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COMBINATION OF VCO *(Virgin Coconut Oil)* AND FISH OIL IN COMMERCIAL FEED ON THE GROWTH AND SURVIVAL OF FRESHWATER POMFRET FISH *(Colossoma macropomum)*

COMBINATION OF VCO (*Virgin Coconut Oil*) AND FISH OIL IN COMMERCIAL FEED ON THE GROWTH AND SURVIVAL OF FRESHWATER POMFRET FISH (*Colossoma macropomum*)

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Abstract

Pomfret (Colossoma macropomum) is a freshwater fish that is one of the leading commodities in Indonesia, and has good prospects for development because it has a delicious and savory taste. The obstacle that is often faced today in pomfret cultivation is the high Feeding Rate value in pomfret fish is not comparable to the growth produced by efforts made to increase growth and survival in pomfret fish, namely by adding VCO and fish oil to commercial feed. The research design used in this study was an experimental method using a Completely Randomized Design (CRD) with 4 treatments and 3 replications where P1: 7% Fish oil / kg feed, P2: 5% Fish oil + 2% VCO / kg feed, P3: 3% Fish Oil + 4% VCO / kg feed, and P4: 7% VCO / kg feed. The results obtained on absolute weight growth showed the best treatment, namely in P3, which was 10.46 g, while the best survival rate was in P1, which was 96.67%. In P1, where fish oil is 7% with a survival value of 96.67%, this is because fish oil contains omega-3 fatty acids such as DHA and EPA which are important for increasing the immunity and physiological function of pomfret fish.

Keywords: *Pomfret Fish, Growth, Survival, VCO (Virgin Coconut Oil), fish oil.*

Abstrak

Ikan bawal *(Colossoma macropomum*) merupakan ikan konsumsi air tawar yang menjadi salah satu komoditas unggulan di Indonesia, serta memiliki prospek yang baik untuk dikembangkan karena memiliki rasa yang enak dan gurih. Kendala yang sering dihadapi saat ini pada budidaya ikan bawal yaitu tingginya nilai Feeding Rate pada ikan bawal tidak sebanding dengan pertumbuhan yang dihasilkan upaya yang dilakukan untuk meningkatkan pertumbuhan dan juga sintasan pada ikan bawal yaitu dengan penambahan VCO dan minyak ikan pada pakan komersil. Adapun rancangan penelitian yang digunakan pada penelitian ini yaitu metode eksperimen menggunakan Rancangan Acak Lengkap (RAL) dengan 4 perlakuan dan 3 kali ulangan dimana P1: 7% Minyak ikan /kg pakan, P2: 5% Minyak ikan + 2 % VCO/ kg pakan, P3: 3% Minyak Ikan + 4% VCO/kg pakan, dan P4: 7% VCO/kg pakan. Hasil yang diperoleh pada pertumbuhan bobot mutlak menunjukkan perlakuan terbaik yaitu pada P3 yakni 10.46 g, sedangkan Tingkat kelangsungan hidup terbaik yaitu pada P1 yakni 96.67%. Pada P1 dimana pada minyak ikan 7% dengan nilai kelangsungan hidup 96.67%, dikarenakan minyak ikan mengandung asam lemak omega-3 seperti DHA dan EPA yang penting untuk meningkatkan imunitas dan fungsi fisiologis ikan bawal.

Kata Kunci: *Endoparasit, Ikan Mas, Intensitas, Prevalensi, Histopatologi*

1. Introduction

Freshwater pomfret has several advantages, such as relatively fast growth and a fairly short production process, and is a disease-resistant fish species (Putri and Tjahjo, 2011). Freshwater pomfret have a high appetite, and their protein requirements in feed are relatively low, with a protein content of 25% in feed sufficient to support their growth (Taufiq *et al.*, 2016).

The Ministry of Marine Affairs and Fisheries (KKP) noted that pomfret production in Indonesia in 2021 reached 128,635 tons with a value of Rp. 5.99 trillion. The total pomfret production in that year decreased by 38.76% compared to 2020, which reached 210,039 tons with a value of Rp. 6.86 trillion. In terms of region, Papua was the province with the highest pomfret production, with a recorded production of 15,206.2 tons in 2021. Meanwhile, North Maluku Province was observed to produce the least amount of pomfret, at 42.43 tons in 2021 (Wijaya *et al.,* 2019).

A common problem currently faced in pomfret farming is that the high *feeding rate* (FR) of pomfret is not proportional to the growth achieved, resulting in an imbalance in the feed provided. Feed is a production input that greatly determines the growth rate of fish. Efforts to increase the growth and survival rate of pomfret include adding VCO and fish oil to commercial feed.

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VCO is an oil derived from fresh mature coconuts that are processed and cooked at low temperatures (<60°C) without bleaching or hydrogenation, resulting in a pure oil. VCO oil, as a source of saturated fatty acids, is one of the sources of vegetable fatty acids. If the essential fatty acid requirements of fish are not met, it will result in health problems in fish, death of larvae, abnormal growth, visual impairment, abnormal behavior, inability to eat in low-light areas, and at low temperatures, decreased membrane function (Tocher, 2003).

Fish oil has the highest content of unsaturated fatty acids compared to other types of oil (Irianto *et al*., 2002). Fish oil is an essential oil that contains many important nutrients, such as 25% saturated fatty acids and 75% unsaturated fatty acids (Isnami, 2013). Based on the above description, it is necessary to conduct this research.

2. Materials and Methods

2.1. Time and Place

This study was conducted over 40 days in June-July 2024 at the Hatchery Laboratory of the Aquaculture Study Program, Faculty of Agriculture, Samudra University. The Prosimat Test analysis to remove fat content was conducted at the PAU Biotech Center Laboratory, Bogor Agricultural University.

2.2. Research Design

The research design used in this study was an experimental method using a completely randomized design (CRD) with 4 treatments and 3 replicates.

P1 : 7% fish oil/kg of feed
P2 : 5% fish oil + 2% VCO/kg feed
P3 : 3% Fish oil + 4% VCO/kg feed
P4 : 7% VCO/kg feed

2.3. Work Procedure

a. Preparation of Maintenance Containers

The medium used in the maintenance of test animals was a 25 L jar. The preparation of the medium consisted of several things, namely cleaning the maintenance container by washing it thoroughly until it was clean, filling it with water as needed, providing containers for storing test feed, preparing water as a living medium for fish, preparing aerators as a source of dissolved oxygen in the maintenance container, and so on. The number of containers used in this study was 12, with a density of 10 fish per container. The containers were filled with 10 L of water, and then aeration was installed to add oxygen to the water.

b. Preparation of Test Fish

The animals used in this study were Bawal fish (*Colossoma macropomum)* fry measuring 3-4 cm in length. Before starting the study, the test fish underwent a 7-day adaptation process, the purpose of which was to reduce stress levels in the fish, thereby lowering mortality rates. Before starting the treatment, the weight and length of the test fish were measured first, and these measurements were used as the initial data for the study.

c. Feed Preparation

This study used commercial feed supplemented with VCO and fish oil at doses according to the treatment. Initially, 1 kg of feed was weighed four times. The stages in adding different fat sources can be carried out as follows:

- The first step is to grind the pellets using a blender, then remove the fat content from the feed. The treatment is carried out by soaking the feed in a hexane solution at a dose of 1 liter/kg for 24 hours, followed by a filtration process using a cloth with small pores. After that, the feed is rinsed in an alcohol solution at a dose of 1 liter/kg for 24 hours. It is then air-dried, and a test is conducted to determine the fat content at the PAU Biotech Center Laboratory, Bogor Agricultural Institute.
- In the second stage, after the feed fat content was reduced to 1%, different types of fat (VCO and fish oil) were added according to the feed treatment (Vergara, 2003).
- Animal and vegetable fats are added by mixing each fat into the feed. The feed is then molded and dried in an oven.

d. Maintenance

- Feed Administration and Water Quality Management

The feeding method used in this study was *at satiation,* or feeding to satiety. Feeding was carried out three times a day. To maintain water quality from feed residues or waste produced from the metabolic process, it was necessary to take measures to maintain water quality so that it remained stable and did not adversely affect the survival of the fish, namely by siphoning and replacing 30-50% of the water volume used in the rearing tank. Siphoning was carried out twice a week.

- Growth Sampling

Sampling was conducted every 10 days (D0, D10, D20, D30, D40) during the 40-day study period. After the sampling equipment was prepared, fish samples were taken from the rearing tanks using nets. The sampled fish were then placed in another container filled with clean water, weighed using digital scales, and measured using a ruler. The results of the weight and length measurements were recorded in the research logbook.

2.4. Parameters Observed

- Absolute Weight Growth (AWG)

Absolute growth or weight gain can be calculated using Effendi's (2002) formula:

$$AWG = Wt - Wo$$

Ket = PBM: Absolute Weight Gain (g); Wo: Weight of test animal at the start of the study (g); Wt: Weight of test animal at the end of the study (g).

- Absolute Length Growth (ALG)

Absolute length growth is used to calculate fish length growth using Effendie's (2007) formula, as follows:

$$ALG = Lt - Lo$$

Key = ALG: Absolute length growth (cm); Lt: Average length at the end of the study (cm); Lo: Average length at the beginning of the study (cm).

- Daily Growth Rate (DGR)

The growth rate is calculated using the formula (Verdegem and Eding, 2010):

$$LPH = \frac{LnWt - LnWo}{t} \; x \; 100$$

Ket= LPH: Daily Growth Rate (%); Wo: Initial animal weight (g); Wt: Final animal weight (g); t: Research period (days).

- Survival Rate (SR)

Survival Rate (SR) can be calculated using Effendi's formula (1997):

$$KH = \frac{Nt}{No} \; x \; 100$$

Ket = KH: Survival rate of test animals (%); No: Number of test animals at the start of the study (heads); Nt: Number of test animals at the end of the study (heads)

- Water Quality Parameters

This study measured water quality parameters consisting of temperature, dissolved oxygen (DO), pH, and ammonia.

2.5. Data Analysis

The data obtained from the research results were analyzed using analysis of variance (ANOVA) to determine the effect of the treatment. If the treatment had a significant effect on the measured changes, it was followed by Duncan's test with a 95% confidence interval. Meanwhile, the water quality data obtained based on the measurement results were analyzed descriptively.

3. Results and Discussion

The results of the ANOVA test show that the combination of VCO and fish oil in commercial feed during the study had a significant effect ($P<0.05$) on absolute weight growth and daily growth rate, while it had no significant effect ($P>0.05$) on absolute length growth and survival rate. The fish growth data during the study are listed in Table 1.

Table 1.
Average absolute weight growth (AWG), absolute length growth (ALL), daily growth rate (DGR)

Treatment	Parameter		
	AWG	ALG	DLGR
P1	10.42 ± 1.23^{b}	3.25 ± 0.62^{a}	4.63 ± 0.21^{b}
P2	7.51 ± 1.32^{a}	2.66 ± 0.70^{a}	3.91 ± 0.33^{a}
P3	10.46 ± 0.39^{b}	3.33 ± 0.65^{a}	4.52 ± 0.09^{b}
P4	9.66 ± 0.99^{ab}	3.06 ± 0.15^{a}	4.27 ± 0.20^{ab}

Note: Numbers followed by the same letter are not significantly different according to Duncan's test at $\alpha = 5\%$. The data listed are standard deviation averages.

Table 1 shows that the Duncan test results for absolute weight gain and daily growth rate indicate that the pomfret in treatment P1 is significantly different from P2 but not significantly different from P3 and P4. P2 is significantly different from P1 and P3 but not significantly different from P4. P3 is significantly different from P2 but not significantly different from P1 and P4. P4 is not significantly different from all treatments.

The results obtained for absolute weight gain showed that the best treatment was P3 (3% fish oil/4% VCO) with a value of 10.46 g, while the lowest weight gain was obtained in P2 (5% fish oil/2% VCO) with a weight value of 7.5 g. This is because the combination of fish oil and VCO provides an optimal proportion of fatty acids and nutrients in VCO, which supports better fish metabolism. VCO is known to contain medium-chain fatty acids (MCT) that are easily digested and utilized as an energy source. If the proportion of fish oil is too high, there may be nutritional imbalances or difficulty in digestion by fish (Arief *et al.,* 2012).

In P2 (5% fish oil/2% VCO), the value is the lowest because the proportion of fish oil is higher at 5% and VCO is lower at 2%, resulting in an unfavorable ratio. Excess fish oil can reduce energy balance or increase excess content that may hinder optimal growth. Fish oil is not only used as a source of fat but also functions as an attractant. This attractant can impart a scent to the feed, encouraging fish to consume it. Fish oil is rich in n-3 fatty acids (Arief *et al.,* 2012). However, an excess of fatty acids in feed can inhibit metabolic processes and reduce feed palatability (Simatupang, 2017).

For absolute length growth, the best treatment was P3 (3% fish oil/4% VCO) with a value of 3.33 cm, while the lowest length growth was obtained in P2 (5% fish oil/2% VCO) with a length value of 2.66 cm. In P3, the combination of 3% fish oil and 4% VCO was the highest treatment because fish oil contains essential fatty acids that support cell membrane formation and bone tissue growth, and also contains fast energy from VCO to help efficient metabolism for length growth. P2 (5% fish oil, 2% VCO): The fish oil content was too high, making the feed difficult to digest, so more energy was used for basal metabolism than for promoting growth. Mutiarasari (2017) stated that fish growth is greatly influenced by the amount of nutrients in the feed provided.

The daily growth rate showed that the best treatment was P1 (7% fish oil) with a value of 4.63 cm, and the lowest length growth was obtained in P2 (5% fish oil/2% VCO) with a value of 3.91 cm. This shows that P1 had the highest daily growth rate because fish oil contains omega-3, which contains saturated fatty acids and a small amount of omega-6, which are very important in supporting fish growth. Fat has various important roles in fish nutrition, including as a source of energy, phospholipids, and steroid components as vital organs, as well as when fish maintain balance in water. In addition, fat in feed also provides *essential fatty acids (*EPA) that are needed for growth, normal development, and to help absorb various types of fat-soluble vitamins (Khalil, 2022). The appropriate addition of fish oil to fish feed provides good results in terms of pomfret weight gain. According to Erfanto *et al. (*2013)*,* growth can be accelerated if the feed provided has good nutritional value.

Survival

The results of the ANOVA test showed that the combination of VCO and fish oil in commercial feed had no significant effect on survival ($P>0.05$). The fish survival data during the study is shown in Figure 1.

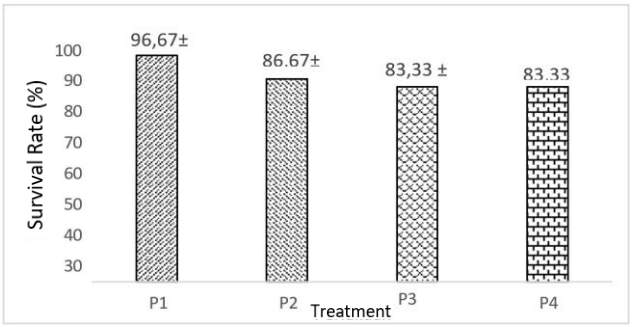

Figure 1. Survival Rate

The results obtained for survival rate (SR) showed that the best treatment was P1 (7% fish oil) with 96.67%, while the lowest growth rate was obtained in P3 (3% fish oil/4% VCO) and P4 (7% VCO) with a growth rate of 83.33%. In P1, where fish oil was 7% with a survival rate of 96.67%, this was because fish oil contains omega-3 fatty acids such as DHA and EPA, which are important for improving the immunity and physiological functions of pomfret. These fatty acids cannot be produced in the body and must be obtained from feed and then converted into long hydrocarbon chains with the help of enzymes. The formation of double bonds to create HUFA, EPA, and DHA is crucial for metabolic functions and as components of cell membranes (Craig & Helfrich, 2002; Lall *et al.,* 2002).

A 7% concentration of fish oil provides the optimal amount of fatty acids for fish to survive and cope with stress during maintenance. Meanwhile, in P3 (3% fish oil + 4% VCO), survival rates were lower because the fish oil concentration (DHA/EPA) was too low, and the contribution of VCO was insufficient to replace the role of omega-3 fatty acids. In P4 (7% VCO), survival rates were the lowest because there was no fish oil at all, so that milkfish do not obtain the essential fatty acids that are very much needed for physiological functions and immunity. The results of research by Lante *et al. (*2010) show that the use of appropriate

fatty acids will have a positive effect on the biological response of fish, especially for fish growth and survival.

Water Quality Parameters

Water quality is one of the most important factors in a cultivation process, which must be maintained properly so that the water conditions remain stable and acceptable to fish as their living environment (Purba *et al.,* 2017). The water quality test results are shown in Table 2.

Table 2.
Water quality parameters during the study

Parameter	Water Quality			
	P1	P2	P3	P4
Temperature (°C)	28.6-29.2	28.7–29.4	28.7-29.4	28.6-29.3
DO (mg/l)	4.35–5.33	4.26–5.33	4.36–5.33	4.26–5.34
pH	6.78–7.05	6.68-7.05	6.54-7.04	6.78–7.06
Ammonia (mg/L)	0.012-0.021	0.012–0.018	0.017–0.021	0.012-0.019

Based on Table 4.2 above, the water quality values during the study were still within the tolerance range that can support the life of freshwater pomfret, namely water temperature during the study, which was 28.6–29.4. pH ranged from 6.54 to 7.06, dissolved oxygen from 4.26 to 5.34 (mg/l), and ammonia from 0.012 to
0.0021 mg/L. When the temperature of the culture medium is maintained within the tolerance range for fish growth, which is between 27°C and 33°C according to research by Sulistyansyah (2013), the optimal temperature range for pomfret is between 29 and 30°C. The growth of freshwater pomfret will be significantly reduced if the water temperature drops below 25°C. Wihardi *et al. (*2014) stated that water temperature greatly affects the growth rate, metabolic rate, appetite, and oxygen solubility in water.

During maintenance, the pH of the fish pond media is still within the tolerance limits for fish growth, ranging from 6.54 to 7.05. Pomfret can grow well at a pH range of 6 to 8. Dissolved oxygen during maintenance is still within the tolerance limits, ranging from 3.26 to 4.34 mg/l. According to Kordi (2011), the dissolved oxygen range for freshwater pomfret is between 4 and 6 mg/l. This opinion is supported by Arie (2009), who states that the appropriate dissolved oxygen concentration for freshwater pomfret maintenance should be at least 4 mg/L. According to Manurung et *al. (*2018), DO is influenced by temperature, pH, and organic matter. The higher the temperature, the lower the DO. Excessively low DO can be caused by algae, dead plankton, water viscosity, and the accumulation of organic matter. Ammonia in the rearing medium ranges from 0.012-0.104 mg/L. Ammonia is toxic to fish even at very low concentrations. However, according to Effendi (2003), the ammonia tolerance for aquatic biota, including pomfret, is no more than 0.2 mg/L.

4. Conclusion

Based on the research results, it was concluded that the combination of VCO and fish oil in commercial feed had a significant effect on absolute weight gain and daily growth rate. However, it had no significant effect on absolute length gain and survival rate. The optimal dose of the combination of VCO and fish oil for absolute weight and length growth is P3 (3% fish oil + 4% VCO/kg feed), while for daily growth rate and survival rate, it is P1 (7% fish oil/kg feed).

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