

**THE USE OF FERMENTED LAMTORO LEAF FLOUR (*Leucaena leucocephala*) IN FORMULATED FEED ON THE GROWTH RATE AND SURVIVAL OF PEARL CATFISH (*Clarias gariepinus*)**

Penggunaan Tepung Daun Lamtoro (*Leucaena leucocephala*) Fermentasi dalam Pakan Buatan Terhadap Laju Pertumbuhan dan Kelangsungan Hidup Ikan Lele Mutiara (*Clarias gariepinus*)

**Riri Chania, Boni Ikhlas\*, Reffi Aryzegovina, Endryeni**

Aquaculture Study Program, Nahdlatul Ulama University of West Sumatra

S. Parman Street No.119 A 25136 Padang, West Sumatra

\*Corresponding Author : [boni.ikhlas@gmail.com](mailto:boni.ikhlas@gmail.com)

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**ABSTRACT**

This study aims to determine the effect of using fermented lamtoro leaf flour (*Leucaena leucocephala*) in artificial feed on the growth rate and survival of African catfish (*Clarias gariepinus*), as well as to identify the optimal percentage for its use. The research was conducted experimentally using a Completely Randomized Design (CRD) with four treatments and three replications: P0 (control/no lamtoro leaf flour), P1 (10% LLF), P2 (20% LLF), and P3 (30% LLF). The results showed that treatment P1 (10% LLF) yielded the best descriptive outcomes, with a specific growth rate (SGR) of  $1.83 \pm 1.14\%$  per day, an absolute length of  $3.9 \pm 2.11$  cm an absolute weight of  $22.7 \pm 18.6$  grams, and a positive allometric growth pattern. The lowest feed conversion ratio (FCR) was 1.65. Survival rate (SR) was high across all treatments, with the highest value of 100% observed in treatments P1 and P3. However, statistically, there were no significant differences among treatments for all observed parameters ( $p > 0.05$ ), thus the null hypothesis ( $H_0$ ) was accepted. Water quality during the study remained within optimal ranges according to Indonesian National Standard (SNI) No. 3 of 2014.

**Keywords:** African Catfish, Lamtoro Leaf Flour, Artificial Feed, Growth, Survival, FCR.

**ABSTRAK**

Penelitian ini bertujuan untuk mengetahui pengaruh penggunaan tepung daun lamtoro (*Leucaena leucocephala*) dalam pakan buatan terhadap laju pertumbuhan dan kelangsungan hidup ikan lele mutiara (*Clarias gariepinus*), serta menentukan persentase optimal penggunaannya. Penelitian dilaksanakan secara eksperimental menggunakan Rancangan Acak Lengkap (RAL) dengan empat perlakuan dan tiga ulangan, yaitu P0 (kontrol/tanpa tepung daun lamtoro), P1 (10% TDL), P2 (20% TDL), dan P3 (30% TDL). Hasil menunjukkan bahwa perlakuan P1 (10% TDL) memberikan hasil terbaik secara deskriptif, dengan laju pertumbuhan harian (SGR) sebesar  $1,83 \pm 1,14\%$  per hari, panjang mutlak  $3,9 \pm 2,11$  cm, bobot mutlak  $22,7 \pm 18,6$  gram, serta tumbuh dengan pola alometrik positif. Rasio konversi pakan (FCR) terendah sebesar 1,65. Tingkat kelangsungan hidup (SR) tergolong tinggi di semua

perlakuan, dengan nilai tertinggi 100% pada perlakuan P1 dan P3. Namun, secara statistik tidak terdapat perbedaan yang signifikan antar perlakuan terhadap seluruh parameter yang diamati ( $p > 0,05$ ), maka  $H_0$  diterima. Kualitas air selama penelitian berada dalam kisaran optimal berdasarkan SNI No. 3 Tahun 2014.

**Kata kunci:** Ikan Lele Mutiara, Tepung Daun Lamtoro, Pakan Buatan, Pertumbuhan, Kelangsungan Hidup, FCR.

## INTRODUCTION

Fishery cultivation is one strategy adopted to increase fishery production, both for current and future needs. Catfish (*Clarias* sp.) is a freshwater commodity that is widely cultivated and consumed. Catfish cultivation is one of the most popular types of freshwater fish among the public. This is due to its ease of maintenance, high market demand, and abundant protein content. Catfish is also a favorite consumption choice because it is easy to process, widely enjoyed, and rich in nutrients, especially protein (Rihi, 2019).

According to the Ministry of Marine Affairs and Fisheries (2020), catfish production showed fairly stable and positive performance from 2015 to 2019, with an average growth of 15.84 percent. Starting in 2017, there was a significant surge in production, reaching 1.2 million tons in 2019, a 44 percent increase compared to the previous year.

In efforts to increase freshwater fisheries production, attention must be paid to feed quality. Aryzegovina *et al.*, (2015) stated that feed is a crucial factor in supporting fish growth. Catfish growth is significantly influenced by the feed they consume, therefore, it is crucial to monitor the quality and quantity of feed provided. Feed that is rich in nutrients and meets the needs of catfish can improve their overall growth and health (Haryasakti & Wahyudi, 2024).

Feed plays a crucial role and is a key determinant of the success of fish farming activities. Commercial feed is generally used in fish farming. Commercial feed typically accounts for 60-70% of total production costs (Arief & Subekti, 2014). This, of course, creates challenges for fish farmers.

Independent fish feed production is a potential solution to address these issues. By utilizing readily available local raw materials, such as bran, fish meal, palm kernel meal, and corn meal, independent feed can reduce production costs compared to manufactured feed. However, the high selling price of fish meal remains a problem in artificial feed production (Andriani *et al.*, 2021).

*Leucaena leucocephala* leaves are known to have a high protein content and can be an economical and sustainable alternative feed source for catfish cultivation (Hoerunnisa *et al.*, 2024). However, the direct use of *leucaena leucocephala* leaves in feed is often hampered by the presence of the toxic compound mimosine. The fermentation process can reduce the content of this toxic compound, thereby increasing feed acceptance by fish (Ali *et al.*, 2019).

Based on this background, a study was conducted on the Use of Fermented *Leucaena Leucocephala* Leaf Meal in Artificial Feed on the Growth Rate and Survival of Pearl Catfish (*Clarias gariepinus*).

## RESEARCH METHODS

### Place and Time

The research was conducted at SiPujuk Farm, located on Jl. Ikua Koto, Koto Panjang Ikua Koto, Koto Tengah District, Padang City, West Sumatra. The study was conducted from May to June 2025 for 40 days.

### Tools and Materials

The tools used in this study were 12 tarpaulin ponds measuring 100x100x50 cm, scales, pellet molding machines, flour machines, thermometers, DO meters, pH meters, e-ISSN : [2622-1934](#), p-ISSN : [2302-6049](#)

stationery, measuring cups, cameras, rulers, plastic containers, scoops. The research materials used were 180 Pearl catfish with an average size of 12-15 cm (15 per pond), fermented lamtoro leaf flour, fish meal, bran, corn flour, tofu dregs, palm kernel meal, tapioca flour, water as a maintenance medium, EM4 livestock, Molasses.

### Research Design

The method used in this study was an experimental method with a completely randomized design (CRD) with four treatments and three replications.

The treatments used were:

P0: control, without the use of lamtoro leaf flour

P1: with the use of 10% lamtoro leaf flour

P2: with the use of 20% lamtoro leaf flour

P3: with the use of 30% lamtoro leaf flour

### Process of Making Lamtoro Leaf Flour

The process of making lamtoro leaf flour according to Asni *et al.*, (2022) which has been modified:

Choose fresh lamtoro leaves, cut the lamtoro leaves into smaller sizes, wash the lamtoro leaves with clean water to remove dirt or dust, put the leaves into a plastic container, prepare a solution of 10ml/liter EM4 and 10ml/liter molasses clean water, stir until evenly distributed, pour the fermenter solution onto the lamtoro leaves until the leaves are completely submerged, stir until evenly distributed, close the plastic container tightly, so that no air enters, store in a shady place and not exposed to direct sunlight, let stand for 12 hours - 24 hours, after soaking is complete, remove the leaves from the solution, then dry the lamtoro leaves in the sun to reduce the water content in the leaves, after the leaves are dry, the lamtoro leaves can be ground into flour, lamtoro leaf flour is ready to be used as fish feed ingredients.

### Feed Formulation and Pellet Feed Making

Table 1. Feed formulation used

Feed ingredients	P0 (0%)	P1 (10%)	P2 (20%)	P3 (30%)
Fish meal	30%	20%	10%	0%
Leucaena leaf meal	0%	10%	20%	30%
Tofu dregs	25%	25%	25%	25%
Corn flour	20%	20%	20%	20%
Bran	15%	15%	15%	15%
Tapioca flour	5%	5%	5%	5%
Palm kernel meal	5%	5%	5%	5%
Total	100%	100%	100%	100%

Source: Primary Data 2025

Making pellet feed is done in the following way:

Mix all the raw materials until evenly distributed according to the formulation, mold

the pellet mixture using a pellet machine with a size suitable for catfish, dry the pellets in the sun until the water content is low to prevent mold growth, then after the pellets are dry, a test is carried out first, namely a proximate test for each feed treatment, the dried pellets are stored in an airtight container to maintain their quality before being given to catfish.

### Feeding

The pearl catfish were reared for 40 days. During this period, they were fed a diet containing fermented lamtoro leaf flour in varying doses. Feeding was conducted ad libitum. Feeding was done twice daily, at 8:00 AM and 5:00 PM WIB.

### Observation Parameters

#### 1. Feed Conversion Ratio / FCR

According to Tacon (1987) in Asni *et al.*, (2022), the feed conversion ratio (FCR) is calculated based on the formula:

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

Information:

- FCR : Feed conversion ratio  
Wt : Average final weight (g)  
Wo : Average initial weight (g)  
D : Total weight of dead fish (g)  
F : Amount of feed consumed during the study (g)

#### 2. Specific Growth Rate / SGR

The daily growth rate (SGR) was calculated using the Effendi (1997) formula in (Asmaini *et al.*, 2020).

$$SGR = \frac{\ln Wt - \ln Wo}{t} \times 100\%$$

Information:

- SGR : Specific growth rate (%)  
 $\ln Wt$  : Average weight of test fish at the end of the study (g)  
 $\ln Wo$  : Average weight of test fish at the start of the study (g)  
t : Maintenance time (days)

#### 3. Absolute Growth of length increase and weight increase

Absolute length growth can be calculated using the Effendi (1979) formula in Harefa *et al.*, (2023), namely:

$$Pm = Pt - P0$$

Information:

- Pm : Absolute growth (cm)  
Pt : Length of fish at the end of observation (cm)  
Po : Length of fish at the start of observation (cm)

Meanwhile, absolute weight growth can also be calculated by weighing the fish once a week. Absolute weight growth can be calculated using the formula of Effendi (1979) in Harefa *et al.*, (2023)

$$W_m = W_t - W_o$$

Information:

- $W_m$  : Absolute Weight (gr)  
 $W_t$  : Fish biomass at the end of observation (gr)  
 $W_o$  : Fish biomass at the beginning of observation (gr)

#### 4. Long and heavy relationship

Lempoy *et al.*, (2020) The relationship between length and weight was analyzed based on the procedure for analyzing the relationship between fish length and weight, as proposed by Le Cren (1951), with the formula:

$$W = aL^b$$

Information:

- $W$  : Total weight (g)  
 $L$  : Total length (cm)  
 $a$  dan  $b$ : Length-weight relationship constant

This equation is then transformed into a logarithm so that it becomes a linear equation as follows:

$$\text{Log } W = \log a + b \log L$$

see whether the growth is:

- Isometric if  $b = 3$  then the growth in weight and length is balanced
- Positive allometric if  $b > 3$  then weight is faster than length
- Negative allometric if  $b < 3$  then length is faster than weight

#### 5. Survival Rate (SR)

Handayani *et al.*, (2017) Survival Rate (SR) is the percentage of fish survival which can be calculated using the following formula:

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

Information:

- $SR$  : Survival rate (%)  
 $N_t$  : Number of Fish at the End of the Study (Tail)  
 $N_o$  : Number of Fish at the Beginning of the Study (Tail)

#### 6. Water Quality

The parameters measured include temperature, pH, and dissolved oxygen (DO) levels using a thermometer, pH meter and DO meter

### Data Analysis

The data obtained were analyzed using analysis of variance (ANOVA). To determine differences in treatment, further testing was conducted using the Duncan's Multiple Range test using the Statistical Product and Service Solution (SPSS) computer program.

The statistical hypothesis tested in this study is as follows:

- $H_o$  : There is no significant difference in the growth rate and survival of Pearl Catfish at various levels of use of lamtoro leaf flour in feed.
- $H_1$  : There are significant differences in the growth rate and survival of Pearl Catfish at various levels of use of lamtoro leaf flour in feed.

## RESULT

### Proximate Test Results of *Leucaena* Leaf Flour and Test Feed

Table 1. Proximate test results of fermented lamtoro leaf flour

Sample	Water content	Protein	Fat	Ash	Carbohydrate
<i>Leucaena</i> leaf flour	7,57%	29,65%	7,03%	7,24%	36,73%

Source: Primary data 2025

Table 2. Proximate test results of test feed  $\pm$  SD

Sample	Water content	Protein	Fat	Ash	Carbohydrate
P0	16,79 $\pm$ 0,13	24,97 $\pm$ 0,18	6,77 $\pm$ 1,37	14,65 $\pm$ 0,04	36,73 $\pm$ 1,11
P1	12,1 $\pm$ 0,04	25,35 $\pm$ 0,50	6,52 $\pm$ 0,05	14,44 $\pm$ 0,09	41,53 $\pm$ 0,50
P2	6,83 $\pm$ 0,15	20,40 $\pm$ 0,04	8,16 $\pm$ 0,26	8,41 $\pm$ 0,09	56,23 $\pm$ 0,02
P3	7,65 $\pm$ 0,13	16,88 $\pm$ 1,63	6,72 $\pm$ 0,16	6,03 $\pm$ 0,06	62,66 $\pm$ 1,67

Source: Primary data 2025

### Feed Conversion Ratio / FCR

The Feed Conversion Ratio (FCR) is the ratio of feed efficiency to fish weight gain. The FCR is calculated by comparing the amount of feed given to the weight gain of the fish. The lower the FCR, the more efficient the feed use, as less feed is required to produce one unit of fish weight.

Table 3. FCR values during maintenance

Treatment	F (g)	Wo (g)	Wt (g)	Dead fish weight (g)	FCR
P0	1.937	1.637	37,2	987	2,81
P1	1.696	1.892	0	867	1,65
P2	1.027	1.271	90,7	808	1,85
P3	1.240	1.082	0	866	5,74

Source: Primary data 2025

### Specific Growth Rate / SGR

Daily growth rate is an important parameter in assessing the effectiveness of artificial feeding on the growth of pearl catfish during the rearing period.

Table 4. Daily growth rate of pearl catfish.

Treatment	Wo(g)	Wt(g)	Mean SGR±SD
P0	21,9	37	1,30 ± 0,31
P1	19,2	42	1,83±1,14
P2	17,9	31	1,15±1,19
P3	19,2	24	0,55±0,27

Source: Primary data 2025

### Absolute Growth of length increase and weight increase

Table 5. Absolute length of pearl catfish

Treatment	Po(cm)	Pt(cm)	Mean PM±SD
P0	14,9	17,5	2,6±0,58
P1	14,3	18,2	3,9±2,11
P2	13,8	15,9	2,1±2,42
P3	14,4	15,5	1,1±0,47

Source: Primary data 2025

Table 6. Absolute weight of pearl catfish during maintenance

Treatment	Wo(g)	Wt(g )	Mean BM ± SD
P0	21,9	37	15,1±4,4
P1	19,2	42	22,7±18,6
P2	17,9	31	13,0±16,4
P3	19,2	24	4,8±2,3

Source: Primary data 2025

### Relationship between Length and Weight

The analysis of the relationship between fish length and weight aims to identify growth patterns, whether they are isometric or allometric. The results of the calculation of the relationship between length and weight are presented in the following graph

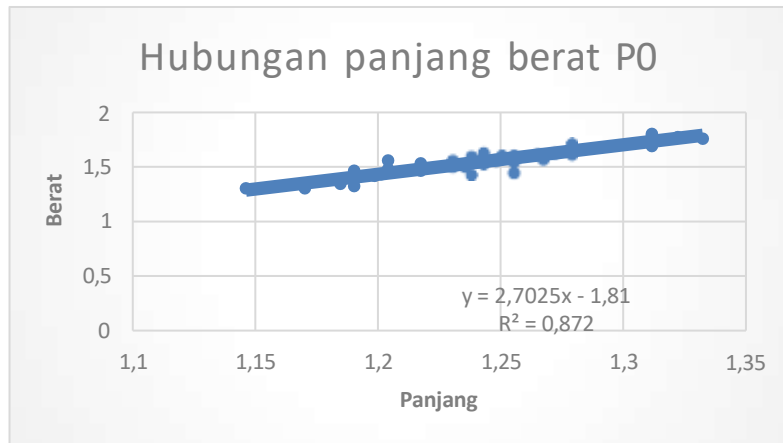


Figure 1: Relationship between Length and Weight P0

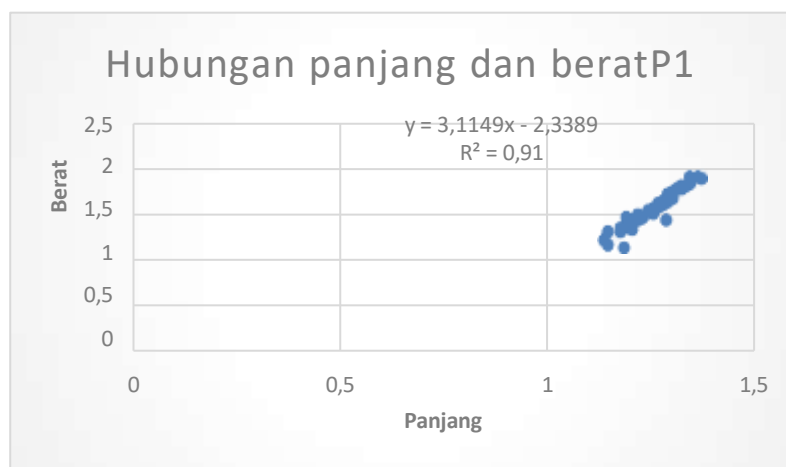


Figure 2: Length-Weight Relationship P1

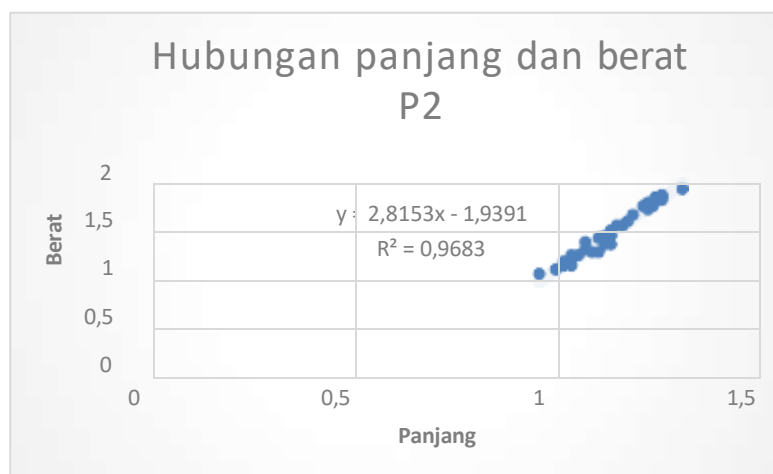


Figure 3: Relationship between Length and Weight P

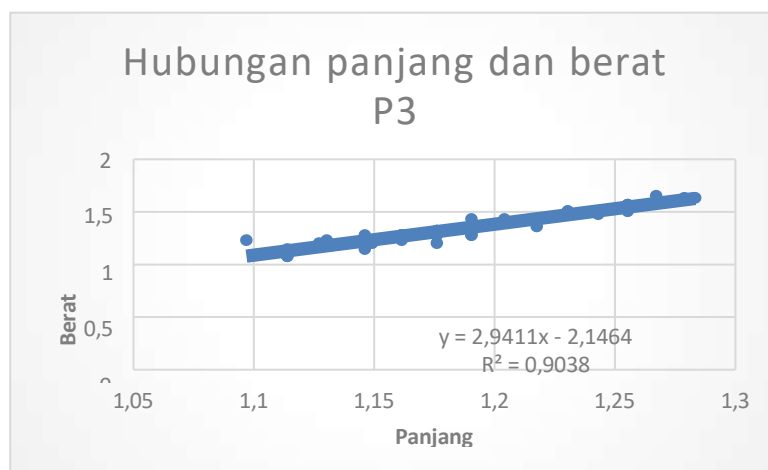


Figure 4: P3 Length and Weight Relationship

### Survival Rate (SR)

*Survival rate* (SR) is an important parameter in fish farming which reflects the success of maintenance during the trial period.

Table 7. Results of observations on the survival of pearl catfish

Treatment	No(Tail)	Nt(Tail)	Mean SR±SD
P0	45	44	97,77 ± 3,84
P1	45	45	100 ± 0
P2	45	42	93,33 ± 6,66
P3	45	45	100 ± 0

Source: Primary data 2025

### Water Quality

During maintenance, water quality in all treatments was within the range that supports catfish growth. Water temperature remained stable between 27.2°C–27.4°C, still within the optimal range according to SNI No. 3 of 2014 (25–30°C). pH values ranged from 7.42–7.62, and all met SNI standards (6.5–8). Dissolved oxygen (DO) levels also met standards (>3 mg/L), with values ranging from 4.4–5.2 mg/L.

Table 8. Average water quality during maintenance

No	Treatment	Average water quality		
		Temperature (°C)	pH	DO(mg/L)
1	P0	27.2	7.42	4.4
2	P1	27.3	7.62	5.2
3	P2	27.4	7.57	4.4
4	P3	27.2	7.54	4.8

Source: Primary data 2025

## DISCUSSION

Table 1 shows the results of proximate tests, indicating that fermented lamtoro leaves can increase nutritional value, particularly their protein content, thus potentially being used as an efficient alternative feed ingredient in fish farming. Table 2 displays the protein values from the proximate test results for each treatment. The highest value was found in treatment P1 at 25.35%, followed by P0 at 24.97%, P2 at 20.40%, and the lowest in treatment P3 at 16.88%. Asni *et al.*, (2022) stated that lamtoro leaf meal can be used as an alternative protein source in catfish feed.

The lowest FCR value was found in treatment P1 at 1.65, indicating that this treatment was the most efficient feed for increasing fish weight growth. Tahir *et al.*, (2023) found that a lower FCR value indicates that the feed is well-consumed.

The highest SGR value in P1 indicates that this treatment is able to encourage optimal fish growth compared to other treatments, which is 1.83%, followed by statistical analysis using the ANOVA test on IBM SPSS, Statistics 26. SPSS, The results show a significance value of Sig.  $p > 0.05$ , then  $H_0$  is accepted. This can be caused by several factors, such as low feeding frequency, initial homogeneity of fish, the influence of the pond environment and palatability of feed. As stated by Haryasakti & Wahyudi, (2024) that there is a positive relationship between feeding frequency and fish growth rate, where growth tends to increase along with increasing feeding frequency. Mukaromah *et al.*, (2024) stated that the use of lamtoro leaf flour in excessive amounts can reduce the level of feed palatability, because the flour has a fairly bitter taste and contains antinutritional compounds.

Treatment P1 showed the highest absolute length increase of 3.9 cm, to determine whether the difference between treatments significantly affected the absolute length of pearl catfish, a statistical analysis was carried out using the ANOVA test using IBM SPSS Statistics 26. SPSS, the results showed Sig.  $p > 0.05$ , then  $H_0$  was accepted. This could occur allegedly because the feed given did not meet the nutritional needs of the fish or was not balanced, therefore it could inhibit the growth of Hoerunnisa *et al.*, (2024). In the absolute weight increase Treatment P1 showed the highest absolute weight of 22.7 grams, to determine whether the difference between treatments significantly affected the absolute weight of pearl catfish, a statistical analysis was carried out using the ANOVA test using IBM SPSS Statistics 26. SPSS, the results showed Sig.  $p > 0.05$ , then  $H_0$  was accepted. This is likely influenced by several factors, including variations in individual fish growth, uniformity of environmental conditions such as relatively stable water quality, feed with high crude fiber content, and the possibility that the maintenance duration was not long enough to show a real impact of the feed treatment given. Marnani *et al.*, (2023) stated that feed with additional lamtoro leaf flour has high crude fiber, which makes it difficult for fish to digest.

The analysis of data from treatments P0, P2, and P3 showed a negative allometric growth pattern ( $b < 3$ ). Patanda & Rahmani (2019) found that the growth pattern was negatively allometric, meaning that body length increased faster than weight. This indicates that during the study, the fish were in a favorable environment and had sufficient food availability. Similar results were also found by several other researchers, including Awendi & Machrizal (2023), who reported that the growth pattern of long-tailed catfish (*C. leiocanthus*) from Aek Silom-lom was negatively allometric. Puspita *et al.*, (2021) found that the silver pomfret cultivated on the island also exhibited a negative allometric growth pattern, with a  $b$  value of 2.04.

The analysis of data from treatment P1 showed a positive allometric growth pattern ( $b > 3$ ), meaning weight increased faster than length. This can be influenced by various factors, both internal and external. These factors include the availability and size of feed, the number of individuals utilizing the available food source, environmental temperature, dissolved oxygen levels, overall water quality, and biological characteristics such as age, body size, and gonad maturity. Patanda & Rahmani (2019) found a similar finding in a study by Nurhayati *et*

*al.*, (2016) that found 14 fish species exhibiting a positive allometric growth pattern. This pattern indicates that fish weight gain occurs faster than body length gain, resulting in a fatter or fuller appearance.

Treatments P1 and P3 had the highest SR values, at  $100 \pm 0$ , indicating no fish mortality during the study. Treatment P0 (control) showed an SR of  $97.77 \pm 3.84$ , which is still relatively high and indicates good rearing conditions. Meanwhile, treatment P2 had the lowest SR, namely  $93.33 \pm 6.66$ , but it was still within normal limits and still showed a survival rate suitable for cultivation. To determine whether the differences between treatments significantly affected the survival rate of pearl catfish, a statistical analysis was conducted using the ANOVA test using IBM SPSS Statistics 26. SPSS, the results showed Sig.  $p > 0.05$ , so  $H_0$  was accepted. Haryasakti & Wahyudi, (2024) reported that a survival rate (SR) of 50% or more is considered good, while an SR between 30% and 50% is categorized as moderate, and if less than 30% is considered poor. Handayani *et al.*, (2017), Asni *et al.*, (2022) that artificial feed containing fermented lamtoro leaf flour can affect growth, but the addition did not show any effect on the survival rate of fish during the maintenance period. All water quality parameters measured during the study showed conditions that were quite stable and supportive for the continued growth of catfish in each treatment given and were still in accordance with the water quality standards set by SNI No. 3 of 2014 concerning catfish production of the National Standardization Agency, (2014).

### CONCLUSION

The use of fermented lamtoro leaf flour in artificial feed has a positive effect on the growth of pearl catfish. The best treatment was obtained in P1 (10% TDL), which produced the highest daily growth rate (SGR) of 1.83% per day, an absolute length of 3.9 cm, and an absolute weight of 22.7 grams, with a positive allometric growth pattern. The survival rate (SR) of fish was high in all treatments, with the highest value reaching 100% in P1 and P3. The best feed efficiency was also found in P1, with an FCR value of 1.65 and the highest protein content of 25.35%. During the study, water quality was within the optimal range according to SNI No. 3 of 2014 standards, so it was not a limiting factor in fish growth.

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