Feed additive of curcuma flour (Curcuma xanthorrhiza) in commercial feed to growth rate and feed efficiency of tambaqui (Colossoma macropomum)

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Abstract. Tambaqui (Colossoma macropomum) is much demand by the public as a consumption fish. Addition of curcuma in feed to increase fish appetite because it contains curcumin and essential oil. The purpose of this study was to determine the growth rate and food efficiency in tambaqui (Colossoma macropomum) with feed additives of curcuma flour (Curcumaxanthorrhiza) on commercial feed. The research method used is the experimental method. The research design used was a Completely Randomized Design (CRD). Having 5 types of treatment with repeated 4 times. The treatment used was the addition of curcuma flour on commercial feed, namely P1 (2.5%), P2 (5%), P3 (7.5%), P4 (10%) and P0 (100% commercial feed). The main parameters observed were the growth rate and feed efficiency. The supporting parameters observed were water quality (temperature, pH, DO and ammonia). Data analysis using Analyze of Variance. The results of the feed additive of curcuma in commercial feed of tambaqui have the highest average value of growth rate in P0 treatment, but not significantly different (P > 0.05) with treatment P1, P2, P3 and P4. Feed efficiency values have the highest average value in P2 treatment, but not significantly different (P > 0.05) with treatments P0, P1, P3 and P4.

1. Introduction

Tambaqui (Colossoma macropomum) is a fishery commodity that has high economic value and is much in demand by the community [1]. Feed is one of several important components in aquaculture activities. Feed costs can reach 60-80% of production costs. The price of feed will affect the cost of production and profits derived from aquaculture businesses so that quality, cheap and more efficient fish feed raw materials are needed [2]. Addition of feed is needed to improve the quality of fish feed [3]. Quality feed has nutrients such as protein, fat, carbohydrates, vitamins and minerals [4]. Alternative feed that can be used, one of which is curcuma. The addition of curcuma in feed affects the increase in appetite. The content of curcumin and essential oil substances is thought to be a cause of the efficacy of curcuma. Curcuma can accelerate gastric emptying, thereby arising hunger and stimulate appetite [5].
2. Material and method

2.1 Materials

The research material used were tambaqui (Colossoma macropomum) with a length of 5-7 cm obtained from the Gunungsari Fish Market in Surabaya, commercial feed and curcuma flour.

2.2 Method

2.2.1 Preparations

The first step was preparing the aquarium is used as many as 20 pieces with a size of 30×30×35 cm³. Fish seeds measuring 5-7 cm are stocked at low temperatures i.e. morning or evening with a density of 4 gr /2 liters. Tambaqui are used as many as 10 fish per aquarium.

2.2.2 Feed

The feed used is a type of commercial feed with a size of 1.3 mm and mixed with temulawak flour. Feed mixing using CMC (Carboxy Methyl Cellulose) material which will then be reprinted using a pellet molding machine. Results Proximate analysis of feed ingredients can be seen in Table 1.

| Table 1. Feed Ingredients Analysis |
|-----------------------------------|
| Contains                        | Commercial Feed | Curcuma Flour |
| Dry Ingredients                 | 92.17 %         | 85.35 %       |
| Ash                             | 10.46 %         | 12.73 %       |
| Crude Protein                   | 38.04 %         | 8.41 %        |
| Crude Fat                       | 4.33 %          | 10.14 %       |
| Crude Fiber                     | 4.51 %          | 5.90 %        |
| Water                           | 7.83 %          | 14.65 %       |
| Nitrogen Free Extract           | 34.81 %         | 48.15 %       |
| Energy Metabolism (kcal/kg)      | 2871.22         | 2796.04       |

Source: a) Unit of Laboratory Veteriner and Feed Analysis, Faculty of Veterinary Medicine, Universitas Airlangga, 2019.

2.2.3 Feeding

Feeding the tambaqui was carried out to total as much as 5% of the tambaqui total weight. Feed is given 3 times a day (8:00 a.m., 12:00 p.m. and 16:00 p.m.). During maintenance carried out the siphon to clean the remaining feed and dirt.

2.2.4 Parameter

The main parameters in this study were the growth rate and feed efficiency of tambaqui. The supporting parameters observed were the water quality parameters such as temperature, DO, pH and ammonia.

2.2.5 Data Analysis

The data obtained was analyzed using the ANOVA (Analysis of Variance) statistical test to determine whether there were differences between treatments. This will be followed by Duncan's Multiple Range Test with a 5% significance level to find out the best treatment [6].

3. Results and discussion

3.1 Growth Rate

Data from the calculation of the growth rate in the tambaqui showed there to be a not significant difference. The average growth rate in the tambaqui ranged from 1.05 to 1.35. The data on the average growth rate in the tambaqui can be seen in Table 2.
Table 2. Average growth rate of tambaqui.

| Treatment | Growth rate ± SD (g.day⁻¹) |
|-----------|-----------------------------|
| P0 (0%)   | 1.35 ± 0.346                |
| P1 (2.5%) | 1.18 ± 0.454                |
| P2 (5%)   | 1.13 ± 0.441                |
| P3 (7.5%) | 1.27 ± 0.469                |
| P4 (10%)  | 1.05 ± 0.319                |

Note: * The same superscript in the same column showed no difference (p> 0.05)

Growth is the increase in size, length or weight over time. Growth occurs due to the addition of tissue from mitotic cell division that occurs due to an excess of energy and protein input derived from feed [7]. Growth is influenced by two factors, namely internal factors and external factors. Internal factors largely depend on the condition of the fish's body, for example the ability of the fish to utilize the remaining energy and protein after its metabolism for growth. Meanwhile, external factors such as environmental and feed factors greatly influence fish growth. Both of these factors will balance the state of the fish's body during maintenance and support the growth of fish [8].

Based on the results of research conducted the average value of the growth rate of tambaqui ranges from 1.05 to 1.35. The high growth rate at each treatment indicates that the adequate amount of nutrients contained in the feed. According to [5] if the nutritional content of feed is able to meet the basic needs of fish and maintenance of body cell membranes, then it can spur fish seed growth properly. Curcuma given has various benefits for fish body, especially for health and growth. The content of curcumin and essential oils in curcuma functions as an antibiotic, can also neutralize toxins, increase bile secretion so that it can increase appetite in fish because curcumin and essential oils can improve the work of the digestive system and are used as a growth booster and improve digestion [9]. Another function of curcuma is as an antibacterial, where this antibacterial can lyse toxins attached to the intestinal wall, so that absorption of nutrients is better and can trigger growth [5].

Based on the results of the Analysis of Variants (ANOVA), it was found that the feed additive of curcuma flour to commercial feed showed no significant differences (p>0.05). Based on the results of Duncan's Multiple Distance Test, there were no significant differences between the treatments. The highest growth rate was obtained from the P0 treatment but this was not significantly different from the P1, P2, P3 and P4 treatment. The lowest value of growth rate is seen on P4.

3.2 Feed efficiency

Data from the calculation of the feed efficiency of feed additive of curcuma flour in tambaqui showed not significant differences. The average feed efficiency in the tambaqui ranged between 47.15% to 72.62%. The average data for feed efficiency can be seen in Table 3.

Table 3. Average feed efficiency in the tambaqui

| Treatment | Feed Efficiency ± SD (%) |
|-----------|--------------------------|
| P0 (0%)   | 70.34 ± 23.17            |
| P1 (2.5%) | 62.87 ± 27.13            |
| P2 (5%)   | 72.62 ± 8.77             |
| P3 (7.5%) | 47.15 ± 24.57            |
| P4 (10%)  | 68.73 ± 8.29             |

Remarks: * The same superscript in the same column showed no difference (p> 0.05)

Based on the results of the Analysis of Variants (ANOVA), it was found that feed additive of curcuma flour in commercial feed showed no significant differences (p>0.05) in each treatment.
The highest average of feed additive was obtained from the P2 treatment but this was not significantly different from the P0, P1, P3 and P4 treatment. The lowest value of feed efficiency is seen on P3. Feed efficiency is the ratio between the bodyweight produced and the amount of feed given during maintenance. The efficiency of feed is directly proportional to the addition of body weight given during maintenance, the greater the value of feed efficiency, the more efficient the fish utilize the food consumed for growth [10]. Based on the value of feed efficiency obtained, the average value ranges from 47.15% to 72.62%. Increased feed efficiency values indicate that the feed has good quality. This is consistent with the statement that high feed efficiency indicates efficient use of feed so that only a small amount of protein is overhauled to meet energy needs and the rest is used for growth [11]. Factors that determine the high and low efficiency of the feed is the source of nutrition and the amount of each component of the source of nutrition in the feed [12].

3.3 Water quality
Good water quality in the maintenance medium would greatly support the growth of the fish is maintained. The average data of water quality can be seen in Table 4.

| Treatment | Parameter | Temperature (°C) | pH | DO (mg L⁻¹) | Ammonia (mg L⁻¹) |
|-----------|-----------|------------------|----|-------------|------------------|
| P0        |           | 26.6–30.1        | 7.8–8.4 | 2.89–3.58 | 0–1 |
| P1        |           | 27.1–30.5        | 7.7–8.7 | 3.13–4.80 | 0–1 |
| P2        |           | 26.6–30          | 7.9–8.7 | 2.61–5.70 | 0–1 |
| P3        |           | 26.6–30.4        | 7.9–8.8 | 2.68–4.90 | 0–1 |
| P4        |           | 26.6–29.9        | 7.9–8.6 | 3.05–4.71 | 0–1 |

The results of water quality observed during the maintenance of tambaqui obtained by the temperature with an average of 26.6–30.5°C. These results are consistent with the opinion of [13] which states that the optimal temperature for fish appetite ranges from 28-32°C. Drastic temperature changes in culture will cause stress on the fish. The pH value obtained during maintenance ranged from 7.7 to 7.9. These results are not in accordance with the opinion of [14] which states that the optimal pH value for the growth of tambaqui is around 7−8. Dissolved oxygen (DO) measured during the study showed an average yield of 2.61-5.70 mg/L. According to [14] the optimal range of dissolved oxygen for tambaqui culture is 2.4 –6 mg / L. Ammonia measurement results obtained at 0–1 mg/L. The range of ammonia values for cultured fish varies depending on the type of fish, fish can tolerate the ammonia toxicity between 0.2-2.0 mg/L [15], but in general concentrations of ammonia contained in water no more than 1 mg/L [16].

4. Conclusions
The addition of curcuma flour to commercial feed on the growth rate of tambaqui (*Colossoma macropomum*) has the highest average value in the P0 treatment which is not significantly different (P> 0.05) with P1, P2, P3 and P4, while the efficiency value tambaqui (*Colossoma macropomum*) had the highest average value in P2 treatment which was not significantly different (P> 0.05) with P0, P1, P3 and P4.

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