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THE RATIO OF SATURATED AND UNSATURATED FAT IN FORMULATION TO PELLET STABILITY AND FISH GROWTH NILE NIRVANA

Kiki HAETAMI[1], Abun[2], Junianto[1], Rita ROSTIKA[1], Iskandar[1]

[1]Faculty of Fisheries and Marine Science, Padjadjaran University, Jalan Raya Bandung-Sumedang KM. 21, 45363, Sumedang-West Java, Indonesia, (phone) +6222 7798241, (fax) +6222 7798212
[2]Faculty of Animal Husbandry, Padjadjaran University, Jalan Raya Bandung-Sumedang KM. 21, 45363, Sumedang-West Java, Indonesia, (phone) +6222 7798241, (fax) +6222 7798212

Corresponding authors emails: kiki.haetami@yahoo.co.id; abunhasbunap@gmail.com

Abstract

The purpose of this study was to determine the level and the ratio of types of vegetable fat supplements that are effective in improving the quality of pellets and growth of tilapia, with the following stages:1) Preliminary test to determine fat level, 2) The extraction of vegetable fats (hazelnuts and coconuts) was then formulated with saturated and unsaturated fatty ratios in pellets at the same fat level, and tested their physical qualities by measuring the stability of fish pellets, 3) Feeding trial of saturated fat sources (coconut extract) compared with unsaturated fats (hazelnut extract) in the formulation of growth and efficiency of tilapia seed feed. The experiment was designed completely randomly (5x3) with the treatment of saturated and unsaturated fatty ratios in low protein feed as follows: (1) basal / no oil feed, (2) coconut oil without combination with hazelnut (1: 0); (3) coconut oil mixture and hazelnut (1: 1), (4)hazelnut oil (0: 1), (5) feed control. Chemical analysis results were tested descriptively, while performance data (growth) were analyzed by variety and the difference between treatments was tested with Duncan analysis. Preliminary test results indicate that the use of 4 percent fat level can be used in the formulation of tilapia feed and in accordance with the needs of optimum fats. Chemical description of unsaturated fat sources (linoleic) in hazelnut meets the nutrient requirements of nirvana Nile seed phase. The results of test of water stability obtained that 4% vegetable fat supplement and can improve the physical quality of pellets; with stability (77.57-80.49%) after two hours. The feeding trial showed that the mixture of coconut and hazelnut fat supplements of 2% each in pellet produced physical quality, growth (daily growth rate and specific growth rate) for Nile Nirvana fish. The results of this study indicate that the ratio of saturated 1: 1 unsaturated fats from vegetable oil sources, can match the growth and efficiency achievement of fish fed with higher protein / containing ω-3.

Key words*: fat supplements, formulations, physical quality of pellets, growth, tilapia.*

INTRODUCTION

Fish cultivation can be economically valuable if it is intensively developed, one of them by paying attention to the efficiency and quality of feed. This is because feed is the biggest input in increasing fish growth in intensive. The balance of energy and protein in the formulation becomes central to feeding. Not only the adequacy of the quantity and quality of proteins that must be guaranteed, often the energy value is not as expected, so the addition of high-calorie ingredients becomes important. In addition to increasing caloric value, dietary fat reduces the dust, texture effect and increases palatability, thereby reducing the lost feed in both the pelletizing process and its delivery, but may have a decrease in the quality of fat as well as processing and duration of storage (Galli, 2000).

Energy sources can be obtained from fats and carbohydrates, so consider their use in formulations. According to Tacon (1986), omnivores can utilize fats and carbohydrates as "spare" proteins. Some carbohydrate source ingredients, have a high content of crude fiber that is less digestible by fish. An important energy source because it has a high calorie value is fat, and can be obtained from some of the raw material feed (invisible fat) or can be from fat and visible fat supplements. The main feed ingredients commonly used in fish feed are fish meal, but high fat content is usually avoided when the choice of the ingredients is easily rancid and affects the duration of drying. Other feed ingredients are generally derived

from by-products of oil-making agro-industries such as soybean meal or derived from the rest of the manufacture of other foodstuffs such as corn bran, wheat bran (polar) which most of the oil content is also lost in pressing and drying. The addition of supplements in the form of oil to be an alternative source of energy that can be pursued since preparation of pellet making.

The addition of oil as a neutral fat which is liquid at room temperature can be adjusted at the time before or after pelleting. Fats in the diet need to be considered the quality and quantity. According to Aderolu and Akinremi (2009), as well as peanut oil 5%, the use of coconut oil as much as 5% can produce better (hemoglobin, hematocrit and protein) characteristics compared to control (without oil) although his blood cholesterol increased in catfish. In addition, the use of coconut oil improves feed conversion (0.57-0.61) compared to control (0.87), with feed cost cheaper than peanut oil.

Problems that can be identified are:

(1) To what extent is the level of fat supplement use in low protein feed formulations on the physical quality of the pellets (durability and palatability).

(2) To what extent is the source of saturated fat (coconut fat) and fat sourcenot saturated (hazelnut fat) affect the growth of tilapia seeds stadiafingerling.

MATERIALS AND METHODS

Research stages

Stages of research includes preliminary scale up preparation and oil characterization of coconut pairing and hazelnut, continued pellet making and oil addition (4%) and physical pellet test (water stability or pellet dispersion). The second stage is a phase aimed at testing fatty acid supplements from alternative materials of coconut and hazelnut as a source of saturated fatty acid and unsaturated fatty acid biological tests to see the value of benefits and efficiency to the growth of tilapia which is maintained on an aquarium container.

Research materials

The research materials used are hazelnut and coconut, tilapia fish stadium fingerling (weight 10 ± 0.20 g), feed ingredients, and research container (fiber and aquarium). The chemicals used include: chemicals for fat extraction (n-hexane), protein, fatty acids, energy, ash, crude fiber.

Research procedure

The fish is acclimatized in a fiber tub. Feed is given on an ad satiation frequency twice a day (at 9:00 and 14:00 hours). Weighing the fish weight done each period and adjusted the amount of feed given. The feeding trial ended on day 60 and in the final period of the study carried out sampling of fish meat.

Variable observed

1) Water stability (%) $= \frac{\text{(Dry weight (g) after dipping)}}{\text{(Dry weight (g) before immersion in water)}}$ x 100%
(Khalil, 1999a)

2) Daily Growth Rate (g/day) $= \frac{\text{Final weight (g)} - \text{Initial weight (g)}}{\text{times of obserbed (days)}}$

3) Specific Growth Rate (%/day)$= \frac{(\text{Ln}W_2 - \text{Ln}\,W_1)}{T_2 - T_1} \times 100\%$

4) Feed Conversion Ratio $= \frac{\text{Feed intake}}{\text{Weight gain}}$

5) Protein Efficiency Ratio (PER)$= \frac{\text{Weight gain}}{\text{Protein consume}}$

Research was conducted experimentally using a Completely Randomized Design of 5 treatments and three replications.

Treatment based on the addition of fatty acid source (from vegetable oil and saturated and unsaturated), namely:

Feed A: Basal/no oil feed (protein 28%);
Feed B: Coconut oil without combination of hazelnut oil (1:0).
Feed C: Coconut oil mixture with hazelnut oil (1:1)
Feed D: Hazelnut oil, without combination of coconut oil (0:1)
Feed E: Control Feed (higher protein 32%).

RESULTS AND DISCUSSIONS

The ratio of saturated fatty acids and unsaturated supplementation results

Table 1 shows that the addition of a 4% fat dietary supplement of coconut oil and coconut oils yields different saturated and unsaturated fatty acids.

The extraction of hazelnut and coconut in this study was done steep extracted, without heating to avoid excessive polymer oxidation.

The extracted ingredients are substances such as oil, fat, or fatty acids and others more quickly and perfectly, while materials such as wax, pigment, and albumin compounds are slightly dissolved.

The results of extraction on coconut and candlenut are affected by water content.

According to Hertrampf and Pascual (2000), the reduced moisture content in the seeds causes the seeds to become hard so that the oil is difficult to remove.

Table 1. Energy Protein and Saturated/Unsaturated Fatty Acid Ratio

Nutrient	Treatments				
	A	B	C	D	E
Protein (%)	28.07	28.14	28.05	28.05	32.05
DE (kcal/kg)	2237	2248	2250	2250	2246
DE/P	7.97	7.99	8.02	8.02	7.17
Saturated Fatty Acid*) (%)	2.18	4,64	6.24	3.04	2.4
Unsaturated Fatty Acid*) (%)	3.15	4.56	2.97	6.16	3.16
SFA : FA Ratio	2 : 3	1 : 1	2 : 1	1 : 2	2 : 3
Linoleic acid (%)	0.49	1.04	0.36	1.73	0.68
Total Fat in Feed (%)	5.33	9.21	9.21	9.21	5.27

Note: DE = digestible energy

From Table 1 it can be seen that the fatty acid content contained in the hazelnut and coconut is sufficient to meet the requirements and is expected to know the balance of unsaturated fats and saturated fats needed for the nutritional benefits of tilapia.

Based on the composition of the feed formulation as well as the results of the analysis and calculation of fatty acid composition, descriptively the ratio of saturated and unsaturated fat components of the oil type exhibits different saturated and unsaturated fatty acids. Mixing the ratio of feed oil supplement ingredients of hazelnut and coconut materials representing the ratio of unsaturated fatty acids and saturated fatty acids to tilapia from the calculation and analysis. The treatment provided is: without supplements (pellet A); SFA: saturated fatty acid ratio of 1:0 (pellet B), 1:1 (pellet C), 0:1 (pellet D), containing 28% crude protein, maximum fish meal 15%, compared to control (commercial) (pellet E). The presence of fat is also required in the diet, fat is a protein sparing effect as a provider of non-protein energy so that proteins are used for growth. In each 2% fat addition derived from the seed fats of hazelnut can increase the calorific value (gross energy), which is about 150 kcal/kg of feed. The use of excess oil can affect the excess energy that quickly leads to satiety, so that protein intake can be reduced.

The content of corn linoleic is quite large, thus increasing the level of unsaturated fatty acid ω-6 although not supplemented fat. As for commercial pellets there are sources of unsaturated fatty linolenic acid other than derived from the source of fish meal, also added fish oil.

Dispersion of pellets from fat added fish

Dispersion of pellets is one of the feed factors that can affect the performance of fish. The results of the variance analysis showed no differences between treatments on the stability of the pellets in water after 30 minutes and 60

minutes. The Duncan Test results (Table 2) showed that fatty supplements in the formulation may affect the physical quality of the pellets, in this case with the stability of the pellets in water after two hours of immersion.

Table 2. Physical quality of pellets (dispersion of pellets)

Treatments	Water Pellet Dispersion (%)		
	30 minutes	60 minutes	120 minutes
A	87.22	84.01	77.57 [b]
B	87.27	85.15	78.79 [b]
C	87.36	85.90	80.33 [a]
D	86.33	84.79	79.49 [ab]
E	88.82	85.96	80.49 [a]

Table 2 shows that control pellets (E), and pellets with coconut oil supplements (C) have higher stability values than basal pellets (A). Pellet control is better than the basal pellet caused by the nature of protein flexibility and the presence of oil. Pellet control is better than the basal pellet caused by the nature of protein spasticity and the presence of fish oil. According Rasyaf (1994), the use of oil as part of the formulation usually only ranges from 1-3%, because if excessive can cause the pellets back into the form of flour. Meanwhile, according to Behnke (2001), the addition of fat in high quantities, i.e. more than 10% can inhibit gelatinization of starch, but can be overcome with the use of higher temperatures.

The addition of fat supplements of the type of coconut oil (feed C) which produces the highest durability compared to other types of oil although not significantly different. Coconut oil supplementation in basal feed formulation (low protein) can increase stability as well as high protein pellets. The use of coconut oil is more resistant to rotation of the tumbling device, due to its more saturated and non-volatile structure, will soon close the pores of the cell wall matrix and act as a lubricant between the feed particles (mash), and the heat conductor. This will have a positive effect on the hardness of the pellets. Coconut oil is one of the vegetable products that contain a lot of saturated fatty acid that is equal to 92%, whereas hazelnut contains many unsaturated fatty acid and tend to be volatile. Volatile fatty acids are fatty acids such as linoleic, linolenic, stearate, oleic, and others that are not bound by glyceride molecules.

The addition of a hazelnut oil supplement (feed D) as well as a mixture of hazelnuts (feed B) produced similar effects with other treatments, including with basal pellets (A). Fat supplements are thought to enhance the surface active properties of pelletizing agents through the formation of emulsions.

Although it can improve texture, fat as a hydrophobic compound can disrupt the binding properties of water-soluble components in feed (starch, protein and fiber) so that it can be detrimental to hardness and endurance of feed.

The presence of a carboxyl-methyl-cellulose binder (CMC) in the feedstock at all treatments may affect durability. Gelatinization of starch that occurs on the surface of the feed material is a critical point of the formation of intra-particle bonds that play an important role in the formation of strength, durability of pellets.

Stability figures of pellets in water or Pellet Dispersion after dripping 30 minutes, 60 minutes, and 120 minutes ranged from 77.57 to 8.82%. Fat treatment tends to increase the stability of the pellets in water.

Galli (2000) states that feed additive materials can improve the quality of pellets by adding moisture and surfactant either in the process before pelleting (during mixing mixing) or after pelleting (during cooling or conditioning). Surfactant and moisturizing incorporation permits many permeations of feed particles and at any given moment (the "glass transition point") causes the fat to trap into the feed particles, so this does not cause oily-looking pellets.

Growth performance and efficiency.

Based on the result of analysis of variance, it is found significance of influence to absolute weight, daily growth rate (DGR and SGR) (Table 3).

Table 3. Growth of Absolute Weight, DGR, and SGR tilapia

Treatments	Weight Gained (g)	Daily Growth Rate (g/day)	Specific Growth Rate (%)
A	21.27 [a]	0.34±0.03 [a]	1.79±0.02 [a]
B	27.33 [cd]	0.43±0.05 [cd]	2.08±004 [b]
C	25.93 [b]	0.41±0.10 [b]	2.02±0.02 [b]
D	26.71 [c]	0.42±0.03 [c]	2.04±0.02 [b]
E	27.56 [d]	0.44±0.04 [d]	2.09±0.03 [b]

The results of the variance analysis show that there is a significant difference in the types of fats (saturated, unsaturated and mixed) resulting in different effects on absolute growth, daily growth rate and specific growth rate indicating that fat addition is effective against growth of tilapia seed stadia fingerling.

The ratio of saturated and unsaturated fatty acids to 1:1 (feed C) resulted in the ratio of feed conversion and feed efficiency (%), which was better than those containing fish oil and high protein (Table 4). The results of this study indicate that feed with the dominance of unsaturated fatty acids (feed D), saturated fatty acids (feed C) and mixed saturated and unsaturated (feed B) of clear coconut oil and hazelnut oil yield the same feed efficiency with high protein pellets (E).

Table 4. Number of Feed, Feed Conversion Ratio and Feed Efficiency of tilapia fish

Treatments	Number of Feed (g)	Feed Conversion index	Feed Efficiency (%)
A	42.41	1.99±0.02 [c]	50.14±0.48 [a]
B	48.62	1.78±0.04 [ab]	56.23±1.37 [bc]
C	46.30	1.73±0.04 [a]	57.93±1.37 [c]
D	46.31	1.73±0.02 [a]	57.68±0.53 [c]
E	50.10	1.82±0.03 [b]	55.01±0.75 [b]

Note: A: basal feed/without supplements; B: a mixture of coconut and hazelnut; C: coconut oil 4%; D: hazelnut 4%; E: commercial/feed (pellet control).

Table 4 shows the best efficiency, conversion, and protein efficiency ratio of feed produced by feed C with 4% coconut oil. Aderolu and Akinremi (2009) showed that a mixture of coconut oil, fish oil, and cow fat respectively produced 1.7% of the best growth in trout. According to Ng and Chong (2004), the fat content of 5% feed can meet the minimum requirement of fat for cultivation.

Feed with 4% fat supplements from both saturated and unsaturated oils, coconut (saturated), or walnut (unsaturated) oils each showed no different conversion of feeds, ranging from 1.73 to 1.78. Although the growth of saturated and unsaturated ratio 1:1 on feed (B) and 1:2 (D) contain coconut oil supplements was higher than that of hazelnut oil on feed C (Table 5), the three treatments of fat supplements resulted in the conversion, efficiency and efficiency of feed proteins no different. The content of unsaturated fatty acids (linoleic) in feed B and D as needed (0.5-1%), compared with coconut fat (C) (Table 3), so the growth is better. The results of Hsieh et al. (2007), enzymatic activity of SCD (sterol-CoA desaturase) was highest seen in mixed-supplemented fish (SFA + PUFA) as well as SFA supplements (coconut oil) (Craigh and Helfreich, 2009), vegetable oil (palm oil, and soybean oil) can be used as a substitute for fish oil without affecting the growth and efficiency of feed in freshwater fish (Hertrampf and Pascual, 2000).

The results of this study indicate that the ratio of saturated 1:1 unsaturated fats from vegetable oil sources, can match the growth achievement and efficiency of fish fed with higher protein and contain ω-3 (fish oil).

CONCLUSIONS

The results showed that the use of level 4% fat can be used in the feed formulation of Nile fish and in accordance with the needs of optimum fats, as well as physical and chemical descriptions that meet the

requirements of Nile fish feed stadia fingerling. A 4% fat supplementation consisting of a 2% coconut oil mixture and 2% hazelnut oil in a 28% protein diet yields the best performance (physical quality of pellets, and growth).

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