

The influence of supplemented *Curcuma* in feed formulation to improve growth rate and feed efficiency of catfish (*Clarias* sp.)

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Abstract. Catfish (*Clarias* sp.) is very potential to be developed as a food fish. The use of the feed additive in feed intended to improve the health, productivity and compliance with animal nutrition. Feed additive is to use ginger are derived from nature. The purpose of this study was to determine the potential increase in feed formulation. The *Curcuma* effect on growth rate and feed efficiency of catfish (*Clarias* sp.). The method used experimental methods and design complete random with 4 treatments and 5 replications. The parameters examined in this study are growth rate and efficiency feed. The research showed that the ANOVA markedly dissimilar ($P < 0.05$) against growth rate and efficiency feed catfishes. The average is 0.275 - 0.33 growth and the results efficiency feed catfishes of 60.70 % - 73.10 % and the results obtained temperature water quality around 27-30°C, pH 7-8, and DO 3.09-6.4. Based on this research cultivator of the suggested use flour curcuma as *feed additive* on formulations feed.

1. Introduction

The catfish (*Clarias* sp.) is a species with the potential to be developed as a food fish. These fish have several advantages, such as they are relatively resistant to disease, have rapid growth and very responsive to the feed given. Catfish production in Indonesia has increased from year to year. In 2011, national catfish production reached 337.577 tons, while it reached 722.623 tons in 2015 [1]. Feed is an important element of the cultivation process that can support the growth and survival of the fish. Feed costs take up about 60-70 % of production costs incurred by the cultivator. Enhancing the growth rate of catfish (*Clarias* sp.) has been done through efficient feed given that the use of more efficient feed would eventually reduce production costs [2].

A good availability of feed, timely feeding and good nutrition are very important in aquaculture. Providing feed which is not in accordance with the quantity of fish maintained as well as low quality feed will not meet the nutritional needs of the fish, thus causing slow growth rates and unable to attain the expected fish production. One effort to improve the efficiency of feed is by using feed additives [3]. The use of additives in feed aims to improve the health and productivity of cattle as well as nutrition [4].

An alternative that can be used to solve this problem is by using natural materials such as curcuma.



Natural materials like curcuma have several advantages, namely: it is more feasible and cheaper than chemical remedies; contains fiber, starch and potassium oxalic, volatile oil and flavonoids; has antibacterial and anti-inflammation properties; prevents the collection of blood; launches the metabolism and maintaining the function of organs [5].

The curcumin in *Curcuma rhizomes* ranges between 1.6 – 2.22 percent calculated based on dry weight. The curcumin and the substances in its volatile oil allegedly causes curcuma to be efficacious. *Curcuma* can affect the pancreas, increases appetite and can speed the emptying of the stomach. Thus it will cause hunger and stimulate the appetite [6]. Along with curcumin, the *Curcuma* and volatile oil content serves as an antiseptic and antibacterial so as to induce growth effectively and can improve endurance [7]. *Curcuma rhizomes* containing curcuminoids is believed to be able to increase employment of the kidney and increase the appetite, as well as having anti-inflammation, anti-cholesterol, anti-oxidant, anti-cancer and anti-microbial properties [8]. This report aims to understand the effects of additional curcuma in feed formulation towards the growth rate and feed efficiency of catfish.

2. Methodology

2.1. Preparation of tool and materials

Research was carried out in the laboratory at the Faculty of Fisheries and Marine, while proximate analysis was conducted at the Faculty of Veterinary Medicine, both at Airlangga University, Surabaya. The tools and materials used were 20 of aquarium sized 50 x 30 x 30 cm³, aeration, hose aeration, stone aeration, trays, printer pellets, loaves, digital scale, fish nets, spoons, siphons, filters, thermometers, pH papers, DO meters and ammonia test-kits.

The material used in the research are catfish (*Clarias* sp.) measuring 9-12 cm in length and 4-8 grams in weight which were obtained from the Gunungsari Fish Market. There were 4 treatments that were tested 5 times. Each aquarium was filled with 10 fish, so 200 fish were needed in total. The materials used for research were fish flour, soybean flour, rice bran, *Curcuma* powder and tapioca flour.

- Experimental procedures: 20 fish were placed inside a 50 x 30 x 30 cm³ aquarium. The aquarium was cleaned and sterilized before use to avoid disease. The equipment was washed with soap and then flushed with chlorine before being dried. The dried aquarium was then filled with fresh water. The aquariums were aerated for 24 hours to improve the level of dissolved oxygen and to remove undesirable chemicals that may still be in the aquarium. The catfish were acclimatized for one day.
- The fish were not given food for one day to remove the effects of previous feed given. The fish used in this research were dumbo catfishes (*Clarias* sp.) with the size of 9-12 cm and weight of 4-8 grams which were free from disease. The fish seeds were stocked during low temperatures, namely in the morning or evening. The catfishes were acclimatized for one day.
- The formulations of feed material was performed at the Feed Laboratory at the Faculty of Fisheries and Maritime, Airlangga University. The coarse materials were sifted beforehand using a sieve to obtain finer material. The fine feed materials were weighed using analytical scales to measure out the appropriate feed formulations. The weighed ingredients were then blended until homogeneous. Materials were added according to the composition amount of the ingredient, from the smallest size to the largest size. Feed material that were evenly mixed were put into loaves and then was run through a pellet-making machine to obtain the feed pellets. The pellets were then dried by the sun and were ready to use.
- Catfish were maintained in a 50x30x30 cm³ aquarium. Each aquarium was filled with fish and kept for 21 days. The formulated feed pellets were shaped according to the size of the mouths of the fishes.
- The fish were fed three times a day with a dose of 5 % of the total weight of fish in each meal. For maintenance, aspiration was performed in the morning to clean the uneaten feed and fish waste. The aspiration was done to maintain good water quality so as to not create a poisonous environment for the fish.

The main parameters of the research were growth rates and feed efficiency, while the supporting parameters were pH, temperature, DO and ammonia levels. Statistical analysis: Analysis of data was carried out through variant analysis (ANOVA) with the study design of Completely Randomized Design (CRD) to determine the differences in treatment. If there is a difference in treatment, the Duncan range test was conducted with a confidence level of 0.05 to determine the differences among all treatments as well as the use of SPSS 22 software.

3. Results

The results of the growth rate of the catfish for 21 days can be seen in table 1. ANOVA test results show that the addition of *Curcuma* powder (*Curcuma xanthorrhiza*) in feed formulation show markedly dissimilar ($P < 0.05$) results of growth rate in dumbo catfishes, so that it can be followed by the Duncan multiple range test.

The results of the Duncan multiple range test show that the lowest growth rate was seen in treatment pd with an average of 0.275 grams per day. The highest growth rate was seen in treatment pc by an average of 0.33 grams per day. The average growth rate of catfish is presented in figure 1.

The average growth rate of the catfish for 21 days can be seen in treatment P_A with the average growth of 0.2756 g/day, P_B treatment with the average of 0.306 g/day, P_C treatment with the average growth of 0.33 grams/day and the treatment of P_D with the average growth of 0.275 grams/day. The highest average growth rate was seen in treatment P_C, while the lowest average growth rate was seen in treatment P_D.

Feed efficiency: the research results for catfish feed efficiency for 21 days can be seen in table 2. The calculation of the value of feed efficiency can be found in Annex 9. Statistical analysis of feed efficiency can be found in Annex 10. ANOVA test results shows that the *Curcuma* powder (*Curcuma xanthorrhiza*) in feed formulations show markedly dissimilar ($P < 0.05$) results to catfish feed efficiency, so that it can be followed by the Duncan multiple range test. The results of the Duncan multiple range test show that the highest feed efficiency is seen in treatment pc with the average of 73.103 % and the lowest feed efficiency can be found in treatment pd with an average of 60.076 % (table 2)

Table 1. The growth rate (gram/day) of catfish during the 21-day study information as follows: P_A (0 % flour) curcuma, P_B (2 % flour) curcuma, P_C (4 % flour) curcuma, P_D (6 % flour) curcuma. Superscript different show there are significant differences ($P < 0.05$).

Treatment	Growth Rate \pm SD
P _A	0,2756 ^b \pm 0,02
P _B	0,306 ^{ab} \pm 0,05
P _C	0,33 ^a \pm 0,02
P _D	0,275 ^b \pm 0,04

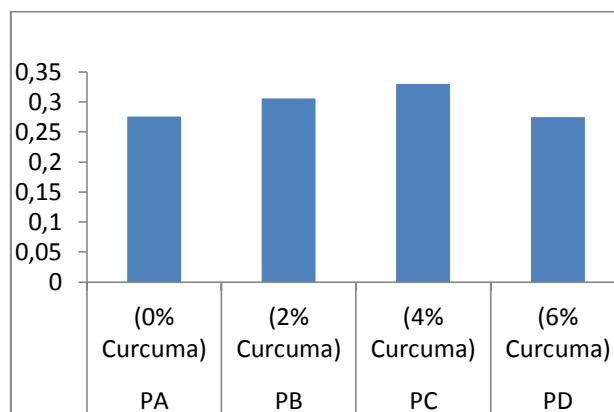


Figure 1. Charts of the average growth rate P_A (0 % flour) curcuma, P_B (2 % flour) curcuma, P_C (4 % flour) curcuma, P_D (6 % flour) curcuma.

The average yield of catfish feed efficiency for 21 days can be seen in treatment P_A with an average of 62.897 %, P_B treatment with an average of 63.29 %, P_C treatment with an average of 73.103 % and treatment P_D with an average of 60.076 %. The highest average growth rate was seen in treatment P_C , while the lowest average was seen in treatment P_D . Water quality data during the maintenance of the catfish (*Clarias* sp.) can be found in table 3. The water quality parameters observed during the survey were temperature, pH, dissolved oxygen and ammonia levels.

Table 2. Charts the average efficiency feed on fish catfish.

Treatment	Feed Efficiency \pm SD (%)
P_A	62,897 ^b \pm 5,44
P_B	63,29 ^b \pm 2,84
P_C	73,103 ^a \pm 8,98
P_D	60,076 ^b \pm 2,82

Table 3. Data the water quality maintenance catfishes for 21 days.

Treatment parameters	parameters			
	temperature (°C)	pH	DO (mg/L)	Amoniak (mg/L)
PA	27-30	7-8	3,77 – 6,01	0,5 – 1
PB	27-30	7-8	3,09 – 5,9	0,5 – 1
PC	27-30	7-8	3,42 – 5,49	0,5 – 1
PD	27-30	7-8	3,18 – 5,22	0,5 – 1

4. Discussion

Growth is measured through size, length or weight in a period of time. Growth occurs due to extra tissue from cell division in mitosis, excess input energy, and a protein derived from feed [9]. Growth is very closely related to the feed given. Feed that fulfils nutritional requirements highly influences the

rapidity of growth. Feed that meets nutritional requirements will also guarantee life and expedite the growth of [10].

Based on the calculation of statistics in table 1, we can see that the growth rate for all treatments of catfish ranges from 0.275-0.33 g/day. The highest growth rate was found in treatment pc which was added with about 4 % curcuma powder with an average growth of 0.33 g/day. The lowest growth rate was found in the treatment P_D which was added with 6 % *Curcuma* powder with an average growth of 0.275 g/day.

Results of the ANOVA test show that the growth rates of the catfish were markedly dissimilar ($P < 0.05$). Next, a Duncan multiple range test was performed and it can be seen that treatment P_B did not show much difference to treatment P_C, although treatment pb was significantly different with treatment pa and pd. The lowest growth rate was seen in treatment pd with average value of 0.275 g/day.

The highest growth rate was seen in treatment P_C by an average of 0.33 grams per day. The best feed formulation was obtained in treatment pc by the addition of a 4 % concentration of *Curcuma* powder in the feed formulation. The addition of 5 percent curcuma powder gives the highest growth rate. It is suspected that the nutrition from curcuma powder increase the growth rate [11]. The treatment pd is the lowest result of the addition of curcuma in feed. It is suspected that it is due to the excess volatile oil content and curcumin in the feed, so that it may cause it to taste bitter and be less tasty for the fish.

The increase in weight may be due to all the feed given to the fish are likely responded to by the fish and applied to the process of metabolism and growth. Growth can be influenced by the balance of the nutrients that are in the feed. Growth occurs when there is excess energy due to metabolism after it is used to maintain the body and activity [9].

The curcumin content as well as the volatile oil in curcuma serves as an anti-biotic, and can also neutralize venom and increase the secretion bile, so that it can increase the appetite in fish. This is because curcumin and volatile oil can improve the digestive system and be used as a pacemaker of growth and increase digestion [12].

Positive growth is supported by the good health of fish and would improve the efficiency of food absorption to meet their life requirements which can be seen by its weight [13]. The rate of growth in treatment d was lower than the treatment c which was caused by the higher dose of curcuma. The high dose had an effect on the bitter taste of the feed produced. The bitter taste causes a lack of response from the fish thus reducing the consumption of feed which is influential to their daily weight.

The *Curcuma* given has a variety of benefits for the fish especially for health and growth. Apart from containing antibiotics, curcuma also contains volatile oil and curcumin. Curcumin serves to increase the appetite and play a role in increasing the employment of digestive organs, stimulating the issuing of wall bile liquid and stimulate the pancreas that contains the enzymes of amylase, lipase and protease to increase the digestion of feed material such as carbohydrates, fat and protein [14]. Its antibacterial properties are also beneficial to lysis the poison attached to the walls of the intestines, so that there is better absorption of substance nutrients and can trigger growth [15].

4.1. Feed efficiency

Feed efficiency is the value of ratio between the weight of organism and the feed consumed in percentage [16]. Based on the known statistics, the feed efficiency for all treatments of catfish ranged from 73.103 % to 62.897 %. The highest feed efficiency was obtained on treatment P_C by the concentration of 4 % curcuma powder with the average value of 73.103 %. The lowest feed efficiency was obtained on treatment P_D by the concentration of 6 percent curcuma powder with the average value of 62.897 %.

Based on the results of the ANOVA test, the feed efficiency of catfish is markedly dissimilar ($P < 0.05$). Following a Duncan multiple range test, it can be seen that treatment P_A, P_B and pd are significantly different with treatment P_C. The highest feed efficiency was seen in treatment pc with the average value of 73.103 %, while the lowest feed efficiency was seen in treatment P_D with the average value of 62.897 %.

Factors that influence feed efficiency are the type of nutrition source and the amount of each nutrient component in the feed. The quantity and quality of feed given to fish is influential on the growth of fish. The higher the efficiency of the feed, the better the response of the fish to the feed [17].

Water quality is vital in the success of fish cultivation. Water quality is defined as water conformity for the continuity and growth of fishes which are generally determined by several parameters. The maintenance media should be done in accordance to the natural habitat of the fish during the maintenance process, so that the physiology and morphology of the fish are not disturbed. The parameters observed were temperature, pH and ammonia. The range of water quality during the study saturation is 4 mg/L. Saturation in this study was not a problem for fish maintenance because physiologically the fish are still able to swim normally. The temperature of media during the study maintenance period was between 27-30°C. The state of temperature between 26-30°C is good for the maintenance of catfish. The pH values were in the range of 7.0-8.0, where the optimal range of the waters is 7.5-8.5. The ammonia concentration was optimal for cultivation which was no more than 1 ppm.

5. Conclusion

It can be concluded that curcuma powder added at a dose of 4 % can be used as a feed additive in feed formulation. Further research needs to be done regarding the increase of curcuma powder in feed formulations with different percentages of protein.

6. References

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