 doi:10.20944/preprints202105.0454.v1

Article

Effect of blend oils from waste paring coconut and candlenut and selenium for formulating of feed-in Nile tilapia and production parameters

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Abstract: This study aims to get growth and feed efficiency of Nile tilapia (*Oreochromis niloticus*) with plant oils supplement from paring coconut (P.C.) and candlenut (C.N.) enrichment of Se in rations formula. The oil of P.C. was dominated by saturated fatty acid (SFA) lauric (42.67%), while the extract of C.N. was unsaturated fatty acids (UFA), linoleic (34.4%), and oleic (48.99%). The extract of P.C. and C.N. or mix oils added 4% in basal ration formula (28% crude protein (C.P.) with energy-protein ratio 8 kcal/kg). Completely Randomized Design (6 × 3) consists R_1: basal ration; R_2: basal formula with blend of paring coconut and candlenut oils (2% PC + 2% CN); R_3: blend oils (R_2) with trace additive Se; R_4: 4% PC + Se; R_5: 4% CN + Se; R6: control ration (32% CP). The result of production parameters showed that blend oils supplement enrichment Se 0.15 ppm in feed formula with ratio SFA: UFA = 1: 1 was the best growth rate equal with high protein feed. Feed efficiency ranged from 50.14-57.93% and protein efficiency ratio 1.72-2.06 both for CN oil (SFA: UFA = 1 : 2), paring coconut (SFA : UFA = 2 : 1) or blend oils (SFA : UFA = 1 : 1). Incorporation of blend oils with Se can be used for Nile tilapia fingerlings (≥ 10 g). Paring coconut oil was trend increasing on feed efficiency for tilapia bigger stadium (≥ 30 g).

Keywords: feed efficiency; *Nile tilapia*; paring coconut and candlenut; plant oils; selenium

1. Introduction

Nutrient balance with sufficient energy is of central importance in feed formulation [1]. As part of the lipid, fat and fatty acids can serve as a precious protein-sparing for growth, as a fuel to generate metabolic energy in fish muscles [2]. Fat is essential as a protective nutrient (coating) in protein-lipid emulsions [3]. Protein content must meet the requirements obtained from protein source feed, but the energy value is often not as predicted.

The use of feed oil supplements is necessary to achieve the balance of fat and its essential components. Some issues in the area of fish nutrition require consideration and improvement, such as feed and nutrient efficiency, overfeeding and waste, fish meal (F.M.), and fish oil (F.O.) replacements [4–6]. The protein feed sources such as fish meal and soybean meal are through pressing and extraction as by-product oil production. Feed source basal protein ingredients such as wheat bran and rice bran in general derived from the rest of the mill, which has reduced starch and fat. The use of plant oils in omnivore fish can serve as a spare protein-energy provider in addition to carbohydrates.

In a few studies, terrestrial plant oils can replace substantial amounts of F.O. in the diets of many fish species without affecting growth or feed efficiency, provided that adequate amounts of specific EFAs are supplied in the diet. Oilseed for plant extract comes from various plant types such as extract palm or coconut and grains [7]. The addition of 5-10% peanut extract can improve feed conversion with a lower feed efficiency

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ratio [8]. The candlenut crop (*Alleurites mollucana*) belongs to the *Euphorbiaceae* class, a hardwood crop commodity in Indonesia, with great potential as an oilseed source. Similarly, coconut (*Cocos nucifera*), as a tropical plant of *Palmae* species, contains many benefits, especially coconut meat, along with its waste (paring coconut). The fat content of candlenut seed was 55% extract ether (E.E.), whereas a crude fat content of paring coconut was about 23.36%. According to [9], brown skin coconut (called coconut testa or paring coconut) had the same amount of fat compared to coconut whole and whole coconut copra, richer in monounsaturated and polyunsaturated than other coconut oil samples.

The high fat and carbohydrate associated with decreased availability of cations in the intestine and increased fat content in the body's cells causing oxidative stress [10][11]. Minerals can enhance attachment (gelation or chelate) by forming bridges of salt between molecules, and their existence plays a role in various processes, according to [12]. Selenium (Se) is an essential trace element in various reactions and regulators of energy metabolism because its function can regulate the esterification of fatty acids and the pentose phosphate pathway (PPP). Selenium requirement for tilapia as much as 0.3 mg/kg [2]. According to [13], mineral Se of 0.15 mg/kg of feed effectively improved conversion through glutathione peroxidase activity mechanism.

Efforts to replace few protein functions as an energy source, choose one of that by plant oils supplement. Fish mainly require several fatty acids such as monoenoic (oleic), linoleic and linolenic fatty acids to synthesize some fatty acids by elongation of the carbon chain and the addition of double bonds (desaturation) [14]. It was necessary to research the result extraction of materials candlenut and paring coconut and ratio of saturated with unsaturated fatty acid in the formula and then feeding trials for production parameters through the growth and efficiency.

2. Results

2.1. Content of Plants oil and Ration

Oilseeds (candlenut) and paring coconut extract result analysis with GCMS descriptively showed in Table 1.

Table 1. Characteristics of Extracted Oil

	Candlenut	Paring coconut*
Crude lipid content of raw material (%) *)	55.00	19.24
The yield of a meal (on preparation stage) (%)	88.00	85.00
Amount of solvent: material	2: 1	1: 1
Oil Amount / g of the mixture (%)	30.00	4.05
Pure oil yield / 100 g raw material**) (%)	48.40	50.00
KOH (mg/g)	178.50	98.00
Iodine g I_2/100 g	112.00	5.16
Fatty acid content (mg/100g) ***)		
(1) Saturated		
- Octadecanoic (Stearate)	5.68	1.78
- Hexadecenoic (Palmitate)	8.87	6.73
- Hexanoic (Caproate)	-	1.57
- Octanoic	-	13.21
- Decanoic (Caprate)	-	11.01
- Dodecanoic (Laurate)	-	42.67
- Tetra decanoic (Myristate)	-	17.64

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(2) Unsaturated		
- Linoleic C18:2 ω6	34.40	0.72
- Oleic C18:1 ω9	48.99	4.65
- Cis-11 Eicosanoid (HUFA)	0.1	-

*) Chemical Instrumentation Laboratory Analysis, UPI.
**) Yield = (% crude fat) × ∑ preparation stage × yield extraction ∑evaporation).
A mixture of paring coconut of skin/ Testa and coconut flesh 1: 1 bb.
***) Chemical Instrumentation Laboratory Analysis, UPI (2016)

The oil extract of the candlenut from the GCMS (*Gas Chromatography-Mass Spectrometry*) analysis showed that the candlenut contained C18: 2 ω-6 (34.40% linoleic) ω-9 (oleic) fatty acids of 48.99%, and ω-3 of 0, 51%. In contrast, the extract of paring coconut contains much lauric acid, around 42.67%, with unsaturated fatty acids only about 5%. Candlenut oil which was dominated by unsaturated fatty acids (89.4%), and paring coconut oil dominated by saturated fatty acids, can be applied as a source of fatty acids.

Table 2. The composition of feed ingredients in formulations and protein-energy content

No	Feed ingredient *)	R_1	R_2	R_3	R_4	R_5	R_6
		……………………………..%	………………………………………				
1	Soybean meal	29.00	30.00	30.00	30.00	30.00	33.50
2	Fish meal	10,.00	10.50	10.50	10.50	10.50	12.00
3	Rice bran	18.00	18.00	18.00	18.00	18.00	18.00
4	Corn meal	14.00	1.00	1.00	1.00	1.00	9.50
5	Blood meal	3.50	2.00	2.00	2.00	2.00	6.00
6	Palm cake	7.50	7.50	7.50	7.50	7.50	8.00
7	Wheat bran	10.00	19.00	19.00	19.00	19.00	5.00
8	CMC	2.00	2.00	2.00	2.00	2.00	2.00
9	$CaCO_3$	2.00	2.00	2.00	2.00	2.00	2.00
10	Bone meal	2.00	2.00	2.00	2.00	2.00	2.00
11	Premix	2.00	2.00	2.00	2.00	2.00	2.00
12	PC extract	0.00	2.00	2.00	4.00	0.00	0.00
13	CN extract	0.00	2.00	2.00	0.00	4.00	0.00
	Total	100.00	100.00	100.00	100.00	100.00	100.00
	Add Se (%)	0	0	0.0015	0.0015	0.0015	0
	Protein (%)	28.07	28.14	28.14	28.05	28.05	32.05
	DE (kcal/kg) *)	2237	2248	2248	2250	2250	2246
	Crude lipid (%)	5.33	9.21	9.21	9.21	9.21	5.27

R_1: basal ration (protein 28%) without supplement; R_2: 4% mix. Plant oils (2% PC + 2% CN extract); R_3: (2% PC + 2% CN extract) + Se; R_4: 4% PC + Se; R_5: 4% CN + Se; R_6: control ration (protein 32%).
*) DE (Digestible Energy) = 70% × GE (Gross Energy) [15].

The content of unsaturated fatty acids (linoleic) in feed treatments R_3 and R_5 as needed (0.5-1%) (Table 3).

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Table 3. Energy-Protein and Saturated-Unsaturated Fatty Acid Ratio of Fish Diet Ingredient with supplemented of P.C. and C.N. extract

Ingredient*)	R_1	R_2	R_3	R_4	R_5	R_6
Protein (%)	28.07	28.14	28.14	28.5	28.05	32.05
DE (kcal/kg)	2237	2248	2248	2250	2250	2246
DE/CP (kcal/g)	7.97	7.99	7.99	8.02	8.02	7.17
Saturated*) (%)	2.18	4.64	4.64	6.24	3.04	2.4
Unsaturated*) (%)	3.15	4.56	4.56	2.97	6.16	3.16
Saturated-unsaturated ratio	2: 3	1: 1	1: 1	2: 1	1: 2	2: 3
Linoleic acid (ω_6) (%)	0.49	1.04	1.04	0.36	1.73	0.68
Selenium (mg/kg) **)	0.09	0.09	0.24	0.24	0.24	0.13
Total Fat (%)	5,33	9,21	9,21	9,21	9,21	5,27

*) Feed Analysis: Laboratory Analysis of Animal Feed Chemistry and Ruminant Nutrition (2019) and reference [16].

R_1: basal ration (protein 28%); R_2: 4% blend plant oils; R_3: 4% blend plant oils + Se; R_4: 4% PC + Se; R_5: 4% CN + Se; R_6: control ration (protein 32%).

**) Content of Selenium in diet

2.2. The growth performance, feed efficiency, and protein efficiency ratio

Figure 1 showed the parameter observed of Average Individual Weight of fish (g) each a week sampling period, which was the higher performance obtain on feed with higher protein (32% protein), and then treat R_3 (low protein with blend oils).

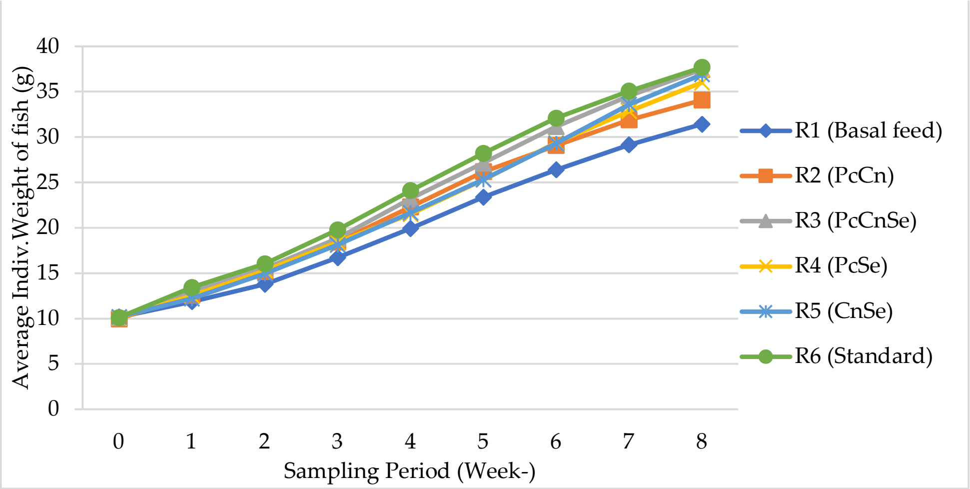

Fig. 1. Average Individual Weight of fish (g) each sampling period

Table 4. Duncan Test Results from Influence of Treatments on Weight gain, absolute daily gain (ADG), and specific growth rate (SGR) of Nile stadium fingerling

Treatment	Weight Gain *	ADG *	SGR *
	(g)	(g/day)	(% /day)
R_1	21.27 ± 0.21 ^{a}	0.34 ± 0.003 ^{a}	1.79 ± 0.02 ^{a}
R_2	24.08 ± 0.16 ^{b}	0.38 ± 0.002 ^{b}	1.95 ± 0.06 ^{b}
R_3	27.33 ± 0.33 ^{de}	0.43 ± 0.005 ^{de}	2.08 ± 0.04 ^{c}
R_4	25.93 ± 0.63 ^{c}	0.41 ± 0.010 ^{c}	2.02 ± 0.02 ^{c}
R_5	26.71 ± 0.17 ^{d}	0.42 ± 0.030 ^{d}	2.04 ± 0.02 ^{c}
R_6	27.56 ± 0.27 ^{e}	0.44 ± 0.004 ^{e}	2.09 ± 0.03 ^{c}

^{a,b,c} Different superscripts within each row indicate significant differences ($p < 0.05$).
R_1: basal ration (protein 28%); R_2: 4% blend plant oils; R_3: 4% blend plant oils + Se;
R_4: 4% PC + Se; R_5: 4% CN + Se; R_6: control ration (protein 32%).

At the base statistical analyses, the absolute weight gain (W.G. and ADG) of fish fingerlings between formula high protein control R_6 not significant ($P > 0.05$) with low protein supplemented blend oils extract + Se (R_3) and R_5 (4% candlenut oil extract + Se) (Table 4). The content of unsaturated fatty acids (linoleic) in feed treatments R_3 and R_5 as needed (0.5-1%) (Table 3), so the growth was better compared with coconut extract (R_4).

Table 5. Duncan Test Results Influence of Treatments on Feed Intake, Feed Conversion of Nile stadium Fingerling

Treatment	F.I. *	Feed Conversion*	Feed Efficiency*	PER*
	(g)	(Index)	(%)	
R_1	42.41±0.49 ^{a}	1.99±0.019 ^{d}	50,14±0.48 ^{a}	1.79 ±0.02 ^{b}
R_2	46.40±0.83 ^{b}	1.93±0.037^{c}	51.91±1.01^{b}	1.85±0.04 ^{c}
R_3	48.62±0.65 ^{c}	1.78±0.044 ^{ab}	56.23±1.37 ^{cd}	2.01±0.05 ^{d}
R_4	46.30±0.41 ^{b}	1.79±0.028 ^{b}	55.99 ± 0.87^{cd}	2.00±0.03 ^{d}
R_5	46.31±0.24 ^{b}	1.73±0.016 ^{a}	57.68±0.53 ^{d}	2.06±0.02 ^{d}
R_6	50.10±0.91 ^{d}	1.82±0.025 ^{b}	55.01±0.75 ^{c}	1.72±0.02 ^{a}

* The same superscripts letter to the column indicate no significant difference ($P > 0.05$)
R_1: basal ration (protein 28%); R_2: 4% blend plant oils; R_3: 4% blend plant oils + Se;
R_4: 4% PC + Se; R_5: 4% CN + Se; R_6: control ration (protein 32%).

Plants oil supplement with enrichment of selenium in low protein diet (28%) had a significant effect ($P < 0.05$) on the specific growth rate (SGR). The control diet (32% protein) produced the highest SGR (2.09%), but it was not significantly different.

R3, R4, and R5 treatments show no different feed efficiency, ranging from 56.23% to 57.68%. Although the growth of R_3 fish (P.C. + C.N. + Se), R_5 (C.N. + Se) was higher than R_4 (P.C. + Se), the three treatments resulted in no different efficiency and protein efficiency.

3. Discussion

3.1. Content of Plants oil and Ration

Results analysis showed that both plant extract has properties and characteristics, primarily determined by the structure of fatty acids in the triglyceride sequence. Important variables influencing the energy content of fats include stadia of the fish, degree of fat saturation, chain length, free fatty acids, and fat inclusion level. Further incorporation by adding the mineral supplement selenium in the feed as an antioxidant cofactor can increase stability. The fatty acids can be bound to glyceride molecules and are not quickly evaporated or turned into free fatty acids. Although paring coconut oil lacks linoleic fatty acids (Table 2), the saturated fatty acids contained in coconut were predominantly of lauric acid, including medium-chain triglycerides (MCTs) having low melting points. Infeed the formula, the ratio of saturated and unsaturated fatty acids (SFA: UFA) both of treatment R_2 and R_3 were the same (1: 1), with the content linoleic of 1.04% (Table 3). Ratio SFA: UFA R_1 and R_6 2 : 3; R_4 2: 1, whereas R_5 1: 2; with adequate linoleic in all treatments. Fatty acid requirement Nile tilapia is recommended no more than 0.5-1% range for 18: 2 ω 6 [17].

Table 2 showed that the crude fat content of candlenut was greater than paring coconut. According to [18], the separation of fat in the plant extraction process both mechanically and chemically is called leaching, which is preceded by inter-phase contact followed by diffusion of the solute phase from the solid phase and the liquid phase, so that the components dissolved in the solid can separate. The chemical and physical properties of candlenut oil according to SNI 01-4462-1998 for industry, free fatty acid (0.1-1.5%), the iodine number (136-167); 184-202 mg KOH/g, density 0.9240-0.9290 and Refractive Index 1.4730-1.4790. The iodine number of candlenut oil was much more significant than coconut oil, indicating the unsaturation of fatty acids. The separation of coconut fat and candlenut in this study was practical because it uses coconut water to extract paring coconut. In contrast, candlenut uses n-hexane, which is inert in the extraction of candlenut, available in the market and repeatedly used.

Table 3 showed that supplementation from the ingredients of candlenut and coconut was enough to meet requirements. A balance of saturated and unsaturated fats needed for the nutritional benefit of tilapia can be found. The use of plant oils, both candlenut oil extract (source of UFA) or coconut extract (source of MCTs), can be used as a supplement of energy sources other than protein (extra protein) for fish. Some F.A. is essential for aquaculture because the fishes cannot synthesize or convert one F.A. to another F.A. within the same series [17]. The essential F.A. includes linoleic acid (C18:2), linolenic acid (C18:3), and arachidonic acid (C20:4) and needs to be supplied in the diet. Energy requirements expressed as a ratio of digestible energy (D.E.) to crude protein (DE/P) range for tilapia (8.13–9.7 kcal/g).

3.2. The growth performance, feed efficiency, and protein efficiency ratio

The treatment of fat and selenium supplements (R_3, R_4, and R_5) was higher SGR ($P < 0.05$) with no Se supplementation (R_1 and R_2). This means that low protein diets with 4% plant oils supplement addition Se produced growth like that of the feed fed with 32% high protein. Fish meal in control treatment was higher than the others. R_6 (control) contain linoleic acid (0.68%) and Se 0.15 ppm (Table 3). According to [19–21], the fat content of 5% feed can meet the minimum requirement of fat for the growth phase, requiring linoleate 0,5-1% for Nile tilapia and *Tilapia zilli.*

Statistical analyses show that Nile tilapia with supplement blend oils plus Se (R_3) and candlenut oil (R_5) was the best on feed efficiency, conversion, and protein efficiency ratio. According to [10], from the experiment, both palm oil and shea-butter oil or mixture could be used as an energy source in the diet of juvenile African catfish up to 1.5% inclusion without any adverse effect to the fish growth and health. The ratio of 1: 1 of both materials can meet the minimum requirement of linoleic acid [22, 23], min. The linoleic acid requirement was 0.5%, and the linoleic/linolenic ratio (ω6/ω3) of 13 was sufficient for the essential fatty acids for Nile fish stadium fingerling.

Feed with 4% fat supplements from both saturated and unsaturated oils, coconut (source of MCT-SFA), or candlenut (UFA) oils each showed no different FCR ($P > 0.04$), ranging from 1.73 to 1.78 (Table 5). According to the results of [24], expression of enzymatic activity of SCD (sterol-CoA desaturase) was highest seen in mixed fish oil and palm oil (SFA + PUFA) as well as SFA. Plant 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 Piedad-Pascual 2012).

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In Table 5, the best feed conversion ratio was obtained in treatment R_5 (4% candlenut extract), i.e., with FCR 1.73 and SFA: UFA 2: 1. R_5 and R_3 have the adequacy of unsaturated essential fatty acids (> 1%) (Table 3). The improved FCR over time has been due to increased digestible nutrient and energy content of the feeds, as well as feed extrusion, which has resulted in the production of feeds with higher lipid levels, improved starch gelatinization (increases digestible energy content and utilization), and improved pellet characteristics (durability, buoyancy, etc.) [26].

The efficiency of fat utilization by fish is dependent on several factors, especially age of birds and composition, inclusion level, and quality of the fat. Studies to better understand these factors and resolve their complexity are warranted to achieve the full benefits of supplemental fats. Of the various strategies available, blended fats and nutritional emulsifiers are potentially valuable for improving fat utilization. The content of unsaturated fatty acids (linoleic) R_3 and R_5 as needed (0.5-1%) [22], compared to R_4 (0.36%). The results of the other research showed a decrease in the growth of *Oreochromis aureus* if dietary excess linoleic fatty acids [24].

The best efficiency, conversion, and protein efficiency ratio results were generated by the dominance of unsaturated fatty acids (R_5) and R_3 with 2% coconut and 2% candlenut supplements. According to [10], better use of the fat mixture was also obtained from research results that coconut extract, fish extract, and tallow mixes of 1.7% produced the best growth trout. The increase of energy from added oil supplements in the fish feed within certain limits can cause a positive effect of protein sparring in its function as a provider of energy.

R3, R4, and R5 treatments show no different conversion of feed, ranging from 1.73 to 1.78. Although the ADG of R_5 was higher than R_4 (Table 5), the three treatments resulted in no different SGR, feed efficiency, and protein efficiency ratio. The content of unsaturated fatty acids (linoleic) R_3 and R_5 as needed (1%) [22] compared to R_4 (0.36%). As for tilapia, the type of unsaturated fatty acids needed for freshwater fish in this tropical area is ω6 fatty acid or mixture. Lauric acid in coconut extract has antiviral, antiprotozoal, and antibacterial properties, and together with that, can increase the body's metabolism [20, 27, 28].

The use of plant oil supplements (R_3, R_4, and R_5) with Selenium improved feed efficiency compared to without supplements (Table 6). Hence the presence of selenium incorporation with oil supplements was significant ($P < 0.05$) affected to increase in fat utilization, so R_2 (without selenium) resulted in lower feed efficiency and protein efficiency ratio than R_3 (with Se supplement). The treatment of incorporation of SFA: UFA (1: 1) ratio and Se (R_3) had a higher feed efficiency than without Se (R_2). Se mineral supplementation as a dose of 0.15 mg/kg of feed effectively improves conversion through the mechanism of glutathione peroxidase activity in reducing oxidation [3]. Parameter of protein use age one is measured from the amount of weight increase of protein divided by protein given (Protein Efficiency Ratio). Plant oil and Se supplements on a low-protein diet (R_3, R_4, R_5) had PER (2.01-2.06) with significantly higher ($P <0.05$) range than R_2 (1.85), R_1 (1.79), and R_6 (1.72).

The ability to optimize energy in feed-in fish is protein> fat> carbohydrates [29]. The presence of selenium which plays a role in the activation of thyroxine concentrations, is essential because, according to [30], the absorption of glucose and fructose becomes saturated more quickly along with the fast hydrolysis of carbohydrates. Table 5 showed that R_4 and R_5 result in low feed intake with better conversion than others (R_1, R_2, and R_6). The trend of the Growth graphic in Fig. 2 at R_4 was increased. According to the estimate of emptying intestine and cavity in fish growth stadium (≥ 20 g), the R_4 (SFA: UFA ratio 2: 1) was lower. Its mean is a giant stadium, feed consumption in diet with SFA: UFA ratio has been efficient to growth increasing.

The high protein content of (30-40%) will produce inorganic nitrogen compounds in ammonia/ammonium, one of the toxic compounds for fish and shrimp. Based on the results of water quality observations (Table 6), the ammonia content in the fat and

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selenium supplementation treatment was in a lower range than without supplements. In R3-5 treatment, the ammonia content tends to be lower, which means that in the presence of selenium, ammonia excretion can decrease as a manifestation of the efficiency of using feed protein. Se can balance S and N compounds because oxidation intermediates (organic acids and ester salts) can be maintained. Free sulfuric acid and other metabolites are protected from further oxidation into H_2S and NH_3 waste.

4. Materials and Methods

The research includes the preparation stage consisting of extraction and feeding trial to determine the value of growth benefits and feed efficiency on the tilapia fish with an initial length of about 5-6 cm and weight of about 10 grams. Red tilapia used in experiments measuring ten ± 0.06 g and stocking density of 250 ind. / m^3 or 20 fish per container 50x40x30 cm^3. The tested fish were adapted for acclimation purposes used four pieces of fibre size one m^3.to the experimental diet for a week with a feeding frequency of three times a day at 08:00 AM, 1:00 PM, and 5:00 PM. The amount of feed that can be given by ad satiation was 4% of the weight of the fish per day on light days (nocturnal).

Extraction techniques for getting seed oils, according to [31], included (i) conventional solid: liquid extraction like maceration, and (ii) non-conventional extractions using either petroleum solvents like hexane. Material Extraction of paring coconut blend with fruit (ratio 1:1) and water coconut as a solute for mechanical extraction through maceration and filtration. Candlenut was extracted mechanically and chemically with maceration in hexane solutions and then evaporated. The extraction of coconut and candlenut in this study was practical because it used coconut water in the extraction of paring coconut waste mix with flesh, while candlenut used n-hexane. Oilseeds extract result then analysis with GCMS (*Gas Chromatography-Mass Spectrometry*) at a Chemical Instrumentation Laboratory Analysis, UPI.

Six types of feed were used in pellets designed isocaloric with a gross energy content of about 3200 kcal kg, or DE 2240 kcal/kg (Table 1). Basal feed raw material consists of soybean, fish meal, palm cake, pollard, rice bran, and premix formulated enriched with fat supplements. The trace additive used Sodium selenite Na_2SeO_3 45% (Behn Meyer merc) as much as 73 mg/kg was equal to 0.15 mg/kg. All feed raw materials were mixed simultaneously to prevent variation, and then it was moulded in a pellet machine with a diameter of 2 mm in the die. The pellets were dried in the air or oven at a temperature of ± 60 - 70^{o}C, then packed and stored at room temperature until they were used for the primary research purposes.

At the feeding trials, siphoning to remove any leftover feed and faeces and replacing 50% of the water gets every four days. Each aquarium was equipped with a thermostat to maintain a stable temperature, aeration to regulate dissolved oxygen, and a top filter to reduce turbidity and ammonia concentration.

The fish weighing was carried out on each fish in an experimental container every week for 63 days of the growth test study. The amount of feed was 4% fish weight/day and adjusted weekly for each experimental unit and calculated from the average weight of individual fish times population, as feed intake. Fish have been counted and weighed individually for the final body weight.

All fish per aquarium were weighed and counted separately during the final sampling. Absolute Weight gain (W.G.), Average Daily Gain (ADG), specific growth rate (SGR), feed conversion, and protein efficiency ratio were evaluated. The following formulas were used:

WG = FBW - IBW; ADG = WG/t; SGR (% BW/day) = 100 × (ln FBW - ln IBW)/T); FCR = FI/WG. Where FBW = body weight final (g), IBW = body weight initial (g), t = duration of the trial in days. WG = wet weight gain (g) and FI = estimated feed intake (g).

The feeding experiment used a Completely Randomized Design (6x3), treats of basal ration (CP 28%) supplemented Selenium (0,15 ppm) and oil of paring coconut (P.C.), candle-nut (C.N.) or blended of both with or no Se. There were R1= basal ration; R2 =

supplemented with 2% PC + 2% CN; R3 = R2 + Se; R4: 4% PC + Se; R5: 4% CN + Se; R6: control diet (CP 32%), and all treatments (R_{1-6}) were formulated isocaloric (Table 2). Data of the study for performance variables were subjected to analysis of variance (ANOVA) as a completely randomized design using the procedure of SPSS. The multiple range test method was used to test the statistical differences among treatments, according to Duncan.

5. Conclusions

The feed efficiency and ratio of protein efficiency ratio on tilapia fingerlings with the incorporation of plant oils and Se in low protein diet, from both extract of candlenut or paring coconut and blend, ranged from 2.01 2.06, better than fish fed with high protein content (32%). A fish diet with the treatment of blend plant oils containing a ratio of saturated and unsaturated fatty acid 1: 1 with the adequation of Se can be used for formula low protein diet for Nile tilapia fingerlings (≥ 10 g). Nile tilapia, more giant stadium (size ≥ 30 g), obtained an average value of A_0 (maximum capacity), receiving feed mass in the digestive tract of about 2-3% body weight/day, with the recommended feeding interval of 1.89 equal to a twice a day, while the maximum time lag for the fish to be hungry (t) was at 12.8 hours.

Supplementary Materials: No supplementary materials

Author Contributions: Conceptualization, Kiki Haetami; Data curation, Kiki Haetami and Junianto; Formal analysis and Investigation, Kiki Haetami and Iskandar; Project administration and Methodology, Kiki Haetami and Abun; Resources, Abun and Junianto; Validation, Kiki Haetami, Junianto, Abun and Iskandar; Visualization, Kiki Haetami; Writing – original draft, Abun; Writing – review & editing, Kiki Haetami, Junianto and Abun.

Funding: This research was funded by the Ministry of Research and Technology/National Research and Innovation Board to approve this research through Research funded by the 2020 Fiscal Year Budget.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.
Data Availability Statement: Not applicable.

Acknowledgements: Researchers would like to thank the Chancellor and Director of Research and Community Service and Innovation, Padjadjaran University, and the Dean of the Faculty of Fisheries and Marine Science, Padjadjaran University, who has given the confidence to do this research.

Conflicts of Interest: The authors declare no conflict of interest.

Abbreviations: PC, paring coconut; CN, candlenut; SFA, saturated fatty acid; UFA, unsaturated fatty acid; BW, body weight; ADG, average daily gain; SGR, specific Growth Rate; D, estimate of feed intake; PER, protein efficiency ratio

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