Physiological response and quality of red tilapia Oreochromis sp. in the culture system using lemna (Lemna perpusilla) as phytoremediator

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Abstract. This study used Lemna as phytoremediator plant in red tilapia culture system and given as feed additive among treatments. The purpose of this study was to measure the production performance (quantity and quality) and physiological response of red tilapia. Study was conducted with two treatments: TL (without lemna) and L (with lemna) treatment. The results showed that L treatment gave the best result based on better feed conversion ratio. However there are no significant difference found in organoleptic test, growth performance, and blood cholesterol parameters. In addition, optimum water quality media that stimulated by lemna, can create a comfortable environmental conditions for red tilapia.

Keywords: lemna Lemna perpusilla, organoleptic test, red tilapia Oreochromis sp.

1. Introduction

Tilapia (Oreochromis sp.) is a freshwater fish commodity widely liked by Indonesian people. Tilapia is quickly bred with good meat quality, thus liked by consumers from various countries, especially Indonesian consumers (Suyanto 2010). Tilapia contains 43.76% protein, 6.80% ash, 7.01% lipid per 100 g fish (David and Anwar 2013). The production target of tilapia culture in 2015 was 1,656,600 ton, in 2016 was 1,822,200 ton, indicate an increasal of 10.85% per year (KKP 2015). Increased production of tilapia can be achieved through intensive culture. Intensive culture system is characterized by high stocking density, using more feed that resulting in organic material exposure from feed waste remains and fish residual metabolism (Djokosetiyanto et al 2006).

One effort to reduce organic material exposure is utilization of water plant to absorb harmful compounds in culture environment known as phytoremediation process. Phytoremediation using water plant in the culture media can stabilize, destroy or alter pollutants that are dangerous to be harmless even become economical value material (Artiyani 2011). Some advantages of phytoremediation includes the natural process between soil, microorganism, and culture environment which is relatively inexpensive and unrequired high technology (Purwaningsih 2009). One example of phytoremediator plant is Lemna plant.
Lemna (*Lemna perpusilla*) is a type of water plant from Lemnaceae family, that floats in freshwater area and can be found widespread in tropical areas (Landesman *et al.* 2005). According to Iqbal (1999), Lemnaceae family can accumulate minerals and nutrients in wastewater. Lemna is used in organic material processing of the culture waste based on its rapid biomass growth as it can utilized the nutrient optimally. Studies on the utilization of *L. perpusilla* as phytoremediator in aquaculture activities has been carried out before, i.e Amalia *et al.* (2014) stated that *L. perpusilla* on catfish cultivation covering 44.1% area had N and P absorption capacity of 2.4 mg of N g biomass \(^{-1}\) day\(^{-1}\) (w/w) and 0.3 mg of P g biomass \(^{-1}\) day\(^{-1}\), respectively.

Lemna can absorb nutrients in the culture waste at once and be used as feed additive for fish. According to Landesman *et al.* (2005), protein content in Lemna ranged among 10-43% of its biomass weight and low lignin content, thus easily consumed by herbivores. Chrismadha and Mardayati (2011) suggested that the addition of Lemna (*Perpusilla torr*) as tilapia (*Oreochromis niloticus*) diet provided a specific growth rate up to 0.02-1.8% day\(^{-1}\) depending its life stadia. Sulawesty *et al.* (2014) showed that fresh lemma biomass that used as food to replace pellets at an equivalent portion of 50% of dry weight feed given on carp (*Cyprinus carpio*) as much as 3% of body weight per day provides higher value of specific growth rate with 2.00% day\(^{-1}\).

Phytoremediation with recirculating system can optimize the utilization of culture water. The recirculation system in cultivation is the utilization of water rotation system for the fish culture tank to the filter tank, then reflowing it into the culture container. The system uses water repeatedly with filtration system. One types of filters used is biological filters, including water plants, microorganisms, and benthic organisms (Samsundari and Wirawan 2013). Biological or biofilters are used to maintain water quality both in closed and open circulation systems. Therefore, it is necessary to conduct further studies about *L. perpusilla* as phytoremediator on red tilapia culture using recirculation system to improve the water quality and productivity of red tilapia (*Oreochromis sp.*) in terms of quantity and quality.

This study aimed to measure the production performance (quantity and quality) and physiological response of red tilapia in the recirculation cultivation system using *L. perpusilla* as phytoremediator. The results of this study are expected to provide information for farmers in the application of environmental manipulation technology to increase the quantity and quality of red tilapia production.

2. Materials and methods

2.1. Materials of test

2.1.1. Tilapia fingerlings. Fish used in this study were red tilapia fingerlings with the average weight of 36.27±0.88 g and length of 9.98±0.07 cm. Red tilapia fingerlings were obtained from trial ponds, Faculty of Fisheries and Marine Sciences, IPB University, Bogor, West Java.

2.1.2. Feed. Fish were fed with commercial pellet sized 1.8-2.7 mm with 26-28% protein and 4-6% lipid content. The feed was obtained from Laladon, Bogor, West Java.

2.1.3. Plants. Plants used were Lemna (*L. perpusilla*) that were obtained from the trial ponds, Faculty of Fisheries and Marine Sciences, IPB University, Bogor

2.1.4. Rearing tank. Rearing tank used in this study was concrete ponds coated with six tarpaulins sized 2.75×1×0.6 m\(^3\), 900 L water volume, and 0.33 m water altitude. Pond was separated into two parts using fiber plastic with holes around the sides, therefore the water could flow onto the rearing and filter pond. The water volume in the rearing pond was 680 L, while the filter pond was 220 L. Water from the rearing pond was streamed through PVC pipe with 0.5 inches diameter using pump under 0.1 L.s\(^{-1}\) flow rate to
the filter pond, which served as water filter out from and restored back to the rearing pond through fiber plastic separation. Four aeration points were installed on each rearing pond.

2.2. Methods
2.2.1. Study design. This study was conducted using randomized complete design with two treatments and three times replications. The following treatments were:

TL : Without *L. Perpusilla* addition
L : *L. Perpusilla* addition with 500 g wet weight

2.2.2. Procedures. This study comprised of preparation (adaptation), rearing, data collection, and data analysis stage. Adaptation stage consisted of tank preparation and red tilapia fingerling adaptation. Second stage contained fish rearing for 60 days and data collection, namely growth parameter, physiological responses, and water quality.

Before this study was conducted, the pond was firstly cleaned and dried. Roof shade and tarpauline were installed on each pond. Fiber plastic separation was also installed on 1/3 section of the pond. Pond was filled with 900 L water and conditioned for 3 days. Before stocking, fish was measured for the initial weight and length. Fish was then acclimatized for 5 minutes. Fish were stocked as much as 46 fish on the rearing pond (Gibtan *et al* 2008). Filter pond on L treatment was given *L. perpusilla* as much as 500 g. Water during the study was remained unchange, however water height was checked everyday to maintain the water height during rearing.

Red tilapia fingerlings were reared in the prepared culture media for 60 days. Feed was given using restricted method based on 3% feeding rate from the biomass (BSN 2009). The feeding frequency performed was three times a day (morning, afternoon, and evening). The feed given was commercial feed in the morning and evening as much as 2% from the total biomass and fresh lemna in the afternoon as much as 1% from the total biomass. Length and weight sampling were performed once every 14 days (Muangkeow *et al* 2007) by taking 15 fish on each pond. Equipments used in sampling were ruler with 1 cm accuracy and digital scale with 0.01 g accuracy.

Data collected consisted of growth, physiological response against stress, organoleptic test, and water quality. Growth sampling was performed once every 14 days by measuring total length and weight parameter. Physiological response was observed once every 20 days by determining cholesterol total, triglycerides, HDL cholesterol, and LDL cholesterol. Organoleptic test data was collected after the end of rearing by determining appearance, aroma, taste, and texture. Water quality data was collected everyday (dissolved oxygen, temperature, and pH) and once every 14 days (alkalinity, carbondioxide, and brightness).

2.2.3. Organoleptic test
The organoleptic test used was the preferences test of product characteristics that concerned the panelist assessment. Panelists were requested to deliver their personal preference response on the product. Organoleptic assessment score was 1 to 9 performed with 35 semi-trained panelists among students. This organoleptic test was conducted by presenting the fish based on the specific code, panelists were asked to give their preferences in the provided score sheet based on SNI 01 2346-2006 regarding organoleptic and sensory test instructions.

Red tilapia were cleaned from the stomach and scales, then washed. Fish were steamed at 100°C for 30 minutes by wrapping the fish in aluminium foil without adding any seasoning. The test was performed in Babakan laboratory which was divided into two parts, namely testing and kitchen room. Testing time was at around 09.00-11.00 (GMT+7). Before conducting the test, each panelist was advised to drink
clear water when performing taste test parameter. Organoleptic parameters observed included appearance, aroma, taste, and texture.

2.2.4. Survival rate. Survival rate (SR) was calculated from the ratio of fish total before and after rearing period. Dead fish were observed everyday and their weight were measured. Survival rate was calculated on the following formula (Goddard 1996):

\[
SR (%) = \left( \frac{N_t}{N_0} \right) \times 100
\]

(1)

SR = Survival rate (%)
Nt = The total of fish after rearing
No = The total of fish before rearing

2.2.5. Specific growth rate. Fish weight was measured using digital scale with 1 g accuracy. Specific growth rate (SGR) is the percentage of individual weight growth. SGR was calculated using the formula (Huisman 1987):

\[
SGR (%) = \left( \frac{\ln W_t - \ln W_0}{t} \right) \times 100
\]

(2)

SGR = Specific growth rate (% day\(^{-1}\))
t = Rearing period (days)
Wt = Average weight after rearing (g)
Wo = Average weight before rearing (g)

2.2.6. Absolute length growth. Absolute length growth (ALG) measured in this study was the total length of fish (from the front head to the end of caudal fin (Effendie 1979). ALG was calculated using the formula (Goddard 1996):

\[
ALG = P_t - P_0
\]

(3)

ALG = Absolute length growth (cm)
Pt = Individual average length on t-day (cm)
P0 = Individual average length on 0 day (cm)

2.2.7. Feed conversion ratio. Feed conversion ratio (FCR) is the ratio of total feed given during the rearing period and fish weight gain until the end of rearing. FCR was calculated based on the following formula (Goddard 1996):

\[
FCR = \left( \frac{F}{(B_t + B_d) - B_o} \right)
\]

(4)

FCR = Feed conversion ratio
F = The total of feed given during rearing (g)
Bt = Final fish biomass (g)
Bd = Dead fish biomass (g)
Bo = Initial fish biomass (g)

2.2.8. Diversity coefficient. Diversity coefficient (DC) was the fish weight variation at the end of rearing. DC was calculated using the following formula from Steel and Torrie (1993):
DC (%) = \left( \frac{S}{Y} \right) \times 100 \quad (5)

Keterangan:
DC = Diversity coefficient (%)
S = Standard deviation
Y = Example average

2.2.9. Blood cholesterol total (BCT) Fish blood was taken as much as 0.5 ml, then centrifuged at 2500 rpm for 15 minutes. Blood Plasma was separated and inserted into the microtube. Cholesterol measurement was performed using CHOPD-PAP (enzymatic colorimetric test for cholesterol with lipid clearing factor) method with Liquicolor cholesterol kit, HUMAN brand. Blanko solution was prepared as much as 1 ml R-Chol. Blanko solution was mixed with 10 μl standard solution (200 mg dL⁻¹). A 10 μl sample was mixed with 1 ml R-Chol. Standard and sample solution were homogenized for a few minutes and incubated for 10 minutes at room temperature. Absorbance concentration was read using a spectrophotometer at 500 nm wavelength (HITACHI-U-2001). Cholesterol calculation content can be determined using the following formula:

\begin{equation}
BCT = \frac{\text{Sample’s absorbance}}{\text{Standard’s absorbance}} \times 200 \text{ mg/dL}
\end{equation}

2.2.10. Triglycerides. Triglycerides measurement was performed using GPO-PAP (enzymatic colorimetric test for triglycerides with lipid clearing factor) method with cholesterol Liquicolor kit Mono, HUMAN brand. Blanko solution was prepared as much as 1 ml R-TG. Blanko solution was mixed with 10 μl standard solution (200 mg dL⁻¹). 10 μl sample was mixed with 1 ml R-TG. Standard and sample solution were homogenized for a few minutes and incubated for 10 minutes at room temperature. Absorbance concentration was read using a spectrophotometer at 500 nm wavelength (HITACHI-U-2001). Calculation of triglyceride content can be determined by the following formula:

\begin{equation}
TG = \frac{\text{Sample’s absorbance}}{\text{Standard’s absorbance}} \times 200 \text{ mg/dL}
\end{equation}

2.2.11. HDL cholesterol. HDL was measured using Liquicolor HUMAN CHOLESTEROL kit (Precipitant and Standart). 200 μl sample solution was mixed with 500 μl precipitation solution, then centrifuged at 2500 rpm for 10 minutes and taken the supernatant. 100 μl supernatant was mixed with 1 ml R-Chol and homogenized for a few minutes, then incubated for 10 minutes at room temperature. Absorbance concentration was read using a spectrophotometer at 500 nm wavelength (HITACHI-U-2001). Total content of HDL cholesterol can be calculated using the following formula:

\begin{equation}
\text{HDL Cholesterol} = \frac{\text{Sample’s absorbance}}{\text{Standard’s absorbance}} \times 200 \text{ mg/dL}
\end{equation}

2.2.12. LDL cholesterol. LDL cholesterol in blood was unanalyzed using enzymatic method with Test Kit. According to Friedwald et al. (1972), LDL cholesterol can be determined using the following formula:

\begin{equation}
\text{LDL Cholesterol} = K - \text{HDL} - \frac{\text{TG}}{5}
\end{equation}
2.2.13. Physical and chemical water quality. Physical and chemical water quality were performed everyday and every 14 days during the rearing period. Parameters measured comprised of dissolved oxygen, temperature, pH, alkalinity, carbon dioxide, and brightness. Water sample was taken on each pond. Water samples were tested in the laboratory of aquaculture environment, Department of Aquaculture, Faculty of Fisheries and Marine Sciences, IPB University.

2.3. Data analysis
Production performance (SR, SGR, ALG, FCR, and DC) and physiological responses (cholesterol total, triglycerides, HDL cholesterol, and LDL cholesterol) were statistically tested using MiniTab 17 with t-test method to compare two treatments. Water quality parameters (dissolved oxygen, temperature, pH, alkalinity, carbon dioxide, and brightness) and organoleptic test (appearance, aroma, taste, and texture) were analyzed descriptively presented on table and figure using Windows Microsoft Excel 2010.

3. Results and discussion

3.1. Organoleptic test
Assessment result of red tilapia organoleptic quality is presented on figure 1. Treatment with or without lemna did not show any significant different result. However the highest assessment value was on L treatment scored as 6 for appearance, aroma, taste, and texture.

![Figure 1](image)

**Figure 1.** Assessment result of red tilapia organoleptic quality (TL: Treatment without *L. perpusilla* addition, L: Treatment with *L. perpusilla* addition).

3.2. Production performance
The calculation result of production performances including SR, SGR, ALG, FCR, and DC after 60 days rearing can be seen on table 1. SR, SGR, and ALG parameter were insignificantly different after added with *L. perpusilla* based on the statistical calculation. SGR and ALG had positive correlation, as high SGR value was followed with high ALG value. L treatment had higher SGR value with 1.24±0.07% day−1, along with higher ALG value reaching 0.75±0.02 cm, than TL treatment. FCR and DC value were significantly different against the addition of *L. perpusilla* with 2.3±0.14 and 15.98±0.31%, respectively. The survival rate of red tilapia ranged among 99.46±0.07% until 100%.

| Growth parameter                      | Treatment  |
|---------------------------------------|------------|
| Survival rate (SR) (%)**              | TL         | L          |
| Specific growth rate (SGR) (% i−1)*   | 1.18±0.11a | 1.24±0.07a |
| Absolute length growth (ALG) (cm)*    | 0.64±0.03a | 0.75±0.02a |
| Feed conversion ratio (FCR)*          | 2.6±0.04a  | 2.3±0.14b  |
| Diversity coefficient (DC) (%)*       | 19.26±0.63a| 15.98±0.31b|

*Significantly different values from the LSD test.
Note: Numbers on the same column are presented in average value ±standard error followed with different letter showing significant different result *(P<0.05) **(P<0.01).

3.3. Cholesterol total
The calculation result of blood cholesterol total in red tilapia during rearing periode can be seen on figure 2. Cholesterol concentration on blood increased from the beginning of rearing until 40 rearing days. Result of L. perpusilla addition was insignificantly different toward the cholesterol concentration. The highest cholesterol value was 184.57 mg.dL$^{-1}$ on TL treatment on 40 days rearing and the lowest was also found on TL treatment at 20 days rearing with 134.85 mgdL$^{-1}$.

![Figure 2](image2.png)

**Figure 2.** Blood cholesterol total on red tilapia (TL: Treatment without L. perpusilla, L: Treatment with L. perpusilla). Different letters above the diagram show significant different result (P<0.05).

3.4. Triglycerides
The calculation result of triglycerides on red tilapia blood during rearing period can be seen on figure 3. Triglyceride concentration on blood increased at 40-60 days rearing. The addition of L. perpusilla was insignificantly different against triglyceride concentration. The highest triglyceride value was 313.25 mg dL$^{-1}$ on TL treatment at 40 days rearing and the lowest value was found on TL treatment at 20 days rearing with 178.5 mg dL$^{-1}$.

![Figure 3](image3.png)

**Figure 3.** Triglyceride calculation result on red tilapia (TL: Treatment without L. perpusilla, L: Treatment with L. perpusilla). Different letters above the diagram show significant different result (P<0.05).
3.5. HDL cholesterol

The calculation result of HDL on red tilapia blood during rearing period can be seen on figure 4. HDL concentration on red tilapia blood increased at the beginning of rearing until 60 days rearing. The addition of *L. perpusilla* was showed insignificantly different results toward HDL cholesterol concentration. The highest HDL concentration was 112.65 mg dL⁻¹ on L treatment at 60 days rearing and the lowest was found on L treatment at 20 days rearing with 66.57 mg dL⁻¹.

![Figure 4](image)

**Figure 4.** HDL cholesterol concentration of red tilapia blood (TL: Treatment without *L. perpusilla*, L: Treatment with *L. perpusilla*). Different letters above the diagram show significant different result (P<0.05).

3.6. LDL cholesterol

The calculation result of LDL on red tilapia blood during rearing is presented in table 5. LDL concentration on red tilapia blood decreased at the beginning of rearing until 60 days rearing. The addition of *L. perpusilla* was insignificantly different against LDL cholesterol concentration. The highest observed LDL concentration was 40.53 mg dL⁻¹ on L treatment at 20 days rearing days and the lowest was found at 60 rearing days with 12.33 mg dL⁻¹.

![Figure 5](image)

**Figure 5.** LDL cholesterol concentration of red tilapia blood (TL: Treatment without *L. perpusilla*, L: Treatment with *L. perpusilla*). Different letters above the diagram show significant different result (P<0.05).
3.7. Water quality parameter

Water physical and chemical quality measured in this study contained of dissolved oxygen, temperature, pH, alkalinity, carbon dioxide (CO₂), and brightness. The measurement result of water quality for 56 rearing days is presented on table 2.

| Water quality parameter | Treatment | Range of threshold |
|-------------------------|-----------|--------------------|
| Dissolved oxygen (mg L⁻¹) | TL        | 4.74 - 6.07        | 1 – 5 (Effendi 2003) |
|                         | L         | 4.21 - 5.53        |                        |
| Temperature (°C)        | TL        | 28.07 - 30.60      | 25 – 30 (Handayani et al. 2013) |
|                         | L         | 28.27 - 30.17      |                        |
| pH                      | TL        | 7.32 - 7.85        | 6.5 - 8.5 (Handayani et al. 2013) |
|                         | L         | 7.51 - 7.74        |                        |
| Alkalinity (mg L⁻¹ CaCO₃) | TL        | 30.53 - 71.75      | 30 – 500 (Effendi 2003) |
|                         | L         | 48.85 - 103.81     |                        |
| CO₂ (mg L⁻¹)            | TL        | 13.32 - 18.64      | < 11 (Sunarso 2008)   |
|                         | L         | 7.99 - 17.31       |                        |
| Brightness (cm)         | TL        | 9.17 - 22.50       | 20 – 35 (Kordi and Tanjung 2007) |
|                         | L         | 17.33 - 27.33      |                        |

Table 2 shows that dissolved oxygen, temperature, pH, and alkalinity on all treatments were on the optimum range standard. The CO₂ range value represents L treatment had lower CO₂ than TL treatment. Brightness value showed L treatment had higher brightness level than TL treatment. Water quality supports the survival rate of red tilapia during rearing. The concentration of dissolved oxygen during rearing ranged among 4.21-6.07 mg.L⁻¹. The value of dissolved oxygen for fish survival is 1-5 mg.L⁻¹ (Effendi 2003). The temperature range during rearing ranged from 28.07-30.60°C. According to Handayani et al. (2013) stated that the optimum temperature range for the cultivation of red tilapia was 25-30°C. pH value during the rearing of red tilapia in this study ranged among 6.88-7.91. The optimum pH range for the red tilapia culture was 6.5-8.5 (Handayani et al. 2013). The value of alkalinity during rearing ranged among 30.53-103.81 mg.L⁻¹ CaCO₃ (Appendix 21). The range of alkalinity should be between 30 to 500 mg.L⁻¹ CaCO₃ (Effendi 2003).

This study was conducted to examine the environmental factor affecting growth and quality of red tilapia with L. perpusilla as phytoremediator which is capable of absorbing dissolved N, thus reducing the cultivation waste and feed additive for fish. The quality of red tilapia can be improved as the presence of L. perpusilla to provide increased quality of red tilapia meat. The quality improvement of fish was tested organoleptically based on the hedonic scale. The fish quality assessment was based on the sensory and flavor aspects, namely appearance, aroma, taste, and texture.

Appearance is the first characteristics assessed that influenced panelists product acceptance. Based on the organoleptic tests, it is known that the panelists level of acceptance against the appearance of red tilapia on L treatment had the highest value due to brighter appearance and more coloured than TL with pale color. This was due to the different light penetration between treatments. Lemma in L treatment had higher brightness of the pond compared to TL treatment. Bright light condition as exposed with rays or light during rearing provides clear and bright fish body color (Said et al 2005).

The fish aroma on L treatment tended to be fresher than TL treatment which had muddy aroma. The muddy aroma in TL treatment was caused by high diversity of phytoplankton type in TL treatments. The main phytoplankton groups are blue green algae (Cyanophyta), such as Oscillatoria sp., and Anabaena sp., bacteria (Streptomyces tendae and Actynomycetes), which produce two chemical compounds, namely geosmin and 2-methylisoborneol (MIB, Tucker 2000). Geosmin causes fish to have muddy taste and aroma, while MIB causes fish meat to be musty (Person 1996). This compound will be easily absorbed by fish through gills, skin, intestines, and meat, thus causing muddy aroma (Yamprayoon and Noomhorm 2000). Aside from absorption, MIB and geosmin compounds can enter the body of fish through phytoplankton that were eaten by fish. So that at the treatment of TL that has a high phytoplakton diversity causes red tilapia smelling mud.
The taste and texture of fish in L treatment was better than TL treatment. Better taste was due to high HDL content in L treatment at the end of rearing. Low LDL content in this case affects the meat texture as the lipid serves as meat wrapper. Low LDL content will cause the fish meat texture to become dense (Goddard 1996). In addition, lipid is also used as aroma, taste, and nutritional value enhancer in fish (Suhardjo and Kusharto 1987).

Observed production performance parameters related to growth were SR, SGR, ALG, FCR, and DC. SR is a production performance parameter that showed the percentage of live fish at the end of the rearing period. SR is closely related to the successful aquaculture production as it determines the biomass harvest result and the amount of feed consumed during rearing. Table 1 showed insignificant different result between treatments (P < 0.01). TL treatment produced 100% SR, while L treatment produced 99.46% SR. According to Kadarini and Prihandani (2011), SR of fish reaches 80-90% can be stated as optimum. This result occured as the water quality data during maintenance tended to be good and still within the tolerance limit of red tilapia (table 2).

SGR and ALG are production performance parameters that showed the growth of fish weight and length. Growth is influenced by internal factors, namely genetic and disease resistance, and external factors, as the feed availability and aquatic environment (Huet 1971). Table 2 showed insignificant different results between treatments (P < 0.05). SGR and ALG parameters were positively related, as high SGR value was aligned with ALG value. L treatment had high SGR value of 1.24%, day\(^{-1}\) followed by TL treatment with 1.00%, day\(^{-1}\). Aligned with the LPS value, L treatment also had high ALG value of 0.75 cm. Both production performance data, LPS and PPM showed that L treatment delivered the best results. This was supported by the optimum water quality range contained in the media presented in table 2. Optimum media water quality can create a comfortable environmental condition for red tilapia. Comfortable environmental conditions greatly affect the metabolic energy in the body. This was associated with derived energy used for basal metabolism and adaptation to the environment that will affect the remaining energy produced. The remaining energy that will be used for the maturation process of gonads and Growth (Watanabe 1988).

FCR is useful to determine the fish ability to digest feed. FCR value showed the amount of feed used to increase fish weight by 1 kg (NRC 1993). Low FCR value indicated high fish efficiency in utilizing the feed consumed. Feeding with 2% pellets and 1% fresh Lemna treatments provided statistically significant result (P < 0.05), whereas L treatment had lower RKP value of 2.3 than TL treatment of 2.6. Low FCR value of L treatment was related to energy utilization. High SGR and ALG value were found in L treatment (table 1). Another factor that supported low FCR value in L treatment was environmental conditions, i.e. the water quality with higher brightness condition, thus effective to be given feed. According to NRC (1993), large and small FCR is influenced by several factors, namely species, size, quality, and quantity of feed as well as the water quality that will determine the feed effectiveness.

DC indicates the level of weight diversity at the end of rearing. The lower KK, the higher uniformity level of weight. Table 2 showed significant results between treatments (P < 0.05). The value of DC on red tilapia at the end of rearing showed higher result on TL treatment with 19.26%. These results indicated that the value of KK was inversely proportional to SR value on TL treatment. SR value on TL treatment was 100%, allowing red tilapia competition to obtained feed, therefore the potential for growth variation in each individual was possible. Low value of KK was found at L treatment with 15.98% on SR value of 99.46%. The low value of SR causes low red tilapia competition as the weight uniformity among individuals becomes high. According to Budiardi et al. (2007), the size of the uniform fish will decrease the level of fish competition in gaining feed, space, and oxygen.

Blood lipid is characterized by cholesterol and triglycerides. Cholesterol is a group of typical sterols found in animals whereas triglycerides are triesters of glycerol and the main components of lipid stored.
for use as energy prereserves. Cholesterol and triglyceride data is presented in figure 2 and 3 which showed that the total value of blood cholesterol and triglycerides in red tilapia blood were not significantly different (\( P < 0.05 \)). The total value of cholesterol on L treatment was lower at the end of rearing than TL treatment. L treatment with low cholesterol and high triglyceride value indicated a better value. This was in line with Goddard (1996), who stated that taste and texture of the fish meat is influenced by lipids and fatty acids stored in the fish body. In addition, the content of cholesterol in fish is influenced by sex, species, feed nutrient, seasonality, and the content of unsaturated fatty acids (Zivkovic et al 2002).

Blood vessels contain lipoproteins circulated into the liver (Colpo 2005). Cholesterol transportation is performed by two types of lipoproteins, i.e. HDL and LDL cholesterol. HDL cholesterol is the least small lipoprotein particles created in the liver, while LDL cholesterol is low density lipoprotein that brings cholesterol from the liver to tissues. HDL and LDL cholesterol are lipoproteins that contain molecules of glyceride and protein (Affandi and Tang 2002). Lipid stored in the body will be transported towards the liver with the help of HDL cholesterol. The value of HDL cholesterol in figure 4 and LDL cholesterol figure 5 was statistically different (\( P < 0.05 \)). However, L treatment had higher HDL cholesterol value of 112.65 mg dL\(^{-1}\) than TL treatment of 110.04 mg dL\(^{-1}\). L treatment also had lower LDL cholesterol on red tilapia blood with 12.33 mg dL\(^{-1}\) than TL treatment with 19.37 mg.dL\(^{-1}\). The results of this study are generally similar to Lehninger (1982), who stated that HDL cholesterol levels are inversely proportional to LDL cholesterol levels. High HDL cholesterol and low LDL cholesterol in L treatment affected the organoleptic test of fish meat, such as taste and nutritional value (figure 1). The content of HDL and LDL cholesterol in blood is influenced by feedstuffs consumed by fish, age, sex, genetics, and physical activity (O'brien 2009).

Therefore, the value of dissolved oxygen, temperature, pH, and alkalinity in all treatments were within the recommended range or within the normal range. The value of carbon dioxide on TL and L treatment ranged among 12.32-18.64 mg L\(^{-1}\) and 7.99-17.31 mg.L\(^{-1}\) respectively. The optimum concentration of carbon dioxide should be 11 mg.L\(^{-1}\) in minimum (Sunarso 2008). The carbon dioxide value range shows that L treatment had lower carbon dioxide value than TL treatment due to the declining of fish respiration activity. According to Suwandi et al (2012), declined carbon dioxide value directly affects the value of dissolved oxygen (DO), as inclined DO consumption will increase the value of carbon dioxide.

Brightness is an important measure of water transparency as it is closely related to the photosynthesis process occurring in the water. Brightness indicates how much light with certain intensity can penetrate into the water. The results of brightness value of red tilapia rearing media for 60 days showed 9.17-22.50 cm on TL treatment and 17.33-27.33 cm on L treatment. The optimum brightness range is 20-35 cm (Kordi and Tanjung 2007). Brightness value range shows that L treatment had better brightness value than TL treatment. Lemma serves to absorb nitrates in water. The content of nitrate absorption resulted in the occurrence of blooming phytoplankton, resulting in abundance of phytoplankton in low water and causing increased brightness. Decreased brightness value causes the loss of light penetration into the water body, thus the photosynthesis process is less performed. According to Goldman and Horne (1983), the condition of water with low and high brightness will decrease the plankton abundance due to diminished food source for plankton and negative phototaxis behavior of the plankton that moves away from the light source.

4. Conclusion

Treatment of Lemma as biofilter provides the best results. Production performance in terms of quality based on the organoleptic test results indicated that there was good acceptance to the quality of red tilapia supported with physiological response in the form of lipid deposits on the quality of red tilapia meat. Growth parameters on Lemma treatment comprised SR (99.46±0.07%), SGR (1.24±0.07%), day\(^{-1}\)
1), ALG (0.75±0.02 cm), FCR (2.3±0.14), and DC (15.98±0.31%), showing the high uniformity of red tilapia at the end of rearing. This conclusion was also supported by optimum water quality media that can create a comfortable environmental condition for red tilapia.

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