Application of virgin coconut oil in feed in efforts to increase growth and survival rate of red tilapia (*Oreochromis* sp.)

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Abstract. The use of natural ingredients in commercial feed has been widely used in the field of cultivation. This natural ingredient is used as a feed additive to increase feed efficiency and promote growth. This study aimed to analyze whether VCO has an influence on the growth of red tilapia (*Oreochromis* sp.). The research method used was the experimental method with 4 treatments and 3 replications (P0 = control; P1 = 5 ml VCO/500 g feed; P2 = 10 ml VCO/500 g feed; P3 = 15 ml VCO/500 g feed). The results showed that the addition of VCO to commercial feed had no effect on the growth in absolute weight, daily growth, survival rate and feed conversion ratio of red tilapia. This happens because the VCO dosage used was not suitable so that it was not effective against the maximum energy intake for red tilapia.

1. Introduction

Red tilapia (*Oreochromis* sp.) is one of the freshwater fish that has high economic value and is an important commodity in the freshwater fish business [1]. In Indonesia, red tilapia (*Oreochromis* sp.) ranks the third largest of freshwater fish after goldfish and tawes fish [2]. Main factors for the success of aquaculture activity are location, water quality parameters, and feed [3]. Feed is an important factor in aquaculture because it greatly influences fish performance which include growth and reproduction [4].

The obstacle that often faced recently is the high of feeding rate (FR) of red tilapia, which is not proportional to growth produced [5] which causing unbalance of feed given. Whereas feed is the aquaculture production input which highly determine the growth rate of fish. The efforts are being made to increase growth and survival rate of red tilapia by adding Virgin Coconut Oil (VCO) to commercial feed. VCO is oil derived from fresh old coconut fruit which is processed and cooked at low temperature (<60 °C) and without bleaching and hydrogenation processes to produce pure oil. Virgin coconut oil
(VCO) has the ability to increase antioxidant enzymes while reducing lipid peroxidation [6]. According to [7] and [8], the abundant MUFAs (65%) of VCO did not participate in the biosynthesis and transport of cholesterol and as such allowed for mobilization of protein for body protein synthesis. It has also been shown to maintain normal levels of lipid parameters in serum and tissues and inhibit LDL-oxidation [9,10].

So far not many have reported about the function and best VCO dosage associated with increased growth and survival rate of red tilapia. Therefore, the results of this study are expected to provide useful information for the development of science.

2. Materials and Methods

2.1. Fish and experimental preparation

The study was conducted in March-April 2019. The feed used was commercial feed that added VCO. This study used a completely randomized design, consisting of 4 treatments (P0: without the addition of VCO; P1: VCO 5 ml; P2: VCO 10 ml; P3: VCO 15 ml) with 3 replications. The red tilapia used had size of 3-4 cm with a density of 10 fish per 25 L. During cultivation period, red tilapia seeds are fed at satiation for 3 times a day (morning, afternoon, evening).

2.2. Growth performance

2.2.1. Absolute Weight Growth (WG)

Body weight measurements were carried out to determine the increasing of body weight of fish during the study. Fish in each group were weighted individually once every seven days within the study period of 35 days. The measurement of the absolute weight of body can be calculated using the formula [11] as follows:

\[ W_G = W_t (g) - W_o (g), \]

\[ W_t \] and \[ W_o \] for final weight and initial weight, respectively.

2.2.2. Specific Growth Rate (SGR)

The speed of the growth rate can be measured by increasing body weight by measuring and weighing the red tilapia under study based on the specified time unit [12]. The growth rate of red tilapia being reared can be determined by calculating using the formula [11] as follows:

\[ SGR = \left( \frac{\ln W_t (g) - \ln W_o (g)}{T} \right) x 100 \% \]

\[ T \] for total number of culture days.

2.2.3. Survival Rate (SR)

The purpose of calculating survival rate is to see the success of a culture, namely to find out what percentage of fish can live during cultivation. According to [11], survival rate can be calculated using a formula, namely:

\[ SR = \frac{N_t}{N_o} x 100 \% \]

\[ N_t \] and \[ N_o \] for total number of fish alive and total number of fish used, respectively.

2.2.4. Feed Conversion Ratio (FCR)

Feed is a factor that plays an important role in fish growth. The amount of feed given to fish must be in accordance with the needs of the fish, it is hoped that with the right feeding it can increase the weight of the body of the fish being kept. The feed conversion ratio can be calculated using the following formula [11]:

\[ FCR = \frac{F}{((W_t + D) - W_o)}, \]

\[ F \] and \[ D \] for the total feed consumed (g) during the entire study and total weight of fish died (g), respectively.

2.3. Data analysis

All data were analyzed using analysis of variance (ANOVA) with a confidence level of 95%. To see the difference in treatment, a further test was carried out with the Least Significant Difference (LSD) test using SPSS.

3. Results and Discussion
3.1. Growth performance

The results of the study for 35 days for each parameter can be seen in Table 1. From this study, it was found that the addition of VCO to commercial feed showed no significant difference (P > 0.05) to the absolute weight growth parameters. This is due to the fact that the VCO content given is not in accordance with the oil requirements needed by red tilapia to carry out metabolism for its growth. Growth can occur if the feed given is digested properly by the fish and the nutrients contained in the feed can be absorbed by the fish digestive system which can produce energy to carry out all body activities and the remaining energy from body activities will be used for growth. [13] had examined the use of VCO oil of 3% as a single lipid to replace fish oil in commercial feed, the results showed that the use of VCO oil had no effect on the growth and survival of O. niloticus fish but VCO can provide antibodies to these fish.

Furthermore, [14] stated that VCO does not affect the growth of red tilapia because the use of VCO in feed is only used as a whole by fish as an addition to energy reserves for the fish itself for other activities such as swimming, maintenance of the body from parasites or diseases that require energy which is quite large. Fish use fat contained in commercial feed as energy reserves which are considered to be in accordance with the needs of certain fish themselves [3,15]. Moreover, [16] stated that fat has an important role for fish because it functions as a source of energy and a source of essential fatty acids, maintains the shape and function of membranes or cell tissues that are important for certain organs, helps in the absorption of fat-soluble vitamins and to maintain buoyancy of the body. Furthermore, [17] stated that fat has an important role for fish because it functions as a source of energy and a source of essential fatty acids, maintains the shape and function of membranes or cell tissues that are important for certain organs, helps in the absorption of fat-soluble vitamins and to maintain buoyancy of the body. If the fat content in the feed exceeds the needs of certain fish, it causes disruption of the fish's body metabolism such as decreased appetite, nutrient absorption is not optimal and others.

Table 1. The absolute weight growth value, daily growth rate, survival rate and feed conversion ratio.

| Parameter | 0VCO (g) | 5VCO (g) | 10VCO (g) | 15VCO (g) |
|-----------|---------|----------|-----------|-----------|
| WG (g)    | 4.53 ± 0.72a | 5.55 ± 1.29a | 4.96 ± 1.00a | 6.11 ± 1.83a |
| SGR (%)   | 5.0 ± 0.55a   | 5.6 ± 0.50a   | 5.1 ± 0.45a   | 5.4 ± 0.94a   |
| SR (%)    | 72.2 ± 9.58a  | 50.0 ± 33.3a  | 38.9 ± 38.45a | 50.0 ± 28.86a |
| FCR       | 1.57 ± 0.70a  | 1.33 ± 0.07a  | 1.41 ± 0.10a  | 1.47 ± 0.39a  |

Note: The numbers followed by the same letter are not significantly different according to the LSD test at α = 5%.

The growth rate in fish is usually influenced by the absorption of nutrients contained in the feed that given to the fish. In addition, the growth rate is also influenced by the amount of feed given, the frequency of feed and the quality of the feed which must be adjusted to the type of fish or the place where the fish live [17]. The results of the analysis of variance showed that the addition of VCO to the feed had no significant effect on the parameters of the daily growth rate of red tilapia (P > 0.05) (Table 1). The daily growth rate is strongly influenced by absolute weight, where indirectly the feed given also has an influence or impact on the daily growth rate of red tilapia, so it can be said that VCO did not cause protein retention processes in reared red tilapia. The protein retention is a number of proteins from feed that are converted into protein stored in the fish's body [18]. This can be caused by the absorption rate of nutrients in the feed for each fish had different nutrient needs, it was due to the addition of the VCO dose given to the feed.

Adding the VCO to commercial feed had no significant effect on red tilapia survival (Table 1). The dose of VCO given is not in accordance or balanced with the nutrient needs of red tilapia. According to [19], there has a good function of VCO on the composition of feed if the dose given is appropriate and balanced with other feed ingredients converted into a commercial feed. Moreover, [14] states that VCO has a good function for the fish body and can be used as a substitute for fish oil as a composition of good feed and suitable for fish growth.
The feed given VCO had low survival rate. It was presumed due to the high content of saturated fatty acids in the feed. Based on [13], tilapia feed given VCO 3% contains 53.17% saturated fatty acids and only about 20% unsaturated fatty acids. This means that saturated fatty acids in VCO are higher than unsaturated fatty acids. [20], tilapia, freshwater fish, requires linoleic acid or lenolenic acid or both which are unsaturated fatty acids. This study is suitable with previous observations which is many deaths until the end of the study in each treatment the VCO dose given. Furthermore, [21] also stated that the adaptation of feed in test fish must be carried out in a vulnerable time to adjust the metabolic system.

Data analysis of FCR showed that the value was not significantly different in each treatment with the addition of VCO into the commercial feed (P> 0.05). This means that a higher FCR value indicates that nutrient absorption in feed is not good and vice versa if a low FCR value indicates that nutrient absorption in feed is good [22]. According to [13], stated that VCO oil is good to be used as a substitute for fish oil in the manufacture of converted feed. Basically, fish needs fat as energy reserves, but the fat needed for energy is not too large compared to protein needs [23]. However, the high FCR in this study is because the VCO used here is as a feed additive where the commercial feed previously contained fish oil, so that the fat content in the feed was high so that the absorption of nutrients in the feed was not absorbed properly by red tilapia.

3.2. Water Quality
Water quality is one of the most important factors in a cultivation process which of course must be properly maintained so that the condition of the waters remains stable and can be accepted by fish as their living environment [24]. If a cultivation activity has good water conditions, it can support maintaining the survival rate of the cultivated fish, but if the water quality is not properly maintained, it will cause adverse impacts [25]. Some of the bad effects that can occur if the poor water quality is decreased appetite, the stress level of fish becomes higher, it can cause the appearance of parasites or disease and the worst effect is that it can lead to death in reared fish [12].

Based on the results of the study, it was found that water quality such as temperature, DO and pH had supported the cultivation of red tilapia (Table 2). This is consistent with the statement of [26], that tilapia can grow well at optimal temperatures with a value range between 25-28 °C. [27] stated that the optimal DO for the growth of tilapia is in the range of 5.6 - 7.9 mg / L, then the optimal pH for growth of tilapia is in the range of 7.6 - 8.3 [28]. It can be concluded that the addition of VCO to the feed does not have a bad effect on water quality or the environment of red tilapia.

Table 2. Water quality parameters during the maintenance of red tilapia.

| Parameters | Value (Range) |
|------------|---------------|
| Temperature | 26.3 – 26.4 °C |
| DO         | 5.8 – 6.06 mg/liter |
| pH         | 7.27 – 7.44 |

4. Conclusion
The addition of VCO to feed has no effect on absolute weight growth, daily growth rate, survival rate and feed conversion ratio of red tilapia because the addition of a high dose of VCO in commercial feed cannot act as a maximum energy intake.

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Virgin Coconut Oil

Oreochromis

Pangasius hypophthalmus

Colossoma

Chanos chanos

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