

THE EFFECT OF ADDING MORINGA LEAF FLOUR (*Moringa oleifera*) TO FERMENTED PASTED FEED ON THE GROWTH AND SURVIVAL OF GURAMI FISH LARVAE (*Osphronemus gouramy* Lac.)

Ihsan Fadhillah^{1*}, Netti Aryani¹, Sukendi¹

¹Department of Aquaculture, Faculty of Fisheries and Marine,
Universitas Riau, Pekanbaru, 28293 Indonesia

*ihsan.fadhillah2364@student.unri.ac.id

ABSTRACT

The growth of gurami fish larvae (*Osphronemus gouramy* Lac.) is often hindered by a limited supply of natural feed such as silkworms. Fermented paste feed supplemented with moringa leaf meal (*Moringa oleifera*) is expected to serve as an alternative feed that can reduce dependence on silkworms. The objective of this study was to determine the effect of fermented paste feed supplemented with moringa leaf meal (MLM) on the growth and survival of gurami fish larvae. The study was conducted over 40 days using a completely randomized design (CRD) consisting of six treatments with three replicates: P1 (0 g/kg MLF), P2 (20 g/kg MLF), P3 (40 g/kg MLF), P4 (60 g/kg MLF), P5 (80 g/kg MLF), and P6 (*Tubifex* sp.). The results showed that the addition of moringa leaf flour had a significant effect ($P < 0.05$) on absolute weight gain, absolute length gain, specific growth rate, and survival rate of gurami fish larvae. The best results were obtained in treatment P4 (60 g/kg TDK), with an absolute weight gain of 0.37 g, an absolute length gain of 1.58 cm, a specific growth rate of 8.36%/day, and a survival rate of 88.87%. Water quality parameters during the study remained within the optimal range, with temperatures ranging from 26.1–27.9 °C, a pH of 6.6–7.1, and dissolved oxygen levels of 5.2–6.6 mg/L.

Keywords: Gurami Fish, Larvae, Pellet feed, Moringa leaf meal, Growth

1. INTRODUCTION

The gurami (*Osphronemus gouramy* Lac.) is a type of freshwater fish that is popular among the public¹. This fish has high and relatively stable economic value, particularly in Riau Province. Public demand for gurami tends to be on the rise, but market demand has not yet been fully met². Gurami fish farming has great potential for development to meet public demand. In line with the expansion of this industry, gurami fry production must also be increased.

To increase the availability of fry, maximum effort must be made in hatchery operations. Larval rearing is a crucial stage in hatchery operations. The success of the larval rearing process depends on the

availability of feed, both in terms of quality and quantity³.

Silkworms are the initial feed given to gurami fish during the larval stage². However, the supply of silkworms still relies heavily on wild-caught specimens, so their availability remains highly dependent on the season⁴. Therefore, an alternative feed source is needed to reduce dependence on silkworms. One alternative feed that can be given to fish larvae is fermented paste. However, this feed has not yet been able to fully replace silkworms. Lase⁵ report Fermented pasta feed can replace 76.67% of the weight gain, 62.12% of the length growth, and 92.68% of the survival rate of silkworms. Therefore, the quality of fermented pasta feed needs to be improved

by adding certain ingredients, one of which is moringa leaf flour.

Moringa leaves (*Moringa oleifera*) are a plant with potential as a phytopharmaceutical because they contain secondary metabolites with natural medicinal properties. The bioactive compounds found in moringa leaves include flavonoids, tannins, alkaloids, and saponins⁶. Flavonoids act as antioxidants, while saponins have antimicrobial properties that can inhibit the growth of bacteria and fungi⁷. This combination of compounds makes moringa leaves beneficial for maintaining the health of fish and boosting their immunity. In addition, moringa leaves also contain essential amino acids⁸ and minerals such as calcium, potassium, and iron⁹. Adding moringa leaves to fish feed has been reported to increase digestive enzyme activity, allowing the nutrients in the feed to be utilized more effectively to support fish growth¹⁰.

According to Perdana et al.¹¹, The addition of moringa leaf flour at a dose of 60 g/kg to commercial feed had a significant effect on the length, weight, specific growth rate, and feed conversion ratio of Nile tilapia (*Oreochromis niloticus*) fry. Rasdi et al.¹² also reported that the addition of moringa leaf powder at a dose of 60 g/kg was able to improve the growth and survival rate of tilapia (*Oreochromis niloticus*) larvae.

Given this background, the availability of initial feed is one of the crucial factors affecting larval growth and survival. Adding moringa leaf powder to fermented paste feed is one alternative that can be used to replace silkworms

2. RESEARCH METHOD

Time and Place

This study was conducted from January to February 2026 over a 40-day rearing period at the Fish Hatchery and Breeding Laboratory (PPI) of the Faculty of Fisheries and Marine Sciences, Universitas Riau.

Method

The treatments used in this study were based on previous research Rasdi et al.¹² regarding the effect of adding moringa leaf powder to feed on the growth and survival of tilapia larvae, with an optimal dosage of 60 g/kg of feed. The Completely Randomized Design (CRD) used was a design model namely:

- P1 = Fermented pasta feed without added moringa leaf flour (control)
- P2 = Fermented pasta feed + moringa leaf flour 20 g/kg
- P3 = Fermented pasta feed + moringa leaf flour 40 g/kg
- P4 = Fermented pasta feed + moringa leaf flour 60 g/kg
- P5 = Fermented pasta feed + moringa leaf flour 80 g/kg
- P6 = Natural feed for silkworms (*Tubifex* sp.) (positive control)

Procedures

Four-day-old gurami fish larvae were obtained directly from Sawah Baru Village, Kampa Subdistrict, Kampar Regency. Moringa leaves were obtained from Sidomulyo Barat Urban Village, Pekanbaru City, by picking them directly from the trees. Before use, the leaves were separated from the stems and placed in a sterile container. Next, the moringa leaves were thoroughly washed, dried at room temperature, and blended until smooth.

The feed used for gurami fish larvae consisted of PF-0 to which moringa leaf flour was added at various doses and then fermented. The feed to which moringa leaf flour had been added was subsequently fermented using EM-4 probiotics that had been activated with condensed milk and mineral water in a 1:1:10 ratio.

The containers used were 18 aquariums measuring 30 x 30 x 30 cm³, located at the Fish Breeding and Improvement Laboratory, Faculty of Fisheries and Marine Sciences, Universitas Riau, and equipped with aeration systems. The water used was sourced from a well and

allowed to settle for 3 days. Feeding was conducted four times a day (07:00, 12:00, 17:00, 22:00).

Measured Parameters

The parameters measured were the larvae's response to feed, absolute weight gain (g), absolute length gain (cm), specific growth rate (%), survival rate (%), the ability

of the feed to replace silkworms (%), and water quality.

3. RESULT AND DISCUSSION

Larval Response to Feed

The results of the observation of gurami larvae's response to fermented paste feed supplemented with moringa leaf flour over a 40-day period are presented in Table 1.

Table 1. Larval response to feed

Treatment	Observations			
	How larvae respond to food	The appeal of larvae	Leftover feed	Total
P1	3	1	3	7
P2	3	1	3	7
P3	3	3	3	9
P4	3	3	5	11
P5	3	3	3	9
P6	5	5	5	15

Description: Score 1: Larvae are not aggressive when feeding, swim slowly to feed, and there is a lot of uneaten food at the bottom of the container; Score 3: Larvae are somewhat aggressive when taking food; they swim quickly toward the food, and there is a small amount of uneaten food at the bottom of the container; and Score 5: Larvae are aggressive when taking food; they swim quickly to take food, and no food remains

Based on Table 1, it can be seen that the larvae's response to the feed in treatment P6 falls into the "very good" category (score of 15). This high response score is due to the fact that silkworms are a natural food source that is highly preferred by gurami fish larvae¹³. Silkworms have an attractant in the form of a scent that can increase their appetite, as well as movements that can prompt the larvae to consume the feed. This is consistent with Yanes-Roca et al.¹⁴ which states that natural feed can provide visual and chemical stimuli to increase feed intake in fish larvae. In P4 (fermented pasta feed + 60 g/kg moringa leaf flour), the larvae's response to the feed was also classified as good (score of 11).

The addition of moringa leaves to the feed has been reported to increase digestive enzyme activity¹⁰, thereby optimizing the digestive process. In addition, the addition of moringa leaf flour to the fermented paste feed at a dose of 60 g/kg is believed to improve the feed's palatability, as evidenced by the absence of uneaten feed at the bottom of the aquarium. This condition can contribute to the growth of gurami fish

larvae, since the more feed they consume, the more energy is absorbed by their bodies¹⁵.

In P5 (fermented paste diet + 80 g/kg moringa leaf flour), the larvae's response to the diet was suboptimal (score 9). The high dose of moringa leaf flour is suspected to have altered the diet's taste due to increased saponin levels, thereby reducing the larvae's interest in the diet. In treatment P3 (fermented paste feed + 40 g/kg moringa leaf flour), the larvae's response to the feed was also classified as suboptimal (score 9). Although the addition of moringa leaf flour to the feed can increase digestive enzyme activity¹⁰, The dose of moringa leaf powder used in that treatment is believed to have been insufficient to produce a positive effect on the increase in digestive enzyme activity.

In P2 (fermented pasta feed + 20 g/kg moringa leaf flour), the larvae's response to the feed was less than optimal (score of 7). The 20 g/kg dose was likely insufficient to have a positive effect on appetite and digestibility. This is consistent with Rasdi et al.¹² which reported that the addition of

moringa leaf flour at low doses did not have a significant effect on feed intake.

In P1 (fermented pasta feed without the addition of moringa leaf flour), the larvae's response to the feed provided was poor (score of 7). This resulted in low feed intake, meaning the larvae's nutrient intake was suboptimal. This condition ultimately led to stunted larval growth.

Proximate Analysis Results

The purpose of feed proximate analysis is to determine the main nutritional components of the feed Islam et al.⁸ reported that moringa leaf flour contains 27.1% protein, 2.3% fat, 19.2% crude fiber, and 38.2% carbohydrates. The results of the proximate analysis are presented in Table 2.

Table 2. Proximate analysis results

Composition	P1 ¹⁶	P2 ^(b)	P3 ^(b)	P4 ^(b)	P5 ^(b)	P6 ¹⁷
Protein (%)	25,29	22,47	24,30	24,28	23,43	52,77
Fat (%)	1,19	3,33	3,88	4,48	3,83	8,3
Crude Fiber (%)	0,15	3,50	3,18	3,21	3,40	5,2
Ash (%)	6,37	5,65	6,92	10,76	5,90	5,05
Moisture Content (%)	47,37	43,44	41,33	40,04	42,75	16,75
BETN (%)	19,26	21,60	20,39	17,23	20,69	11,93

Source: ^aResults of Proximate Analysis at the Fish Nutrition Laboratory, Bogor Agricultural University

Based on Table 2, the proximate analysis results show that silkworms have the highest protein content, at 52.77%, whereas in the fermented pasta feed treatment group, the highest protein content was found in P1 at 25.29%, followed by P3 at 24.30%, P4 at 24.28%, and P5 at 23.43%, with the lowest protein content found in P2 at 22.47%. The decrease in protein content in these feeds is consistent with reports Handajani et al.¹⁸ Specifically, the addition of moringa leaf flour to the feed reduced the protein content from 43.15% in the control group to 37.97% at a dose of 50 g/kg of feed.

The crude fiber content in the fermented pasta feed supplemented with moringa leaf flour increased from 0.15% in P1 to 3.40% in P5. This increase was due to the high crude fiber content of moringa leaf flour, which was 19.2%⁸. Although the crude fiber content in P1 through P5 increased, the values remained within the limits set by SNI¹⁹ For gurami fry feed, the percentage is 7%. Furthermore, the fat content in the fermented pasta feed supplemented with moringa leaf flour increased from 1.19% in treatment P1 to 3.83% in P5. This is consistent with Windarti et al.²⁰, which reported that the addition of moringa leaf flour to commercial feed increased the fat content from 5% in the

control group (0 g/kg) to 9.86% in the treatment group receiving a dose of 15 g/kg. On the other hand, the BETN content showed a slight increase from 19.26% in P1 to 20.69% in P5. This indicates that the addition of moringa leaf flour contributes to an increase in the crude fiber, fat, and BETN content of the feed.

Growth and Survival of Gurami Fish Larvae

Based on Table 3, it was found that the absolute weight gain of gurami fish larvae ranged from 0.29 to 0.44 g, the absolute length gain ranged from 1.16 to 1.95 cm, the specific growth rate ranges from 7.82 to 8.77% per day, and the survival rate ranges from 78.87 to 94.43%.

The addition of moringa leaf powder to fermented pasta feed had a significant effect ($P < 0.05$) on the weight gain of gurami fish larvae. No significant increase in the weight gain of gurami fish larvae was observed from the start of rearing through day 10. This is thought to be because the larvae were still adapting from relying on their yolk sac reserves to external feed.

From day 11 through day 20, an increase in the average larval weight began to be observed across all treatments. P6 (silkworms) showed the highest daily weight

gain compared to the other treatments. This is consistent with Febrianti et al.¹³ which states that silkworms are a natural food

source preferred by gurami fish larvae and can promote faster growth compared to other types of feed.

Table 3. Absolute weight gain (g), Absolute length gain (cm), Specific growth rate (%/day), and survival rate (%) of gurami fish larvae

Treatment	Absolute Mass (g)	Absolute Length (cm)	Specific Growth Rate (%/Day)	Survival Rate (%)
P1	0,29 ± 0,002 ^a	1,16 ± 0,02 ^a	7,82 ± 0,01 ^a	78,87 ± 3,84 ^a
P2	0,30 ± 0,002 ^b	1,20 ± 0,01 ^a	7,90 ± 0,01 ^b	82,20 ± 3,85 ^{ab}
P3	0,33 ± 0,003 ^c	1,37 ± 0,02 ^b	8,13 ± 0,02 ^c	85,53 ± 1,92 ^{bc}
P4	0,37 ± 0,003 ^e	1,58 ± 0,02 ^d	8,36 ± 0,01 ^e	88,87 ± 1,92 ^{bc}
P5	0,35 ± 0,001 ^d	1,48 ± 0,02 ^c	8,25 ± 0,01 ^d	87,77 ± 1,92 ^c
P6	0,44 ± 0,002 ^f	1,95 ± 0,03 ^e	8,77 ± 0,01 ^f	94,43 ± 1,92 ^d

From days 21 to 40 of the experiment, noticeable differences began to appear among the treatment groups. Treatment P4 (fermented paste feed + 60 g/kg moringa leaf flour) showed higher daily weight gain compared to the other treatment groups. This higher growth is believed to be due to the nutritional content of the moringa leaf flour, such as essential amino acids⁸, vitamins, and essential minerals such as calcium and iron. In P5 (fermented paste feed + 80 g/kg moringa leaf flour), the highest dose of moringa leaf flour did not result in higher weight gain compared to P4. This was because the feed response value in P5 was lower than that in P4. Nevertheless, the weight gain in P5 was still considered good.

In line with weight gain, P4 (fermented pasta feed + 60 g/kg moringa leaf flour) also showed the highest length growth compared to the other pasta feed groups. This high growth is believed to be due to the contribution of various nutrients found in moringa leaf flour, such as essential amino acids and vitamins A, C, and E²¹. In addition, the high calcium content is believed to support bone formation and growth, thereby promoting longitudinal growth⁸.

In P5 (fermented paste feed + 80 g/kg moringa leaf flour), an increase in the moringa leaf flour dose actually resulted in a decrease in length growth compared to P4. This finding indicates that increasing the moringa leaf flour dose does not provide any additional effect on the length growth of gurami larvae.

The highest specific growth rate in the fermented pasta diet treatment group was observed in P4 (fermented pasta diet + 60 g/kg moringa leaf flour), at 8.36%/day. Although this figure does not yet fully match the growth rate observed in the silkworm treatment, the addition of moringa leaf powder at this dose provides additional benefits in terms of boosting immunity and enhancing the larvae's resistance to disease. This is because bioactive compounds such as flavonoids and saponins found in moringa leaves can strengthen the immune system and protect the body from pathogen attacks⁷.

The highest survival rate in the fermented paste feed group was observed in P4 (fermented paste feed + 60 g/kg moringa leaf flour). This is believed to be due to the contribution of bioactive compounds in moringa leaf flour, such as flavonoids which act as antioxidants and alkaloids which possess anti-inflammatory and antimicrobial activity that have the potential to enhance the fish's resistance to disease²². These various bioactive compounds give moringa leaves the potential to serve as a natural antibiotic²³. Therefore, the larvae are able to adapt to environmental conditions, thereby reducing stress levels and ensuring that larval survival rates remain optimal.

The Ability of Fermented Pasta Feed to Replace Silkworms

Based on a 40-day study, the ability of fermented pasta feed supplemented with

moringa leaf flour to replace silkworms is shown in Table 4.

Table 4. The ability of feed to replace silkworms

Treatment	α (%)	β (%)	γ (%)
P1 (0 g/kg)	67,58	59,49	78,87
P2 (20 g/kg)	69,89	61,53	87,05
P3 (40 g/kg)	76,77	70,26	90,57
P4 (60 g/kg)	84,61	81,03	94,11
P5 (80 g/kg)	80,90	75,90	92,94
P6 (<i>Tubifex</i>)	100,00	100,00	100,00

Description: α (the ability of feed to account for weight gain); β (the ability of feed to account for length growth); γ (the ability to account for survival).

Based on Table 4, it was found that fermented pasta feed supplemented with moringa leaf flour at a dose of 60 g/kg (P4)

yielded the best results in replacing silkworms, with 84.61% of the weight, 81.03% of the length, and 94.11% of the survival rate of gurami fish larvae.

P4 (fermented feed paste + 60 g/kg moringa leaf flour) yielded the best results in replacing silkworms due to the contribution of various nutrients found in moringa leaf flour, such as essential amino acids, vitamins A, C, and E, and important minerals such as calcium, iron, and potassium²¹.

Water quality is one of the factors that significantly influences the growth of gurami fish larvae. The parameters measured during the study were temperature, pH, and dissolved oxygen (DO) levels. The results of the water quality measurements are presented in Table 5.

Table 5. Water quality measurement

Parameters	Time		
	Beginning	Center	End
Temperature (°C)	26,1-26,8	26,9-27,9	26,6-27,4
pH	6,6-7,0	7,0-7,1	6,8-7,1
DO (mg/L)	5,2-5,6	5,4-5,8	5,8-6,6

Based on Table 5, it was found that the temperature from the beginning to the end of the study ranged from 26 to 27°C. This temperature range falls within the optimal range for supporting the growth and survival of gurami fish larvae. This is consistent with SNI²⁴ which states that the optimal temperature for gurami growth ranges from 25 to 30°C. Temperatures that are too low can cause a decrease in metabolic activity and tissue damage²⁵. On the other hand, excessively high temperatures can cause stress and increase the risk of disease. In addition, excessively high temperatures can also lead to a decrease in dissolved oxygen levels in the water, which can disrupt the fish's respiration and metabolism²⁶.

The pH levels measured during the study ranged from 6.8 to 7.1. These figures indicate that the water pH during the rearing period fell within the normal range and met the requirements for rearing gurami fish larvae. Based on SNI²⁴, The optimal pH range for rearing gurami fish larvae is 6.5–

8.0. The measured pH level plays a crucial role in determining the success of aquaculture operations. A low pH level in a body of water can reduce metabolic activity and inhibit the growth of farmed fish; conversely, a pH that is too high can increase the concentration of ammonia in the water, making it toxic to the fish²⁵.

The dissolved oxygen (DO) level in the rearing tanks ranges from 5.2 to 6.6 mg/L. This range is considered optimal for rearing gurami fish larvae. The optimal dissolved oxygen (DO) level in aquatic environments ranges from 5 to 8 mg/L. A decrease in dissolved oxygen levels to 3 mg/L can trigger stress behavior in fish, characterized by a reduced appetite and an increased frequency of swimming to the surface²⁷.

4. CONCLUSION

The results of the study showed that the addition of moringa leaf flour to fermented pasta feed had a significant effect

($P < 0.05$) on the growth and survival of gurami fish larvae. A dose of 60 g/kg yielded the best results, with an absolute weight gain

of 0.3690 g, an absolute length gain of 1.58 cm, a specific growth rate of 8.36%, and a survival rate of 88.87%.

REFERENCES

1. Wibowo, P., Hayati, N., Wirawan, I., Agustini, M. Pengaruh Kombinasi Pakan Komersial dengan Cacing Sutra (*Tubifex* sp) terhadap Pertumbuhan Berat Mutlak Ikan Gurame (*Osphronemus gouramy* L). *Juvenil: Jurnal Ilmiah Kelautan dan Perikanan*, 2024; 5(3): 266-273.
2. Siagian, D.R., Aryani, N., Heltonika, B., Tartila, S.S.Q. Evaluasi Waktu Pemberian Kombinasi Cacing Sutera dan Pakan Pasta terhadap Pertumbuhan dan Sintasan Larva Ikan Gurami. *Jurnal Riset Akuakultur*, 2022; 265-277.
3. Nugrahesthi, G.H., Wijayanti, G.E., Habibah, A.N. Embryo and Larvae Development of Nilem Fish, *Osteochilus vittatus* Reared in Batik Liquid Waste. *Nusantara Bioscience*, 2023; 15(1): 105-112.
4. Fatmala, W., Aryani, N., Asiah, N. The Effect of Probiotics on Growth and Survival Rate of Fish Larvae Asian Redtail Catfish (*Hemibagrus nemurus*) Through Pasta Feed. *Jurnal Akuakultur SEBATIN*, 2024; 5(2), 126-136.
5. Lase, F. *Pengaruh Dosis Probiotik EM4 Berbeda pada Fermentasi Pakan terhadap Pertumbuhan dan Kelulushidupan Larva Ikan Gurami (Osphronemus gouramy)*. Fakultas Perikanan dan Kelautan. Universitas Riau. Pekanbaru, 2025.
6. Fachriyaha, E., Kusrinia, D., Haryanto, I.B. Phytochemical Test, Determination of Total Phenol, Total Flavonoids and Antioxidant Activity of Ethanol Extract of Moringa. *Jurnal Kimia Sains dan Aplikasi*, 2020; 23(8): 290-4.
7. Li, J., Monje, G.V. In Vitro and an Silico Studies af Antimicrobial Saponins: A Review. *Processes*, 2023; 11(10): 2856.
8. Islam, Z., Islam, S.R., Hossen, F., Mahtab-ul-Islam, K., Hasan, M.R., Karim, R. *Moringa oleifera* Is a Prominent Source of Nutrients with Potential Health Benefits. *International Journal of Food Science*, 2021; 2021(1): 6627265.
9. Iwami, Y., Yoshida, M. Quantitative Evaluation of Minerals, Vitamin C, and Antioxidants in the Leaves of *Moringa oleifera*. *Trace Nutrients Research*, 2023; 40:1-5.
10. Saleh, S.Y., Younis, N.A., Sherif, A.H., Gaber, H.G. The role of *Moringa oleifera* in Enhancing Fish Performance and Health: A Comprehensive Review of Sustainable Aquaculture Applications. *Veterinary Research Communications*, 2025; 49: 308.
11. Perdana, A.W., Syafitri, A., Akbar, S.A. Optimization of Commercial Feed with Moringa Leaf Powder (*Moringa oleifera*) for the Growth of Nilem Fish Fingerlings (*Osteochilus hasselti*). *Akuakultura*, 2024; 8(2): 25-29.
12. Rasdi, S.P., Muslimin, I., Nurfadilah, N., Kalsum, U. Kombinasi Tepung Daun Kelor dalam Pakan terhadap Kecernaan Pakan, Ketahanan Stress, Pertumbuhan, dan Sintasan Larva Ikan Nila (*Oreochromis niloticus*). *Jurnal Intek Akuakultur*, 2023; 7(2), 29-43.
13. Febriati, A., Aryani, N., Sukendi, S. Pengaruh Padat Tebar dan Jumlah Pakan terhadap Pertumbuhan dan Kelulushidupan Larva Ikan Gurami (*Osphronemus goramy*, Lac). *South East Asian Aquaculture*, 2025; 2(2): 78-86.
14. Yanes-Roca, C., Holzer, A., Mraz, J., Veselý, L., Malinovskyi, O., Policar, T. Improvements on Live Feed Enrichments for Pikeperch (*Sander lucioperca*) Larval Culture. *Animals*, 2020; 10(3): 401.
15. Nugraha, E.H. Pengaruh Pakan Buatan terhadap Pertumbuhan Benih *Clarias gariepinus* di Kelompok Budidaya Ikan Manunggal Jaya. *Jurnal Pendidikan Fisika dan Sains (JPFS)*, 2020; 3(2): 59-67.

16. Manik, Y.S. *Pengayaan Pakan Pasta Terfermentasi dengan Minyak Ikan dari Limbah Ikan Patin terhadap Pertumbuhan dan Kelulushidupan Larva Ikan Baung (Hemibagrus nemurus)*. Fakultas Perikanan dan Ilmu Kelautan. Universitas Riau. Pekanbaru, 2025.
17. Umidayati, I., Sofia, I.K., Rahardjo, S., Marlina, E., Sumarsih, S., Muktar, M., Aulia, D., Indrayati, A., Khaerudin, K., Sabariyah, N. Effectiveness of Sanitation Treatment for Natural Bloodworms (*Tubifex* sp.) in Breeding Siamese Catfish (*Pangasius hypophthalmus*). *Journal of Fish Health*, 2024; 4(4), 168-178.
18. Handajani, H., Soengkawati, W.P., Andriawan, S. Effect of *Moringa oleifera* Leaf Meal Supplementation on Growth and Reproductive Performance of *Barbodes binotatus*. *Fish Aquaculture Science*, 2025; 28(11): 750-761.
19. [SNI] Standar Nasional Indonesia. SNI 9043-8:2023. *Pakan Buatan - Bagian 8: Ikan Gurami (Osphronemus gouramy Lac.)*. Badan Standardisasi Nasional. Jakarta. 2023; 1-p.44.
20. Windarti, W., Effendi, I., Kurniawan, R. Addition of Moringa Leaves to Feed to Improve Growth Performance and Feed Use of Striped Catfish (*Pangasianodon hypophthalmus*). *Nongye Jixie Xuebao / Transactions of the Chinese Society of Agricultural Machinery*, 2023; 54(5).
21. Hridoy, M.A.A.M., Munny, F.J., Shahriar, F., Rahman, M.M., Islam, M.F., Kazmi, A., Kawsar, M.A. Exploring the Potentials of Sajana (*Moringa oleifera* Lam.) as a Plant based Feed Ingredient to Sustainable and Good Aquaculture Practices: An Analysis of Growth Performance and Health Benefits. *Aquaculture Research*, 2025; 2025(1): 3580123.
22. Mali, S., Bendre, S., Patil, S. Overview of Pharmacognostical and Pharmacological Properties of *Moringa oleifera*. *Asian J Pharm Technol.*, 2022; 12(1): 77-83
23. Shourbela, R.M., El-Hawarry, W.N., Abo, K.S. Potentiality of *Moringa oleifera* Aqueous Extract as a Growth Modulator and Antistress in Acute Hypoxic Nile Tilapia *Oreochromis niloticus*. *Iranian Journal of Fisheries Sciences*, 2020; 19(1): 67-84.
24. [SNI] Standar Nasional Indonesia. SNI: 01- 6485.3 - 2000. *Produksi Benih Ikan Gurami (Osphronemus goramy Lac.) Kelas Benih Sebar*. Badan Standardisasi Nasional. Jakarta. 2002; 1 - 7 pp.
25. Supriyono, E., Nurussalam, W., Rirojoyo, G.P., Faturachman, I., Rohman, R., Hastuti, S., Mahmud, M.B. Kelayakan Kualitas Air dan Tanah Budidaya Segmentasi Pembesaran di Kecamatan Kemang Kabupaten Bogor. *Jurnal Sains Akuakultur Tropis*, 2025; 9(1): 62-78.
26. Ali, B., Anuska, A., Mishra, A. Effects of Dissolved Oxygen Concentration on Freshwater Fish: A review. *International Journal of Fisheries and Aquatic Studies*, 2022; 10(4): 113-127.
27. Telaumbanua, M. Pengaruh Oksigen Terlarut (DO) dalam Budidaya Perairan. *PERAUT: Jurnal Perikanan dan Kelautan*, 2025; 2(1): 200-206.