The Effect of Adding Lysine in Commercial Feed on Growth Rate, Feed Efficiency, and Feed Conversion Ratio to Tambaqui (Colossoma Macropomum)

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Abstract. Tambaqui (Colossoma macropomum) is one of the freshwater fishery commodities of high economic value. Its delicious taste like that of carp makes it popular and the demand for this commodity increases every year both for domestic and export market (Samardyanto, 2011). Tambaqui needs amino acids to improve its growth process, one essential amino acids can only be obtained through lysine foods. Lysine is one of the ten essential amino acids. The purpose of this research is to find out how the administration of lysine on commercial feed increases tambaqui’s growth rate, feed efficiency, and feed conversion ratio. This is experimental research, using Completely Random Design (RAL) with 4 treatments and 5 repeats on each treatment. The dosage of lysine added in commercial diet were P0 (0%), P1 (0.6%), P2 (1.2%), and P3 (2%). The observed parameters include growth rate, feed efficiency, and feed conversion ratio. The data analysis used was Variant Analysis (ANOVA) followed by Double Distance Test Duncan. The results showed the addition of lysine on commercial feed during a 30-day maintenance had the same effect (P > 0.05) on the growth rate of tambaqui, the same effect (P > 0.05) on the feed efficiency, and quite similar (P > 0.05) on the feed conversion ratio of tambaqui. When we increased the amount of lysine in the administration of commercial feed to the fish, we observed an increase in the growth rate, specific growth rate, feed efficiency, and feed conversion ratio in tambaqui. The best treatment was found in P1 treatment with lysine dosage 0.6%, and the highest growth rate of 1.726 grams/day, specific growth rate was 2.326%/day, feed efficiency 68.70%, and the feed conversion ratio of 1.472. We observed that the P0 treatment i.e. treatment without lysine had a value growth rate, specific growth rate, feed efficiency, and feed conversion ratio of respectively 1.243 grams/day, 1.796%/day, 53.25%, and the feed conversion ratio 1.924.

1. Introduction
Tambaqui is one of the freshwater fishery commodities of high economic value. According to the Performance Report of Directorate General of Aquaculture (2016), the production development of tambaqui increases every year. It increased from 4,152 tons in 2015 to 17,683 tons in 2016. This suggests that tambaqui cultivation is one of fishery commodities in demand by the community.

Tambaqui is relatively easy to cultivate, as it tends to be adaptive and has good resistance against environmental changes and diseases. Despite having these advantages, its maintenance poses several obstacles therefore making this commodity less developed. Problems often faced in the current cultivation include water quality, disease and feed (Tantri, 2014). These factors resulted in low
production of tambaqui, one of which is the feed which does not meet the criteria of nutritional needs for tambaqui. According to Nur (2011), animal feed plays a critical role in the sustainability of cultivation. Suitability to fulfill nutrients in the feed can influence the formation of energy in the body. Energy sources in the feed can be utilized in the growth process. The nutrients needed by tambaqui include protein, fat, carbohydrates, vitamins, and minerals. Protein is the main energy source for fish. The optimal content of protein in the feed supports optimum fish growth.

One effort in improving the feed quality to support the productivity of tambaqui cultivation can be done with a feed supplement. A feed supplement is food ingredient mixed with other ingredients to increase the harmony to form a whole food (Hartadi et al., 1997). Lysine is a type of feed supplement derived from essential amino acids. Essential amino acids are amino acids that cannot be synthesized by the body (Lovell, 1998). Administration of Lysine supplement in several studies has shown other positive effects on various types of fish (Borlongan and Benitez, 1990).

Several studies also reported the advantages of adding lysine to the feed in several fish species. Robinshon et al. (1991) reported that the addition of lysine can increase the use of kapok seed flour to 100% replace soybean flour for channel catfish. Wu et.al. (1998) also reported that tilapia fed with 39% corn gluten and the addition of lysine could improve the growth of tilapia. Based on the above descriptions, it is expected that the addition of lysine in commercial feed to tambaqui can increase its growth rate, feed efficiency, and feed conversion ratio (FCR).

The purpose of this study was to examine if the administration of lysine in commercial feed to tambaqui can increase its growth rate, feed efficiency, and feed conversion ratio.

The expected benefit of the study is to provide information regarding the addition of lysine administration in the right dosage to commercial feed as feed supplement within the fishery sector which can influence the increase in growth, feed efficiency, and feed conversion ratio in tambaqui cultivation.

2. Research methodology
This research was carried out in Balai Benih Ikan Kabat, Banyuwangi from March 24 till April 22 2018. Method of the study is experimental to determine the effect of certain variables, on a group of fish in a controlled environment.

The experimental design used was completely randomized design (CRD) with 4 treatments and 5 replications on each treatment. The treatment is as follows:

- **P0**: 100% commercial feed + 0% lysine (control).
- **P1**: 99.4% Commercial feed + lysine 0.6%.
- **P2**: 98.8% Commercial feed + lysine 1.2%.
- **P3**: 98% commercial feed + 2% lysine.

This research used tambaqui of 5 cm long. The maintenance containers consisted of 20 aquarium with the size of 30x20x20 cm3/aquarium. The feed used in this study was commercial feed added with lysine. The lysine dosage was adjusted according to treatment requirements. The tools used in the research are sampling devices (analytical scales and rulers) and water quality measuring devices (Thermometers), pH Indicators, and Test-Kits.

The preparation stage included preparation of containers, fish maintenance, and feeding. The implementation stage included fish sampling i.e. measuring the length and weight of the test fish and the water quality.

Parameters measured were growth rate, feed efficiency, feed conversion ratio, and water quality as supporting data. Data Analysis used is variance analysis (ANOVA). If the analysis results are significantly different, we shall proceed with Duncan's Multiple Distance test.
3. Result and Discussion
The result on the addition of lysine in commercial feed of tambaqui with different dosage is presented in Table 1 and the water quality in Table 2.

Table 1. Data on growth rate (growth rate (gram/day), Specific Growth rate (SGR (%/day), Feed efficiency (EP (%)), and feed conversion ratio (FCR) in tambaqui fed with commercial feed with the addition of lysine with various dosages.

| Parameter    | P0 (lisin 0%) | P1 (lisin 0.6%) | P2 (lisin 1.2%) | P3 (lisin 2%) |
|--------------|---------------|-----------------|-----------------|---------------|
| GR (gram/day)| 1.243 ± 0.36  | 1.726 ± 0.28    | 1.538 ± 0.40    | 1.392 ± 0.24  |
| SGR (%/day)  | 1.796 ± 0.41  | 2.326 ± 0.35    | 2.132 ± 0.55    | 1.952 ± 0.29  |
| EP (%)       | 53.25 ± 11.24 | 68.70 ± 10.88   | 66.15 ± 10.01   | 54.97 ± 8.80  |
| FCR          | 1.924 ± 0.50  | 1.472 ± 0.29    | 1.55 ± 0.31     | 1.894 ± 0.20  |

Note: Different superscripts in the same column show a difference in (p<0.05)

Table 2. Water quality data during maintenance.

| Parameter          | Range |
|--------------------|-------|
| Temperature (°C)   | 27-30 |
| pH                 | 7     |
| Dissolved Oxygen (mg/l) | 5     |

3.1. Growth
Growth is the process of an increase in the length and weight of an organism observable from changes in the size of length and weight in units of time (Mulqan et al., 2017). Based on the ANOVA statistical analysis testing, the result of lysine administration commercial food to tambaqui shows that there was an insignificant difference (p>0.05) in the growth rate of tambaqui, which means that both feed administration with lysine and without lysine were insignificant for the growth rate of tambaqui. The highest growth rate in this study was found in P1 treatment (1.723 grams/day) with the addition of lysine by 0.6%, but it was not significantly different from P1 treatment (1.538 gram/day) with the addition of lysine by 1.2%. The lowest growth rate was found in P0 treatment (0.243 grams/day) with no addition of lysine which was not significantly different from P3 treatment (1.392 grams/day) with the feed administration added by lysine by 2%. This shows that the use of good feed with lysine did not show a better growth rate compared to feed without lysine (controlled treatment).

The increase in tambaqui growth rate may occur because lysine is an essential amino acid that cannot be produced by the fish, so its utilization must be added through a feed, proper feeding with appropriate doses which may increase the growth rate of tambaqui. This result is in line with the statement of Ananda (2015) that the addition of essential amino acids in a feed can increase fish growth rate, because essential amino acid is a simple compound derived from protein that is easier to digest and absorbed by the body. In addition, the treatment with lysine dosage higher than P1, i.e P2 treatment (1.538 grams/day) with the addition of lysine by 1.2% and P3 treatment (1.392 grams/day) with the addition of lysine by 2% showed an adverse impact, i.e. a drop in growth rate. Giri’s research (2009) stated that the addition of lysine amino acid above the optimum requirement amount in fish can cause a decrease in the growth of the final weight by 31.5 grams. Suwarsito’s study (2005) also mentions the addition of 0.29% lysine amino acids above the optimum requirements on catfish (Pangasius hypophthalmus) caused fish growth to decrease by 208.53 grams. This is presumably because an increase of lysine dose in the feed can increase the formation of carnitine in the fish. High carnitine levels will lead to higher oxidation of long chain fatty acids. As a result, high fatty acid oxidation may cause fish to experience fatty acid deficiency. Previous studies suggest that long chain fatty acids are needed by fish as essential fatty acids. According to Taekuchi (1997) essential fatty acids play an important role in maintaining cell membrane integrity, so that if there is a lack of
fatty acid in fish, it can disrupt cell metabolism. This will inhibit the body's protein synthesis which results in a decrease in growth. Therefore, the administration of excess amino acid lysine will cause fish growth to decline (Suwarsito, 2005).

The specific growth rate serves to present calculation of the percentage growth of fish’s weight per day (Jaya, 2013). The ANOVA Statistical Analysis Test result shows that the addition of lysine to commercial feed were not significantly different (P> 0.05) on the specific growth rate of tambaqui. The result shows that the highest specific growth rate was found in P1 treatment (2.326%/day) with the addition of 0.6% lysine, P2 treatment (2.132%/day) with the addition of 1.2% lysine, P3 treatment (1.952%/day) and P0 treatment (1.796%/day) without the addition of lysine (control). P1 treatment (2.326%/day) is in accordance with the nutritional needs of tambaqui. This is due to the minimum requirement of essential amino acid i.e. lysine for omnivorous fish by 2.07% (FAO, 2014), whereas according to a study from Santoso (2016) the amount of essential amino acid of lysine in commercial feed shall be 1.41%. The amount of essential amino acid of lysine in the treated feed was the closest to the minimum requirement of fish amino acids after the addition of lysine in commercial feed with 1.41% lysine addition from outside commercial feed found in P1 treatment with the addition of 0.6% lysine which produced the highest growth rate of tambaqui is 2.326%/day. This happens, because the use of lysine as much as 0.6% in feed is the most suitable feed use to meet the needs of essential amino acids Tambaqui, so that the nutrients in the feed can be absorbed by the body of tambaqui optimally. This is in accordance with Heptarina, et al. (2010) stating that the availability of amino acids in feed that will be stored in the body will be higher with the addition of essential acids into the feed.

P3 Treatment (1.952%/day) with the highest dose of lysine 2% gave a lower specific growth rate than P1 treatment (2.326%/day) with the addition of lysine as much as 0.6% and P2 (2.132%/day) with addition of lysine by 1.2%. This is allegedly because the excess amino acids in the feed given are not used by fish in the growth process, but the excess amino acids in the body will be released along with feces in the form of ammonia.

3.2. Feed efficiency
Feeding efficiency shows the value (in percentage) of food that can be utilized by the fish (Buwono, 2000). Based on the results of the ANOVA statistical analysis, the result was not significantly different (p> 0.05) on the feed efficiency of tambaqui. The highest efficiency of tambaqui feed in the study was found in P1 treatment (68.70%). This shows that P1 treatment is the most suitable treatment according to the efficiency value of tambaqui feed need, thus the absorption of feed with lysine is 0.6 % and was effectively absorbed by the fish to increase its weight and the percentage of feed converted into meat also increased. The feed efficiency value was in a good range, as stated by Craig and Helfrich (2002), that a good feed shows an efficiency of more than 50% or even close to 100%.

The P0 treatment showed a low feed efficiency value of 53.25%. This is caused by the lack of absorption of essential amino acids in the body which may be influenced by the low composition and the number of essential amino acids in the feed. In this case, lysine is limiting the amino acid. The other amino acids with the right amount or above the right amount can not be used to accumulate body proteins that can be used for fish growth, due to limited availability of lysine, which can later result in slow fish growth. This is in line with the statement of Arief’s et.al. (2014) that factors that influence the high and low feed efficiency derive from the type of nutrient source and the amount of each component of the nutrient source in the feed. The higher the value of feed efficiency, the better the response from the fish to the feed given as indicated by the rapid growth (Hariyadi et al., 2005).

3.3. Feed conversion rate
Parameters that describe the amount of feed given to fish in the specified period during maintenance can be determined by the value of feed conversion ratio. A higher feed conversion ratio value indicates that the feed provided is not efficient in feed utilization for the growth (Huet, 1979) and the value of low feed conversion ratio indicates that feed utilization for growth is very good (Ihsanudin et al., 2014).

Based on the results of ANOVA statistical analysis, the addition of lysine in commercial feed resulted
in no significant difference (P> 0.5) to feed conversion ratio for tambaqui which means both feed treated with lysine or not (controlled) did not influence the value of feed conversion ratio for tambaqui. The lowest value of feed conversion ratio was found in P1 treatment of 1.472 and the highest was found in P0 treatment of 1.924. This shows that the addition of lysine in the feed was able to provide a much better feed conversion value than the feed given without lysine (controlled). This is in line with a statement from Sri (2015) that the treated fish (administered with lysine) were more efficient in utilizing energy for growth, more efficient in their daily metabolism, and maintenance activity.

The addition lysine in the feed resulted in a better feed conversion ratio than the feed without the addition of lysine (controlled), mainly because lysine is an essential component of amino acids that can increase the growth of tambaqui. This is in line with the statement from Thaiin (2016) that the addition of lysine which is a protein monomer has resulted in the feed nutrient absorption faster in the intestine, thus the use of feed for the fish will be more efficient for the growth than the feed without lysine addition.

3.4. Quality of water
Water quality is one of the important factors that can affect the survival and growth rate of fish during maintenance. Based on the water quality parameters measured in this study which include temperature, dissolved oxygen content, and pH. The results of the analysis of water quality during maintenance indicate that the water quality parameters in the maintenance environment are still in the range corresponding to the needs of tambaqui. The temperature range is 27-30 0C, oxygen solubility is 5 ppm, and pH 7. According to Bramantya (2005) states the appropriate temperature to maintain tambaqui is 26-32 0C. The dissolved oxygen content is good for the maintenance of tambaqui at least 5 mg/l (Zonneveld, 1991), and the optimal pH for the maintenance of tambaqui ranges from 7-8 (Ghufran, 2011).

4. Conclusion and suggestion
4.1. Conclusion
We summarize the result of this research on the addition of lysine to commercial feed as follows:  
1. The addition of lysine to commercial feed did not affect the growth rate of tambaqui.  
2. The addition of lysine to commercial feed did not affect the feed efficiency of tambaqui.  
3. The addition of lysine in commercial feed did not affect the feed conversion ratio of tambaqui.

4.2. Suggestion
Based on the results of the study, in order to determine the effect of good feeding with both the addition of lysine or without the addition of lysine it is recommended to extend the observation time of fish maintenance so that each treatment can present a significant effect on increasing growth rate, feed efficiency and feed conversion ratio Tambaqui.

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