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FEED OIL SUPPLEMENT FROM ALTERNATIVE MATERIALS ON FEED EFFICIENCY AND PROTEIN EFFICIENCY RATIO IN RED TILAPIA FISH (*OREOCHROMIS NILOTICUS*) SEED PHASE

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Abstract

Optimization of cultivation through input protein-energy efficient in the diet is very urgent. Fish need fat as an energy source and to maintain the shape and function of membrane tissue. This study aims to explore source fat from alternative materials of animal fat (caterpillar flour or larvae of Tenebrio molitor) and seed fat (hazelnut) in the form of feed oil supplement (FOS) its impact on feed efficiency and protein efficiency ratio in red tilapia fish seed phase. Methods of extraction descriptively, followed by a biological test experimentally, completely randomized design (7x3) use of feed oil supplement from caterpillar flour and hazenut (each with a dossage 1%, 2% and 2% a mixture of both) were added to the basal feed (low protein), and treatment standard feed (high protein). The extraction of hazelnut (31.72% crude protein, fat 35.32%) and the caterpillar flour (crude protein 55.11%; 15.51% fat), obtained the total yield of 30-35% material and extract oil supplements each 9.9 % and 4.05% initial weight. Biological test showed that the highest feed efficiency in the use of 2% a mixture of both caterpilar and hazelnut oil, but not significatly different with the use of standard feed and 2% hazelnut oil and caterpillar oil. Feed efficiency and Protein efficiency ratio of 2% feed oil supplement was higher compared to 1% feed oil supplement award and the basal feed. The addition of feed oil supplement will be increasing content of Energy-Protein Balance in the feed (ranging from 6.8 to 8.9 kcal.g^{-1} protein). There means the protein sparring effect (effect of partial substitution of protein as an energy sources by fat) so as to conserve resources N and in turn be able to eliminate the discharge of nitrogen in the water.

***Key words**: Feed oil supplement, the balance of energy-protein, feed efficiency, red tilapia fish seed phase.*

INTRODUCTION

The provision of feed with a proportion of energy-protein effective quantitative (exact amount) and qualitative needs to be supported by information characteristics of energy sources and their influence on the diet (the rate of gastric emptying, the amount of feed, and interval feeding) are expected to provide benefits to improve efficiency feed on red tilapia fish (*Oreochromis niloticus*). Meat of red tilapia fish is thick and appreciated by the public abroad, especially Japan, USA, and Singapore, has an interesting color, flesh rough savory, and resembles a red snapper or red sea bream that have a high price.

Feed oil supplement is one application to add a component of fat and fatty acids. Fatty acids are a source of energy that has the ability to partially replace protein (protein sparring effect) and essential for cell permeability. Source of unsaturated fatty acids in fish feed is fish oil, linseed oil, and corn oil, but limited availability. Alternative materials locally-based dietary fat supplements showed that potentially is a caterpillar flour and hazelnut.

Caterpillar flour (insect larvae *Tenebrio molitor*) is cultured in a medium flour-based cereal. Caterpillars fresh flour contains high crude fat is equal to 32.4% and various other nutrients, but contain chitin as anti-nutrient if fed as a whole (Anguilar-Miranda et al., 2002). The nutritional value of caterpillar flour can be more helpful if the fat extracted oil (*feed oil supplement*). Hazelnut (*Alleurites mollucana*) is known as a spice native to Indonesia recommended as a source of unsaturated fatty acid linseed oil substitute for part of the fruit (seed) oil content of 55-65%, and oil content in the shell by 60%.

Fish needs for energy is expected to largely be met by non-protein nutrients such as fat and carbohydrates. If the energy derived from the non-protein sufficiently available, the majority of protein would be used to grow, but if the energy and non-protein nutrients are not met, then the protein will be used as an energy source so that the protein functions as a body builder will be reduced. The energy levels of protein in the diet also affect feed intake. If the energy level exceeds the needs of protein will decrease the consumption of so making more nutrients including protein will decline. Therefore we need the right balance between energy and protein in order to achieve efficiency and effectiveness of feed utilization.

Based on this background, it is very important to do research that aims to discover the source of the fatty acids from alternative materials as feed oil supplement in feed efficiency to achieve the balance of protein to energy.

Problems that can be identified is how far oil feed supplement extracted from alternative materials of vegetable and animal origin affect the energy balance of protein and protein utilization efficiency. The results of the study expected in the manufacture of feed supplements gained alternative sources of fatty acids and fish oil replacement strategy obtained in fish feed formulations with protein proper energy balance in order to achieve high feed efficiency.

Extraction is one of process or treatment performed on a given material as a product extracts to animals (Hartadi et al., 1986). Mechanically extracted which the extraction process from grain to heat and mechanical a way that the result is left is cake. Furthermore, the process of solvent extraction

is the term used for the extraction or removal of a material (for the purpose of fat or oil), using an organic solvent. The use a mixture of alcohols, alkanes, and water; also the use of solvents hexane and isopropanol are successfully used for the extraction of tissue. During the extraction solvent breaking of hydrogen bonds, van der Walls bonding and electrostatic interactions (Akoh and Min, 2002).

Lipid extraction procedure according Akoh and Min (2002), through the stages:

(A) Pretreatment (drying, size reduction, or hydrolysis.

Hydrolysis process can be done by using an acid (3-6 M HCl) or alkali. Acid or alkali is necessary to break the covalent and ionic binding between lipids and carbohydrates as well as fat emulsification.

(B) Homogenize network with solvent and separation / separation of the liquid component (organic and solutions) and solids.

(C) Expenditure contaminants

(D) Expenditure component solvent and drying the extract

Generally, the overall use of fish oil supplements is 5-10%, which functions other than as a source of fatty acids as well as attractant and structural improvements pellets. According Hsieh et al. (2007), the largest source of ω3 than beef tallow, linseed oil, and corn oil is fish oil with the use of the number of fish oil supplements in the diet as much as 6% that it contains 1.5% ω3. Given caterpillar flour oil and hazelnut oil fatty acids, it is expected that its use can be an alternative to fish oil.

MATERIALS AND METHODS

Materials used in this study were: 270 fish tail test, artificial feed, and chemicals for analysis.

The fish samples used are red tilapia fish one month old 5 - 6 cm in length (5 g body weight).

Table 1. Composition of Feed Ingredients Proximate Analysis Results

No.	Raw Feed	Crude Protein	Extract ether	Crude Fiber	Gross Energy*)
1.	Soybean meal	27.00	0.90	6.00	2240
2.	Fish meal	46.41	3.22	1.0	2593
3.	Rice bran	8.75	12.00	12.00	1630
4.	Pollard	14.69	3.91	10.00	1300
5.	Oil/Fat	3.00	100	0	9859
6.	Blood meal	72.87	0.00	1.00	1208
7.	Coconut meal	17.36	1.80	15.00	1597

*) DE (Digestible Energy) = 70% ×GE (Hepher, 1989)

Experimental Procedure:

1. The extraction of materials, analyzes of feed (Table 1), and Formulation (Table 2) and was measured in Energy-Protein Balance.
2. Test Feed (feeding trial), involves the collection and recording of data growth over the two-month maintenance and measurement of feed efficiency and protein efficiency ratio (Ensminger, 1997).

Table 2. Feed Formulation Treatment

No.	Raw Feed	A	B	C	D	E	F	G
1.	Soybean meal	11	11	11	11	11	11	11
2.	Fish meal	12	11	11	10	10	10	30
3.	Rice bran	30	30	30	30	30	30	20
4.	Pollard	30	30	30	30	30	30	28
5.	Oil/Fat	5	5	5	5	5	5	5
6.	Blood meal	12	12	12	12	12	12	6
7.	FOS seed fat (K)	0	1	0	2	0	1	0
8.	FOS animal fat (U)	0	0	1	0	2	1	0
		100	100	100	100	100	100	100

Treatment effect was tested by F test and statistical analysis to determine the differences of each treatment used Duncan's Multiple Range Test.

RESULTS AND DISCUSSION

Nutrient Content and Energy Protein Ratio

Table 3. Protein and Fat Content of Materials of Alternated Fat Sources

	Hazelnut*	Caterpillar flour*
Crude Protein (%)	19	55.11
Crude Fat (%)	55	15.51
Moisture (%)	12	9.45
Ash (%)	-	5.11
NFE (%)	13	21.65
Yield flour*	60%	70%
Yield of extraction**	30%	35%
Yield of oil/100 g raw material ***	9.9%	4.05%
The value of the acid number (mg KOH)	78.5	10.31

Note:

* The results of the mechanical extraction process Steamed (steamed), Crushed (breakdown), Rolled, Blend (mixing), and Mill (flouring)

** The results of solvent extraction with hexane solvent using techniques of maceration (soaking 24 hours) the hazelnut and caterpillar flour.

*** NFA= Fat (BK100%) × yield preparation stage × yield of solvent extraction

Table 3 shows the protein content of the extracted mechanical hazelnut and caterpillar flour respectively 19% and 55.11%; whereas in the extraction process (ether extract or crude lipid) on these two materials of different hazelnut fat 55%, while the caterpillar flour by 15.51%.

Insolubility lipid in the water allow the separation of the components of carbohydrate, protein and water in a network hazelnut and caterpillar flour. Fat hazelnut was large enough that 55%, compared with fat caterpillar flour. Based on Table 3, it is also evident that the value of the acid number of hazelnut oil is high at 78.5 mg KOH while the fatty acid value of 10.31caterpillar flour.

This means triglycerides contained in pecan has an average molecular weight lower.

It allows too many parts of free fatty acids, in accordance with the opinion of Estrada (2011), as well as castor oil, generally non-food seed oils containing high free fatty acids.

Table 4. Nutrient Content (%) and Energy-Protein Balance (kcal/g protein)

	Crude Protein	DE	Crude Fat	Crude Fiber	EPB*
Basal Feed (A)	21.37	1689	5.47	9.23	7.9
Added Fos 1%	20.93	1761	6.44	9.22	8.4
Added Fos 2%	20.5	1834	7.41	9.21	8.9
Standard Feed	27.51	1871	4.67	7.11	6.8

- EPB = Energy-Protein Balance

The results of the analysis of the content of unsaturated fatty acids are dominant in caterpillar flour oils are oleic (C18: 1 ω9) amounted to 19.77% and linoleic (C18: 2 ω6) 8.51% still need to be tested further the amount of benefit to the fish. There still exists the possibility of contaminants, and the presence of residual solvents may occur. Non-lipid component separation is done by evaporation of the lipid extract by drying in a vacuum and then extraction with non-polar solvent. In this study, the solvent used is n-hexane.

Growth Rate and Efficiency

Growth rate of fish biomass at each sampling period showed a weight change that indicates that the fish have adapted to respond to the test feed (Figure 1).

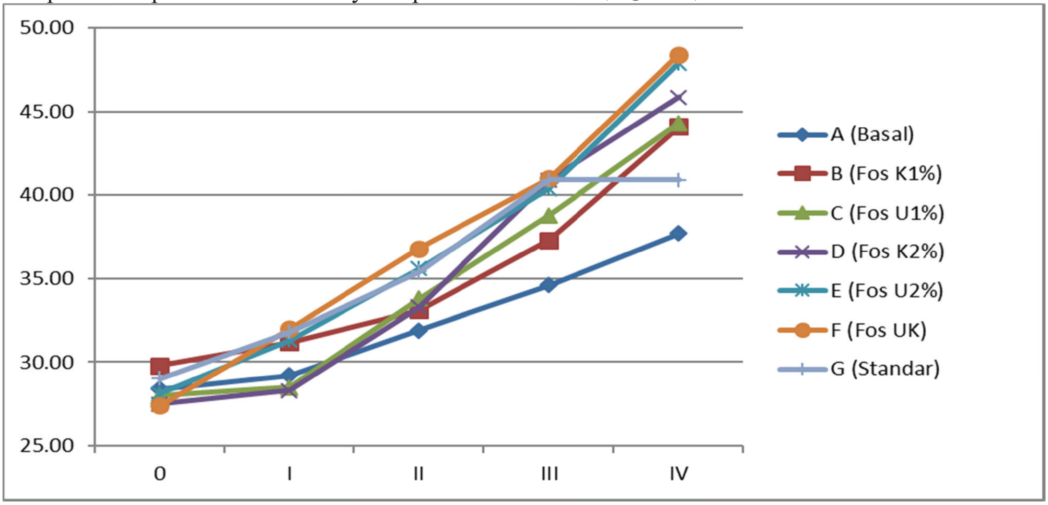

Figure 1. Growth Rate of Red Tilapia Biomass

This suggests that neither animal fat nor seed oils as feed supplements can be responded well by fish. Basal feed while increasing the weight of the lowest each week.

The growth of fish fry with standard feed at the end treatment decreased growth, which may be caused by factors of water quality due to discharge N of metabolites.

Table 4 shows that the addition of seed oil supplement will increase DE:P which means that also the mechanism of protein sparring effect (effect of partial substitution by protein sources of energy (fat) N which saves natural resources and in turn could eliminate the discharge of nitrogen in the water.

The results of the study in Japan showed that the highest growth and feed conversion in carp and eel, obtained on feed containing 1% supplement 18: 3 ω3 and 1% supplement 18: 2 ω6 (de Silva, 1989).

While tropical herbivorous fish (*Tillapia zilli*) more require 18: 2ω6 or 20: 2ω6 than ω3 series (de Silva, 1989).

Duncan Test Results on Feed Efficiency and Balance Protein Efficiency can be seen in Table 5.

Table 5. Feed Efficiency and Ratio Efficiency Protein

Treatment	Feed Efficiency	Protein Efficiency Ratio *)
A (Basal feed, CP 20%)	26.69 d	1.25
B (Added Fos Hazelnut K1%)	38.98 b	1.86
C (Added Fos Caterpillar U1%)	45.15 c	2.19
D (Fos K2%)	52.73 a	2.57
E (Fos U2%)	52.22 a	2.55
G (Standard Feed; CP 27,5%)	54.87 a	2.63
F (Added Fos mix U1%+K1%)	56.17 a	2.04

*) Not showed significant differences in the level of 95%.

Table 5 shows that the standard feed (crude protein content 27.5%) and feed with the addition of oil feed supplement of 2% resulted in higher feed efficiency when compared with 1% feed oil supplements and basal feed (crude protein content 20%). The highest protein efficiency is in the use of 2% a mixture of both caterpilar and hazelnut oil. Protein efficiency ratio ranging ranges from 1.25-2.63, but did not show significant differences.

Energy-Protein Balance in the feed (DE/CP) ranging from 6.8 to 8.9 kcal.g^{-1} protein (Table 4), which means that also the protein sparring effect (effect of partial substitution of protein as an energy by fat) so as to conserve resources N and in turn be able to eliminate the discharge of nitrogen in the water.

CONCLUSIONS

In the manufacture of feed oil supplements gained as much as 30-35% oil yield, while purified extract obtained only by 9.9% and 4.05% of the raw material origin.

Feed efficiency and Protein efficiency ratio of 2% feed oil supplement was higher compared to 1% feed oil supplement award and the basal feed.

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