

EFFECTS OF APPLYING LIQUID ORGANIC FERTILIZER FROM NONI FRUIT (*Morinda citrifolia* L.) ON THE BIOMASS OF *Lemna* sp. IN THE CULTURE MEDIA FOR NILE TILAPIA (*Oreochromis niloticus*)

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ABSTRACT

Lemna sp. is an aquatic plant with high nutritional content, especially protein, and can grow rapidly in favorable environmental conditions. In addition to being a food source, *Lemna* sp. acts as a phytoremediator by absorbing ammonia, nitrate, and phosphate compounds derived from feed residues and fish metabolism. This study aims to investigate the use of Liquid Organic Fertilizer (LOF) derived from noni fruit to support the growth of *Lemna* sp. in tilapia fish culture media. The study was conducted from September to October 2025 at the Aquaculture Environmental Quality Laboratory, Faculty of Fisheries and Marine Sciences, Universitas Riau. This study used an experimental method. The experimental design used a Completely Randomized Design (CRD) consisting of 5 treatment levels and 3 replications so that there were a total of 15 treatment units, namely P0: Without giving noni fruit POC, P1: Giving noni fruit LOF 1.75 mL/L, P2: Giving noni fruit LOF 2 mL/L, P3: Giving noni fruit LOF 2.25 mL/L, P4: Giving noni fruit LOF 2.5 mL/L. The results of the study showed that the administration of noni fruit LOF at a dose of 2.5 mL/L was the best treatment for the growth of absolute weight in *Lemna* sp, with an average absolute weight of 145.66 ± 4.81 g and a specific growth rate of $4.70 \pm 0.08\%$ / day. Treatment with this dose was able to support the growth of tilapia for 30 days without commercial feed and only using *Lemna* sp as a single feed by producing an absolute weight of tilapia of 1.71 ± 0.10 g, an absolute length of 2.8 ± 0.11 cm, a specific growth rate of $3.22 \pm 0.07\%$ / day, and a survival rate of 96%. In addition, the presence of *Lemna* sp in the maintenance medium acts as a phytoremediation agent, helping maintain stable water quality. Water quality parameters during the study remained within a reasonable range, with temperatures ranging from 26.4–30.1°C, pH 6.0–7.9, DO 4.1–7.2 mg/L, nitrate 0.06–19.05 mg/L, phosphate 0.13–4.16 mg/L, and ammonia 0.01–0.02 mg/L, supporting tilapia survival and growth.

Keywords: Biomass of *Lemna* sp., Liquid Organic Fertilizer, Noni Fruit, Tilapia

1. INTRODUCTION

One of the challenges in tilapia (*Oreochromis niloticus*) aquaculture is the high cost of feed, which accounts for 60–75% of total production costs, underscoring the need to improve operational efficiency. One strategy is to use natural feed that grows directly in the rearing medium, such as

Lemna sp, so that it not only serves as a feed source but also improves water quality.

Lemna sp is an aquatic plant with high nutritional content, particularly protein, and is capable of growing rapidly under favorable environmental conditions. In addition to serving as feed, *Lemna* sp acts as a phytoremediator by absorbing ammonia, nitrate, and phosphate compounds derived

from uneaten feed and fish metabolism. The absorption of these compounds directly reduces the accumulation of toxic substances in water, thereby maintaining water quality and supporting tilapia growth¹.

However, *Lemna* sp's ability to perform these dual functions is highly dependent on nutrient availability in the culture medium. Under intensive aquaculture conditions, water nutrient levels are often insufficient to support optimal *Lemna* sp growth, thereby limiting biomass growth rates. Consequently, the role of *Lemna* sp as both a natural feed source and a phytoremediation agent is not fully realized, which may ultimately lead to reduced water quality and impaired fish growth performance.

One strategy to address this nutrient limitation is to add safe external nutrient sources to the aquaculture system, such as liquid organic fertilizer (LOF). LOF derived from noni fruit (*Morinda citrifolia* L.) contains macronutrients like nitrogen, phosphorus, and potassium, as well as micronutrients and bioactive compounds that can stimulate the growth of aquatic plants. Adding noni-based POC to the medium can increase the availability of dissolved nutrients, which are directly utilized by *Lemna* sp, thereby accelerating growth and increasing biomass².

This increase in *Lemna* sp biomass will subsequently strengthen its role in absorbing nitrogen and phosphate compounds in the water. The higher the *Lemna* sp biomass, the greater the nutrient-absorption capacity, thereby reducing the concentrations of ammonia and other potentially toxic compounds. This condition will improve water quality by stabilizing pH, indirectly increasing dissolved oxygen, and reducing the accumulation of metabolic waste.

This study aims to determine the effect of administering liquid organic fertilizer (LOF) made from noni fruit on the biomass growth of *Lemna* sp in tilapia rearing media and to identify the optimal dose of liquid organic fertilizer (LOF) made from noni

fruit that can enhance the biomass growth of *Lemna* sp in tilapia rearing media. This study is also beneficial for understanding the utilization of Liquid Organic Fertilizer (LOF) derived from noni fruit to support the growth of *Lemna* sp in tilapia rearing media.

Furthermore, the results of this study are expected to serve as a reference for environmentally friendly aquaculture by using natural materials as nutrient sources for aquatic plants. The application of noni fruit LOF can also reduce reliance on chemical fertilizers, thereby supporting sustainable, economically efficient aquaculture practices.

2. RESEARCH METHOD

Time and Place

This study was conducted from September to October 2025 at the Aquaculture Environmental Quality Laboratory of the Faculty of Fisheries and Marine Sciences at the University of Riau.

Method

This study employed an experimental method. The experimental design used a completely randomized design (CRD) with 5 treatment levels and 3 replicates, resulting in a total of 15 treatment units and 5 control containers for monitoring *Lemna* sp³. The treatments used in this study are based on the research by Suyatni et al.⁴, which found the optimal dose of banana peel POC to be 2 ml/L in the carp (*Cyprinus carpio*) culture medium. Thus, the treatment levels for this study are as follows:

- P0 : No application of noni fruit LOF
- P1 : Application of 1.75 ml/L of noni fruit LOF
- P2 : 2 ml/L of noni fruit LOF
- P3 : 2.25 ml/L of noni fruit LOF
- P4 : 2.5 ml/L of noni fruit LOF

Procedures

Production of Liquid Organic Fertilizer

Liquid organic noni fruit fertilizer is made using ripe noni fruit. Ripe noni fruit is characterized by a yellowish-white color and a soft texture⁵. The fruit is washed

thoroughly, drained, and then cut into small pieces to facilitate blending. The blended mixture is then placed in a sealed container to undergo anaerobic fermentation. During this process, 700 g of brown sugar dissolved in 700 ml of water is added as an energy source for the microorganisms. EM4 is used as an inoculant to accelerate fermentation. The ingredient ratio is 7 kg of noni fruit, 700 ml of brown sugar solution, 700 ml of EM4, and an additional 7 L of water. This mixture is stirred thoroughly, sealed tightly, and stored at room temperature (approximately 25–30°C) for 15 days. During fermentation, the container must be opened every 2 to 3 days to release fermentation gases and to measure the pH. After 15 days of fermentation, the liquid organic fertilizer (LOF) is harvested. The mixture is filtered to separate the solids from the liquid. This filtered liquid is used as an organic fertilizer and is then stored in sealed bottles, ready for application⁶.

The fermentation product of the noni fruit LOF was subsequently analyzed for nutrient content, including total N, total K, and organic C, at the Soil Laboratory of the Faculty of Agriculture, Universitas Riau. The nutrient content analysis of the noni fruit POC showed total N at 0.35%, total K at 0.54%, P at 0.13%, and organic C at 2.41%. Signs of successful fermentation can be observed through several indicators, such as a pH drop to 3.5. Additionally, a sour aroma with a faint characteristic noni fruit scent emerges, bubbles form on the surface as a sign of microbial activity, and the color changes to dark brown⁷.

Preparing the Rearing Container

The containers used in this study were cylindrical buckets with a top diameter of 60 cm, a bottom diameter of 48 cm, and a height of 45 cm; a total of 15 containers, each with a water capacity of 100 L. Before use, the containers were cleaned with a PK solution, then rinsed and dried. Next, the containers were randomized and filled with 60 L of water. An aeration system was then

installed, and the containers were labeled according to the treatment and its replicates.

Fertilization Process

Fertilization was carried out using fermented liquid organic fertilizer from noni fruit. The fertilizer was applied at the predetermined treatment dosage, then mixed directly into the water in each rearing container. The fertilization process was carried out in the following steps: 1) Fertilization was applied directly to containers holding 60 L of water; 2) Fertilization was performed three times, once every 10 days; 3) Fertilization was performed in the treatment containers as follows: P0 (control) did not use noni fruit LOF; P1 received 1.75 ml/L of noni fruit LOF; P2 received 2 ml/L of noni fruit LOF; P3 received 2.25 ml/L of noni fruit LOF; and P4 received 2.5 ml/L of noni fruit LOF, followed by aeration for 24 hours.

Measurement of Water Quality Parameters

The water quality parameters measured were temperature and pH, which were measured daily. Measurements of dissolved oxygen, ammonia, nitrate, and phosphate were taken three times: on day 1, day 15, and day 30 of the rearing period.

Cultivation of *Lemna* sp.

Before use, *Lemna* sp was acclimated for 3 days in a separate container to ensure the plants were free of contaminants, including small aquatic snails, insect larvae, and algae. A bright green color, with no leaf damage or yellowing, characterized the *Lemna* sp used. *Lemna* sp was introduced into the culture vessel after fertilization was complete and the water had settled for 24 hours. The seeding rate of *Lemna* sp followed Nisa's⁸ study, which was 50 g over a surface area of 1.48 m², or 33.78 g/m². Converted based on the surface area of the container in this study, which is 1.41 m², the amount of *Lemna* sp used is 47 g/m². Measurements of *Lemna* sp biomass growth were taken every 3 days.

Tilapia Farming

Twenty-four hours after the *Lemna* sp were introduced, tilapia fingerlings were stocked at a stocking density of 1 fish per 2 L of water⁹. The water volume was 60 L, so each tank contained 30 fish, averaging ± 3 –5 cm in size. Tilapia were sampled every 10 days to measure length and weight. The number of tilapia measured was 30% of the fish in each rearing container, as reported by Sebayang et al.¹⁰. Since each container had a stocking density of 30 fish, 30% of the total fish in the container equaled 9 fish. Each tilapia was measured individually using graph paper corresponding to the treatment tank by placing the fish on the graph paper and recording its length. After length measurement, the fish were weighed using a digital scale.

Body weight was measured by placing the fish on an analytical balance and recording its weight. The reared fish were not fed commercial feed but relied solely on *Lemna* sp as the sole feed source throughout the rearing period. The use of *Lemna* sp as the sole food source aimed to assess the effectiveness and potential of this aquatic plant in supporting the natural growth of tilapia. Without the addition of artificial feed, the fish's growth response and survival rate could directly reflect the role of *Lemna* sp in this study.

Measured parameters

Absolute Biomass Growth of *Lemna* sp.

Biomass growth of *Lemna* sp was measured every three days by weighing the *Lemna* sp. biomass at the beginning and end of the study. The formula for calculating the absolute weight growth of *Lemna* sp is as follows:

$$Wn = Wt - Wo$$

Description:

- Wn : Absolute weight gain (g).
- Wt : Average weight of *Lemna* sp. at the end of the study (g).
- Wo : Average weight of *Lemna* sp. at the beginning of the study (g).

Specific Growth Rate

The specific growth rate was calculated using the formula:

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

Description:

- LPS : Specific growth rate (%/day)
- Wt : Average weight at the end of the rearing period (g)
- Wo : Average weight at the beginning of the rearing period (g)
- t : Duration of the rearing period (days)

Measurement of Absolute Length Gain in Tilapia

Nine tilapia fry were placed in each container¹⁰; their total length, measured from the tip of the mouth to the tip of the tail using a measuring tape or ruler, was recorded. Measurements of absolute length growth were taken every 10 days. The formula for calculating absolute length growth is as follows:

$$L = Lt - Lo$$

Description:

- L : Absolute length increase (cm).
- Lt : Body length of the fish at the end of the study (cm).
- Lo : Body length of the fish at the beginning of the study (cm).

Measurement of Absolute Weight Gain in Tilapia

Nine tilapia fingerlings were taken per container¹⁰, then weighed using a digital scale, and the results were recorded. The weighed fish were returned to the rearing containers. Measurements of absolute weight gain were taken every 10 days. The formula for calculating absolute weight is as follows:

$$Wg = Wt - Wo$$

Description:

- Wg : Absolute weight gain (g).
- Wt : Fish weight at the end of the study (g).
- Wo : Fish weight at the beginning of the study (g).

Survival can be calculated using the formula:

$$SR = \frac{Nt}{No} \times 100\%$$

Description:

SR : Survival rate (%)

Nt : Number of fish at the end of the rearing period (individuals)

No : Number of fish at the start of the rearing period (individuals)

Data Analysis

The data obtained, such as the fresh weight of *Lemna* sp (g), the specific growth rate of *Lemna* sp (%/day), the total length of tilapia (cm), the fresh weight of tilapia (g), the specific growth rate of tilapia (%/day), the survival rate of tilapia (%), were tabulated in the form of tables and graphs and then analyzed using SPSS, including analysis of variance (ANOVA), to determine whether the treatments had a significant effect ($P < 0.05$). If the results showed a

significant effect, the analysis was followed by a Student-Newman-Keuls post hoc test to determine differences between treatments. Meanwhile, water quality data were presented in tables and graphs and then analyzed descriptively

3. RESULT AND DISCUSSION

Water Quality

This study examined the effect of adding noni fruit LOF to the biomass of *Lemna* sp in a tilapia rearing system. The water quality parameters measured included temperature, pH, dissolved oxygen (DO), nitrate, phosphate, and ammonia. These measurements were taken to monitor environmental conditions throughout the study to ensure they remained conducive to the growth of *Lemna* sp and the survival of the tilapia. The results of the water quality measurements during the study are presented in Table 1.

Table 1. Range of average water quality measurement

Parameters	Measurement results					References
	P ₀	P ₁	P ₂	P ₃	P ₄	
Temperature (°C)	26,9-30,1	26,4-30,0	26,7- 29,5	26,6-29,1	26,3-29,3	25°-30 ¹¹
pH	6,0-7,8	6,2-7,9	6,2-7,9	6,5-7,6	6,2-7,6	6,5-8,5 ¹¹
DO (mg/L)	4,6-6,7	4,4-6,7	4,1-6,4	4,4-7,1	4,4-7,2	6,1-14,5 ¹²
Nitrate (mg/L)	0,06-16,35	0,07-16,47	0,09-17,30	0,10-18,24	0,10-19,05	1-10 ¹³
Phosphate (mg/L)	0,13-2,09	0,17-2,13	0,16-2,32	0,15-2,99	0,17-4,16	4-22 ¹³
Ammonia (mg/L)	0,01-0,02	0,01-0,01	0,01-0,02	0,01-0,01	0,01-0,01	0,6-2 ¹⁴

Description: P₀ = No LOF; P₁ = 1.75 ml/L LOF; P₂ = 2 ml/L LOF; P₃ = 2.25 ml/L LOF; P₄ = 2.5 ml/L LOF.

Observations during the study showed that water quality parameters, including temperature, pH, dissolved oxygen (DO), and ammonia concentration, remained within tolerable ranges for tilapia. This indicates that the addition of noni fruit POC to the medium did not negatively affect water conditions but instead provided nutrients for the growth of *Lemna* sp as a natural food source. According to Boyd¹⁵, the success of fish farming is largely determined by stable water quality within an optimal range, as water's physical and chemical parameters influence fish physiological processes such as respiration,

osmoregulation, metabolism, and the immune system.

In this study, the presence of *Lemna* sp also had a positive effect on water quality stability. *Lemna* sp is known to absorb excess nutrients, such as nitrogen and phosphate, thereby helping to suppress the accumulation of toxic compounds, such as ammonia and nitrite, in the water medium¹⁶. This aligns with the findings of Utami et al.¹⁷, who reported that using aquatic plants such as *Lemna* sp can improve water quality through phytoremediation, thereby stabilizing the rearing environment and supporting optimal fish growth.

Absolute Weight Gain and Specific Growth Rate (*Lemna* sp.)

The biomass of *Lemna* sp used at the start of the study was 47 g/m². The observations showed that applying liquid organic fertilizer (LOF) from noni fruit at

different doses resulted in varying *Lemna* sp biomass growth across treatments. The data on biomass and specific growth rate of *Lemna* sp observed during the study are presented in Table 2.

Table 2. Average absolute weight and specific growth rate of *Lemna* sp.

Treatment	Absolute Weight (Wk) (g)	Absolute weight of Wi (g)	<i>Lemna</i> sp. consumed by fish (g)	SGR (Wi) (%/day)
P ₀	9,94	4,96 ± 2,67 ^a	4,98	0,33 ± 0,17 ^a
P ₁	113,04	52,00 ± 1,81 ^b	61,04	2,48 ± 0,06 ^b
P ₂	134,48	55,66 ± 2,07 ^b	78,82	2,60 ± 0,07 ^b
P ₃	285,91	100,56 ± 3,80 ^c	185,35	3,81 ± 0,08 ^c
P ₄	485,57	145,66 ± 4,81 ^d	339,91	4,70 ± 0,08 ^d

Description: Wk = Control tank with *Lemna* sp. without tilapia; Wi = Tank with *Lemna* sp. and tilapia. Different superscripts in the same column indicate significant differences between treatments (P < 0.05)

Table 2 shows that the highest absolute weight of *Lemna* sp was observed in the treatment with 2.5 ml/L of noni fruit LOF, at 145.66 ± 4.81 g. The highest absolute weight of *Lemna* sp in the control container (without tilapia) was observed in the 2.5 ml/L LOF treatment, at 485.57 g. This is consistent with results from containers maintained with tilapia, where the 2.5 ml/L treatment also produced the highest biomass.

The specific growth rate (SGR) of *Lemna* sp in this study increased with increasing noni fruit LOF dose. The highest SG value was observed in the P₄ (2.5 ml/L), with a rate of 4.70 ± 0.08%/day. The high SG value in the P₄ indicates that the addition of noni fruit LOF can provide sufficient nutrients for *Lemna* sp growth, particularly nitrogen and phosphorus, which play crucial roles in plant tissue formation and photosynthesis. The higher the nutrient availability in the medium, the faster the cell division and vegetative growth of *Lemna* sp occur, thereby increasing the specific growth rate.

The high SGR value in P₄ also indicates that *Lemna* sp growth can still keep pace with tilapia consumption. This condition is likely due to the 2.5 ml/L dose being the optimal concentration that rapidly enhances the regeneration of *Lemna* sp. Conversely, the low SGR in the control treatment indicates that, without nutrient

supplementation from LOF, *Lemna* sp growth is limited by low nutrient availability in the culture medium. According to Kristin et al.¹⁸, adequate nutrient supply significantly influences the metabolic activity of aquatic plants, thereby directly affecting biomass accumulation and growth rates.

These findings align with the study by Ramadhan et al.¹⁹ on the use of LOF derived from banana peels and catfish offal in culture media for *Lemna* sp and gurami fish, in which the highest specific growth rate of 6.17%/day was achieved at a dose of 1.625 ml/L. This value is higher than that found in this study, likely due to differences in the nutrient content of the LOF used, as well as differences in the fish species and culture medium conditions. In that study, the organic nitrogen content from fish waste was likely higher, thereby supporting faster growth of *Lemna* sp (Figure 1).

Figure 1 shows that, in each treatment involving tilapia rearing tanks, *Lemna* sp biomass decreased during the rearing period. This indicates that the tilapia fry utilized the *Lemna* sp available in the medium as a food source. The highest *Lemna* sp. biomass in the tilapia rearing tanks was observed in the treatment with LOF at 2.5 ml/L, amounting to 145.66 g. The high *Lemna* sp biomass in P₄ is likely due to the 2.5 ml/L dose being optimal in this study. The growth rate of

Lemna sp kept pace with the tilapia's consumption rate. Sufficient nutrient availability allows *Lemna* sp to undergo rapid regeneration; thus, even with utilization as natural feed, biomass can still

be maintained at a relatively high level. Consequently, the balance between *Lemna* sp growth and fish consumption pressure is a critical factor in determining final biomass²⁰.

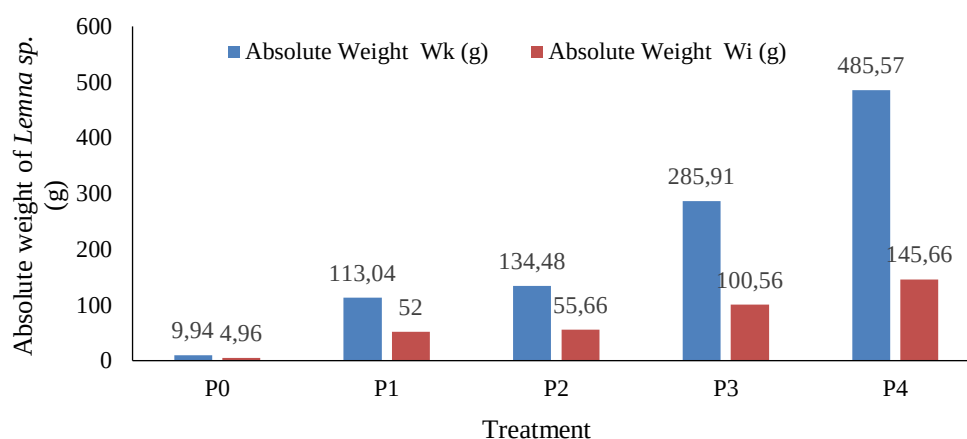


Figure 1. Growth of *Lemna* sp in fish-rearing tanks (Wi) and tanks without tilapia (Wk)

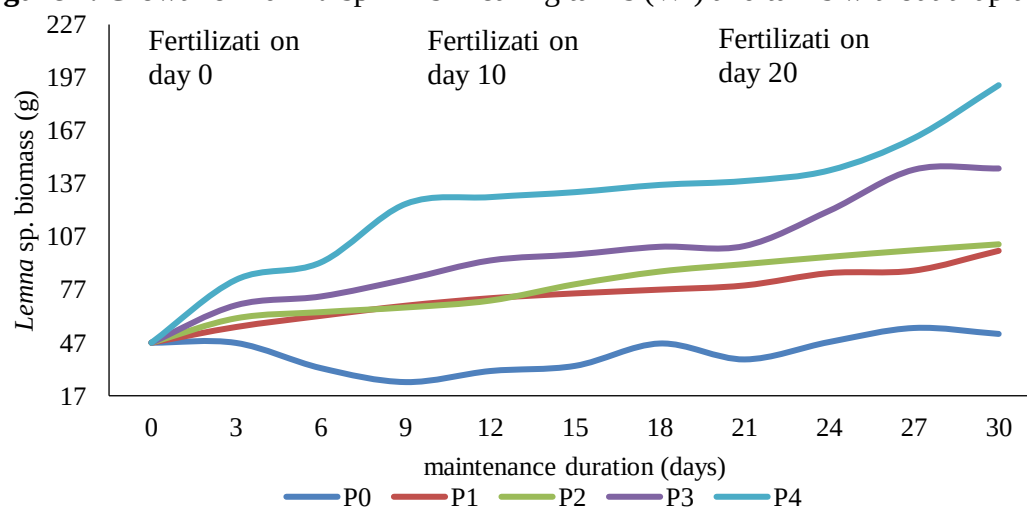


Figure 2. The biomass growth of *Lemna* sp every 3 days

Similar conditions were observed in tanks without tilapia, where P4 still produced the highest *Lemna* sp. biomass, at 485.57 g. The high *Lemna* sp. biomass in P4 is likely due to the 2.5 ml/L dose being the optimal concentration to support nutrient availability and enhance photosynthesis, thereby maximizing biomass growth. Additionally, the absence of tilapia in the control tank allowed *Lemna* sp to grow without biomass loss due to consumption, resulting in higher biomass accumulation.

Based on the *Lemna* sp biomass growth graph, which was recorded every 3 days over a 30-day cultivation period, it is

evident that biomass growth in each treatment exhibited distinct patterns corresponding to the administered doses of noni fruit LOF. In general, treatments with higher LOF doses resulted in greater increases in biomass compared to those with lower doses or the control.

At the start of the cultivation period (days 0 to 9), the biomass of *Lemna* sp in P1, P2, P3, and P4 increased in response to the first fertilization applied on day 0. The highest increase during this period occurred in P4, which rose from 47 g to 125.5 g by day 9. Conversely, in the control (P0), biomass decreased to 24.73 g. This decrease

indicates that without the addition of POC, nutrient availability in the medium becomes limited, so that *Lemna* sp growth cannot keep pace with tilapia consumption. Research by Nurhadi et al.²¹ indicates that under high-nutrient conditions, *Lemna* sp can grow rapidly, thereby compensating for biomass loss due to fish predation.

Following the second fertilization on day 10, *Lemna* sp biomass again increased across all treatments receiving LOF supplementation. This was observed from day 12 to day 18, during which biomass continued to increase, particularly in P3 and P4. These conditions indicate that the addition of LOF once again increased the availability of nutrients such as nitrogen, phosphorus, and potassium, which are required for photosynthesis, new tissue formation, and cell division. Noni fruit LOF contains macronutrients in the form of nitrogen, phosphorus, and potassium. The results of the chemical analysis of noni fruit POC in this study are presented in Table 3.

Table 3. Chemical analysis of Liquid Organic Fertilizer (LOF) made from noni fruit

No.	Contents	Concentration (%)
1.	C-Organic	2,41
2.	Nitrogen	0,35
3.	Phosphorus	0,13
4.	Potassium	0,54

Source: Soil Laboratory, Faculty of Agriculture, Universitas Riau

Chemical analysis results show that noni fruit LOF has higher nitrogen and potassium content than banana stem waste LOF. Sinaga et al.²² reported that LOF from banana stem waste contains 2.55% organic carbon, 0.23% nitrogen (N), 0.16% phosphorus (P), and 0.27% potassium (K). Meanwhile, when compared to LOF from pineapple peel waste, the nutrient content of noni fruit POC is also relatively higher. Taradifa et al.²³ stated that pineapple peel waste POC has a nitrogen (N) content of 0.11%, phosphorus (P) 0.04%, potassium (K) 0.17%, a pH of 4, and organic carbon (C) 1.13%.

In this study, these differences were clearly evident between the *Lemna* sp containers treated with POC and those without LOF (control). Containers treated with fertilizer showed better growth and greener leaf color, whereas in the untreated containers, *Lemna* sp exhibited slower growth and a tendency toward leaf discoloration. Kinanti et al.²⁴ also confirmed that nutrients play a direct role in chlorophyll formation and plant tissue development; thus, when nutrients are limited, not only does biomass decrease, but the leaf color of *Lemna* sp also becomes pale yellow, and growth is stunted. A visual comparison of the conditions of *Lemna* sp under each treatment is shown in Figure 3.

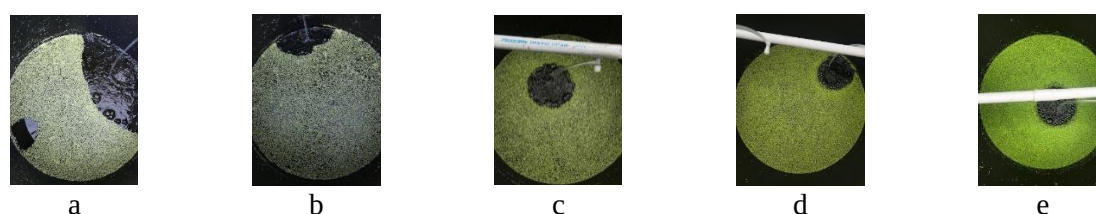


Figure 3. Visual comparison of the condition of *Lemna* sp under each treatment; a.) P0 = No LOF; b.) P1 = 1.75 mL/L LOF; c.) P2 = 2 mL/L LOF; d.) P3 = 2.25 mL/L LOF; e.) P4 = 2.5 mL/L LOF

Figure 3 shows that the addition of noni fruit LOF serves as a source of organic nutrients, increasing water nutrient levels and supporting biomass formation. However, without an adequate supply of

nutrients, *Lemna* sp will experience nutrient deficiencies, reduced photosynthesis rates, and reduced growth efficiency, even when the medium's surface area is ideal²⁵. Thus, optimal growth of *Lemna* sp results from a

combination of spatial (surface area) and chemical (nutrient availability) factors, which complement each other to determine the success of *Lemna* sp biomass production.

Absolute Weight Gain and Specific Growth Rate of Tilapia

The application of liquid organic fertilizer (LOF) derived from noni fruit to the tilapia rearing medium provides a nutrient source for *Lemna* sp plants, which can be utilized by tilapia as their primary feed in this study. Data on the absolute weight and specific growth rate of tilapia during the study are presented in Table 4.

The highest absolute weight of tilapia was obtained with a LOF dose of 2.5 ml/L, at 1.71 ± 0.10 g. The specific growth rate of tilapia during the study was consistent with the absolute weight gain, with the highest SGR observed at a LOF dose of 2.5 ml/L ($3.22 \pm 0.07\%$). The results of the Analysis of Variance test indicate that the addition of noni fruit POC at different doses had a significant effect ($P < 0.05$) on the absolute weight and specific growth rate of tilapia. The results of the Newman-Keuls test showed that P4 differed significantly from P3, P2, P1, and P0. Results of the Analysis of Variance (ANOVA) for the absolute weight and specific growth rate of tilapia.

Table 4. Average absolute weight and specific growth rate of tilapia

Treatment	Absolute weight (g)	Specific Growth Rate (%/day)
P ₀	0.51 ± 0.01^a	1.39 ± 0.08^a
P ₁	0.77 ± 0.03^b	1.89 ± 0.06^b
P ₂	0.84 ± 0.04^b	2.04 ± 0.09^b
P ₃	1.09 ± 0.08^c	2.37 ± 0.06^c
P ₄	1.71 ± 0.10^d	3.22 ± 0.07^d

Description: Different superscript letters in the same column indicate a statistically significant difference ($P < 0.05$)

Survival Rate of Tilapia

Survival rate is a key parameter in fish farming, as it indicates a fish's ability to survive during rearing. Survival rates are influenced by various factors, such as the quality of the rearing medium, feed availability, the nutritional content of the feed, and the fish's stress levels during the study. A high survival rate indicates that the rearing environment during the study supported the tilapia well. The observed survival data for tilapia are shown in Table 5.

Based on Table 5, the tilapia survival rate during the study ranged from 93% to 96%. This percentage is relatively high and indicates that the rearing conditions remained within an acceptable range to support tilapia survival. The results of the analysis of variance (ANOVA) showed that applying liquid organic fertilizer (LOF) from noni fruit at different doses had no significant effect ($P > 0.05$) on tilapia survival rate. This indicates that adding noni fruit POC up to 2.5 ml/L did not negatively affect the survival rate of the fish during the rearing period.

Table 5. Average survival rate of tilapia

Treatment	Survival Rate (%)
P ₀	93 ± 3.51
P ₁	96 ± 3.51
P ₂	93 ± 3.51
P ₃	96 ± 3.51
P ₄	96 ± 3.51

4. CONCLUSION

Based on the study's results, the application of liquid organic fertilizer (LOF) derived from noni fruit affects biomass growth of *Lemna* sp in tilapia culture media. The application of noni fruit LOF at a dose of 2.5 ml/L was the most effective treatment for the absolute weight growth of *Lemna* sp,

yielding an average absolute weight of 145.66 ± 4.81 g and a specific growth rate of 4.70 ± 0.08 %/day. This treatment was able to support the growth of Nile tilapia for 30 days without the use of commercial feed, relying solely on *Lemna* sp as the sole feed source, resulting in a final body weight of 1.71 ± 0.10 g, a final length of 2.8 ± 0.11 cm, a specific growth rate of 3.22 ± 0.07 %/day, and a survival rate of 96%. Additionally, the

presence of *Lemna* sp in the rearing medium acts as a phytoremediation agent, helping maintain water quality stability. Water quality parameters during the study remained within acceptable ranges, with temperature ranging from 26.4–30.1°C, pH 6.0–7.9, DO 4.1–7.2 mg/L, nitrate 0.06–19.05 mg/L, phosphate 0.13–4.16 mg/L, and ammonia 0.01–0.02 mg/L, supporting the survival and growth of tilapia.

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