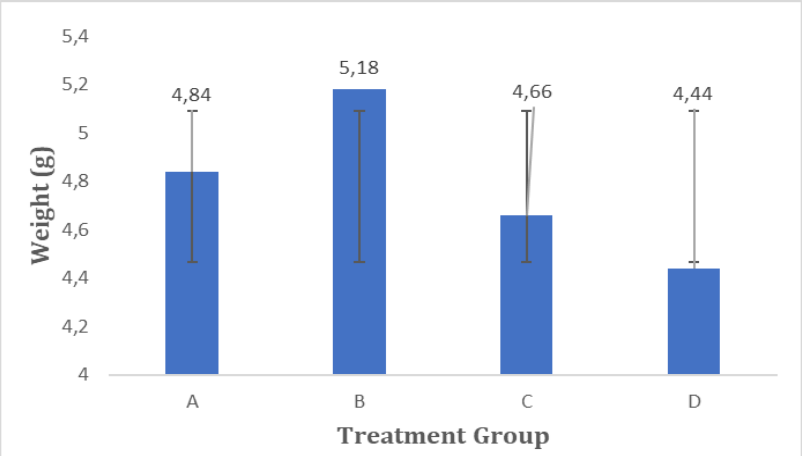

Figure 4. Histogram of *L. hoevenii* body weight growth
Description: A = Treatment group given 100% pellet feed, B = Treatment group given 25% pellet feed + 75% *T. tubifex*, C = Treatment group given 50% pellet feed + 50% *T. tubifex*, D = Treatment group given 75% pellet feed + 25% *T. tubifex*.

Based on the results of the analysis of variance (ANOVA) test, it shows that feeding with each different treatment can significantly affect the growth of *L. hoevenii* with a significance value (P <0.05) at a confidence level of 95%. From Table 1 and Figure 4, it is known that the best weight gain during the study was in treatment B (25% Pellets + 75% *T. tubifex*) which

was from 4.16-5.18 g, followed by treatment A (100% Pellets) from 4.34-4.84 g, continued with treatment C (50% Pellets + 50% *T. tubifex*) from 4.12-4.66 g, and the lowest in treatment D (75% Pellets + 25% *T. tubifex*) from 4.10-4.44 g. The results of observations of *L. hoevenii* body length growth can be seen in Table 2.

Table 2. Data on the results of the growth of *L. hoevenii* body length

Treatment Group	N	P_1 ($\bar{x}$±SD)	P_2 ($\bar{x}$±SD)	P_3 ($\bar{x}$±SD)	P_3-P_1 (%)
A (Pelet 100%)	5	31,6±2,07	33,2±1,64	35,0±1,87[a]	3,4 (10,75)
B (Pelet 25%+ *T. tubifex* 75%)	5	32,6±1,95	43,8±6,06	57,2±5,81[c]	24,6* (75,46)
C (Pelet 50%+*T. tubifex*50%)	5	33,0±1,58	38,0±3,16	42,6±3,97[b]	9,6 (29,09)
D (Pelet 75%+*T. tubifex* 25%)	5	34,2±1,92	37,4±2,70	43,2±3,83[b]	9,0 (26,31)

Description: N = Repeat, P1 = 1st Measurement (September 28, 2023), P2 = 2nd Measurement (October 12, 2023), P3 = 3rd Measurement (October 26, 2023), $\bar{x}$ = Average, SD = Standard Deviation, Number notation followed by the same letter indicates no significant difference at the 0.05% significance level, * shows very substantial growth.

Observation results are in Table 2. This can be seen more clearly in Figure 5.

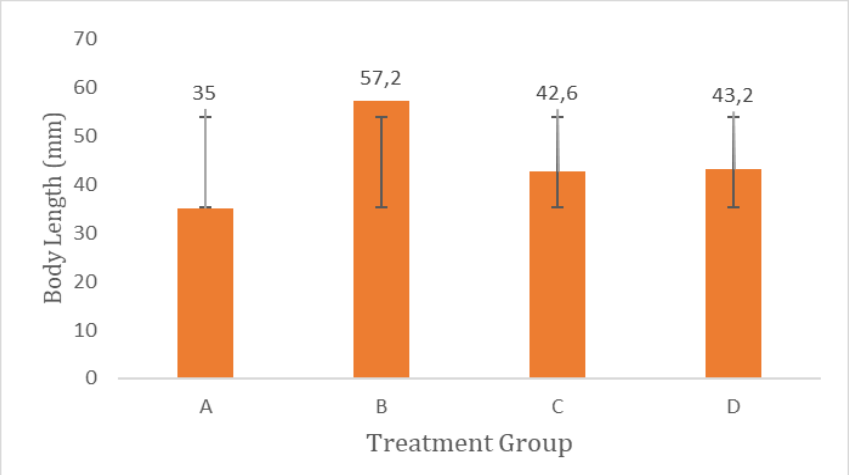

Figure 5. Histogram of body length growth of *L. hoevenii*

Description: A = Treatment group fed 100% pellets, B = Treatment group fed 25% pellets + 75% *T. tubifex*, C = Treatment group fed 50% pellets + 50% *T. tubifex*, D = Treatment group fed 75% pellets + 25% *T. tubifex*.

Based on the results of the analysis of variance (ANOVA) test, it shows that feeding with each different treatment can significantly affect the growth of *L. hoevenii* with a significance value (P <0.05) at a 95% confidence level. From Table 2 and Figure 5, it can be seen that the best body length growth during the study was in treatment B (25% Pellets + 75% *T. tubifex*) which was from 32.6-57.2 mm, followed by treatment D (75% Pellets + 25% *T. tubifex*) from 34.2-43.2 mm, continued with treatment C (50% Pellets + 50% *T. tubifex*) from 33.0-42.6 mm, and the lowest in treatment A (100% Pellets) from 31.6-35.0 mm. The results of observations of *L. hoevenii* body thickness can be seen in Table 3.

Table 3. Data on the results of *L. hoevenii* body thickness growth

Treatment Group	N	P_1 ($\bar{x}$±SD)	P_2 ($\bar{x}$±SD)	P_3 ($\bar{x}$±SD)	P_3-P_1 (%)
A (Pelet 100%)	5	10,51±0,29	10,61±0,21	10,86±0,21[a]	0,35 (3,33)
B (Pelet 25%+ *T. tubifex* 75%)	5	10,46±0,33	11,47±0,21	13,30±0,50[c]	2,84* (27,15)
C (Pelet 50%+*T. tubifex*50%)	5	10,56±0,34	11,27±0,59	12,27±0,54[b]	1,71 (16,19)
D (Pelet 75%+*T. tubifex* 25%)	5	10,46±0,33	11,12±0,33	11,83±0,43[b]	1,37 (13,09)

Description: N = Repetition, P1 = 1st measurement (September 28, 2023), P2 = 2nd measurement (October 12, 2023), P3 = 3rd measurement (October 26, 2023), $\bar{x}$ = Average, SD = Standard Deviation, Number notation followed by the same letter indicates no significant difference at the 0.05% significance level, Notation * shows very substantial growth.

Observation results Table 3. This can be seen more clearly in Figure 6.

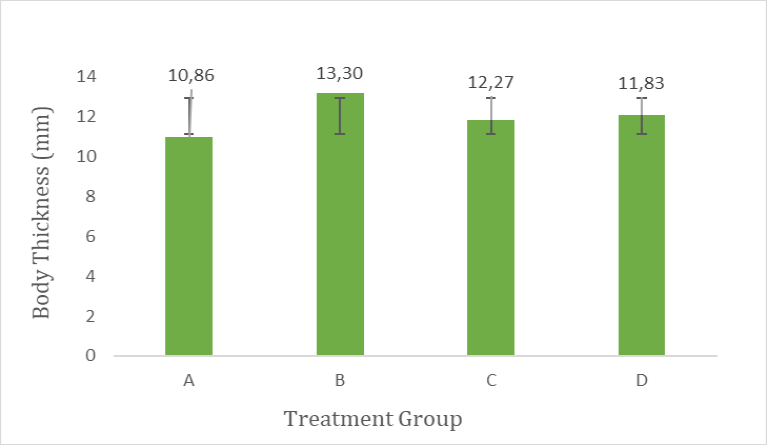

Figure 6. Histogram of *L. hoevenii* body thickness growth

Description: A = Treatment group given 100% pellet feed, B = Treatment group given 25% pellet feed + 75% *T. tubifex*, C = Treatment group given 50% pellet feed + 50% *T. tubifex*, D = Treatment group given 75% pellet feed + 25% *T. tubifex*.

Based on the results of the analysis of variance (ANOVA) test, it shows that feeding with each different treatment can significantly affect the growth of *L. hoevenii* with a significance value (P<0.05) at a confidence level of 95%. From Table 3 and Figure 6, it is known that the best body thickness growth during the study was in treatment B (25% Pellets + 75% *T. tubifex*) which was from 10.46-13.30 mm, followed by treatment D (75% Pellets + 25% *T. tubifex*) from 10.46-11.83 mm, continued with treatment C (50% Pellets + 50% *T. tubifex*) from 10.56-12.27 mm, and the lowest was in treatment A (100% Pellets) from 10.51-10.86 mm.

Discussion

Growth Rate of Jelawat Fish (Leptobabus hoevenii)

In this study, the growth rate of jelawat fish can be seen within two weeks; based on the results of the analysis of variance (ANOVA), it was found that the provision of silkworms (*Tubifex tubifex*) and PF 1000 had a significant effect on the growth of jelawat fish, differences in growth rates can occur due to differences in the dose of feed given to each treatment. The protein content in the feed can affect the growth rate of the fish being raised. The protein content follows the needs of the fish so that fish growth can increase. If the dose of feed in each treatment is different, the nutrients given for each treatment are also other (Hidayat et al., 2013).

The SGR of each treatment gets a different value, and it can be seen that treatment B gets the highest SGR value of 18.21%, followed by treatment C, which is 9.64%, continued with treatment A, which is 8.92%, and the lowest is in treatment D which is 6.07%. The weight gain in each treatment was also different; Treatment B got the highest weight value of 5.1 g, followed by Treatment C, which was 2.7 g, followed by Treatment A, which was 2.5 g, and the lowest was Treatment D, which was 1.7 g. The FCR in each treatment was also different, and it can be seen that the FCR figure in treatment D was significant, namely 6.02%, followed by treatment C, which was 2.93%, then treatment B, which was 2.20%, and lowest was in treatment A which was 0.88%. The growth rate of fish is also determined by the swimming ability of the fish (Sinaga & Dimenta, 2022). Good feed efficiency was found in treatment A, but a more significant growth rate was found in treatment B. The swimming ability of *L. hoevenii* found in treatment A was more active than treatment B, so the growth rate in treatment A was lower than treatment B. *L. hoevenii* found in treatment A had a lower appetite than *L. hoevenii* found in treatment B. The factor thought to influence fish appetite is the environment. A clean environment rich in oxygen and low levels of dissolved ammonia (metabolic waste and feces) can increase fish appetite (Septimesy et al., 2016). SR in each treatment has the same value of 100% because no fish died during the study. The results of weight gain, SGR, SR, and FCR of jelawat fish can be seen in Table 4.

Table 4. Results of data analysis of fish weight gain, Sustainable Growth Rate (SGR), Survival Rate (SR), and Food Conversion Rate (FCR) *L. hoevenii*.

Treatment Group	N	Weight Gain	SGR (%)	SR (%)	FCR (%)
A (Pelet 100%)	5	2,5	8,92	100	0,88
B (Pelet 25%+ *T. tubifex* 75%)	5	5,1	18,21	100	2,20
C (Pelet 50%+*T. tubifex*50%)	5	2,7	9,64	100	2,93
D (Pelet 75%+*T. tubifex* 25%)	5	1,7	6,07	100	6,02

Description: N = Repeat, SGR = Sustainable Growth Rate, SR = Growth Rate, FCR = Food Conversion Rate.

Feed Combination Showing the Highest Growth of Jelawat Fish (Leptobabus hoevenii)

In addition to the effectiveness of feed that can affect fish growth, the ability of fish to get food can also affect fish growth. The size of the feed to be given to fish should also be adjusted to the mouth of the fish. If the feed given to the fish is larger than the fish's mouth, the fish will have difficulty eating it, which can inhibit fish growth.

In this study, the size of the feed was adjusted to the size of the mouth of *L. hoevenii*, namely using pellets (PF 1000) produced by the Matahari Sakti factory, which has several nutrients including 39% protein, 6% fat, 3% fiber, 11% ash content, and 10% water content. The next feed is *T. tubifex*, which is obtained in the Bentiring area, Bengkulu City, Muara Bangka Hulu District; the nutritional content of silkworms is 57% protein, 13.3% fat, 2.04% crude fiber, 3.6% ash content, and 87.7% water content and silkworms also contain 13 amino acids (Febrianti et al., 2020). According to previous research results, a good feed combination for *L. hoevenii* is 25% pellets with 75% *T. tubifex* capable of producing a specific weight growth rate of 4.17%, a specific length growth of 6.96% (Aini et al., 2023). Based on the results of the research that has been conducted on the development of *L. hoevenii*, including fish weight, fish body length, and fish body thickness in each treatment, it can be seen that treatment B (25% pellets + 75% *T. tubifex*) gave the highest growth to *L. hoevenii*; this is thought to be because the protein content of the feed in treatment B is sufficient so that it produces good growth.

Water Quality of L. hoevenii Maintenance Media

During fish maintenance, water quality also needs to be considered because cloudy water conditions can cause the potential for bacteria or fungi that are harmful to fish. Water quality in fish maintenance can affect fish survival and gonad development (Habibah et al., 2020). Poor water quality can stress fish, so water quality also plays a role in fish growth. The water quality parameters measured in this study were temperature, potential Hydrogen (pH), Total Dissolved Solid (TDS), and Dissolved Oxygen (DO). Water quality data as a medium for maintaining *L. hoevenii* can be seen in Table 5.

Table 5. Water quality data for maintaining *L. hoevenii*

Treatment Group	N	Temperature (°C)	Do (%)	TDS (ppm)	pH
A (Pelet 100%)	5	30,3-33,1	1,9-5,7	196-531	6,8-8,8
B (Pelet 25%+ *T. tubifex* 75%)	5	30,3-33,0	1,8-5,4	199-518	6,8-8,0
C (Pelet 50%+*T. tubifex*50%)	5	30,3-32,0	2,2-5,0	428-520	6,7-8,1
D (Pelet 75%+*T. tubifex* 25%)	5	30,2-32,1	2,0-5,9	351-577	7,6-7,9

Description: N = Repeat, Do = Dissolved Oxygen, TDS = Total Dissolved Solid, Ph = Potential Hydrogen.

The results obtained during the temperature measurement were 30-33.1°C. The temperature range during the study was still categorized as unsafe enough for fish survival. A suitable temperature for fish growth is around 25-30°C (Herlina, 2016). The factor that caused the temperature during the study to be relatively high was the hot weather when the study was taking place. Temperature measurements in this study were carried out from noon to evening. The results obtained during the Do measurement were 1.8-5.9. The TDS value obtained ranged from 351-577. The ideal TDS value is around 300-500. The higher the

TDS value obtained, the more bitter the water will taste (Untari, 2022). The pH results obtained during the study ranged from 6-8.8. The lower the pH value obtained, the weaker the movement of the fish being kept (Nasrullah et al., 2021). In the maintenance of *L. hoevenii*, ketapang leaves are placed in a maintenance container; ketapang leaves contain flavonoids and tannins, which can be antioxidants and antibiotics for fish (Scabra et al., 2021). In this study, fish salt was added to the water media to prevent bacteria from growing (Puspitasari et al., 2021). Methylene blue, given three drops to fish in this study, aims to reduce stress levels in fish and fungi that attack fish. Adding methylene blue and fish salt can be used as recommended antibiotics to cure fish diseases and mitigate stress in fish (Putri, 2021). Fish have a robust immune system so they can live in water with many microbes. Fish skin will cause infection if it remains in a water environment with many microbes. Fish skin mucus is one of the first ways for fish to avoid the many microbes in the water (Fakih & Dewi, 2020).

Conclusion

Feeding pellets (PF 1000) with additional feed *T. tubifex* can significantly affect the growth of *L. hoevenii*. The best treatment for the growth of *L. hoevenii* in this study was treatment B (25% pellets + 75% *T. tubifex*). This study was limited to 28 days, resulting in good growth of *L. hoevenii*. The maintenance time of *L. hoevenii* can be added to produce better growth.

Acknowledgments

The author would like to thank Diah Suprihatin, who helped and accompanied the author during the research. The author would also like to congratulate Atmajaya Ginting and Rostety Br Bangun, who have given their prayers and all forms of sacrifice to encourage the author. SBIH Ruyani has also been willing to be a place for research and facilitate this research.

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