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The Effects of Fermented Kapok (*Ceiba petandra*) Seed Meal Diet in Growth and Survival Rate of White Shrimp (*Litopenaeus vannamei*) Juvenile

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ABSTRACT

Kapok seed meal (KSM) is a side product of kapok seed oil (KSO) processing and it can be used as protein source for shrimp feed. Unfortunately, the kapok seeds contain gossypol that plays as an anti nutrient substance and cyclopropenoic fatty acids, that could interfere the function of hepatopancreas, digestive enzymes and body fat composition. The gossypol can be eliminated by microbial activity namely the fermentation proocess. This research aims to understand the effect of fermented kapok (*Ceiba petandra*) seed meal the addition in the diet white shrimp (*Litopenaeus vannamei*) juveniles on growth and survival rate of the shrimp. The shrimp were maintained in aquarium with a density of 15 shrimps/aquarium for 42 days. There were 4 treatments applied (3 repetition/ treatments). The control shrimp was feed on commercial pellet and they was not provided with KSM (Diet 4); while the feed of shrimp in Diet 1, Diet 2, and Diet were provided with 10, 20, and 30% of the fermented KSM. Specific growth rate, feed convertion ratio and survival rate were evaluated. Results shown that there was no different in weight gain, specific growth rate and survival rate of the shrimp, while feed convertion ratio was different diet and the best result was found in Diet 1 (2.44 ± 0.23%).

***Keywords**: fermented kapok seed meal, white shrimp, growth, survival rate*

INTRODUCTION

Feed is a very important factor in determining the success of shrimp farming and must be met in order to maintain the viability of shrimp. In intensive shrimp farming led to heavy reliance on the use of artificial feed. According to Suprayudi (2010), arround 48-89% of the production costs are generally used for artificial feeding. High feed prices caused by the high price of fish meal and soybean meal as a protein source that is both imported raw materials. Therefore, there must be alternative local raw materials that have cheaper prices than that of the imported materials, abundant and continuously available. The use of this materials is expected to reduce or even replace the use of imported raw feed materials (Suprayudi, 2010).

An alternative to overcome the high cost of feed problem is by using the alternative feed ingredients that have high nutritional content such as kapok (*Ceiba petandra*) seed meal. Kapok seed meal is a source of vegetable protein which can be used as a source of protein in shrimp feed. The addition of kapok seed meal in white shrimp feed have been applied. According to Utami (2008) the addition of kapok seed meal as much as 30% of artificial feed causing mass death in white shrimp juvenile and it is happened in day - 6. The feed that contain kapok seed meal may decrease the activity of protease, lipase and amylase enzymes as well as damaging the hepatopancreas (Muskita, 2012[ab]). A decrease in the activity of the protease, lipase and amylase enzyme in juvenile white shrimp is caused by toxic materials, they are the gossypols and cyclopropenoic fatty acids. As a consequence, the kapok seed meal might be used as a source of vegetable protein for white shrimp, as long as the

content of cyclopropenoic fatty acids and gossypol is reduced by involving the microbial fermentation.

Fermentation is a chemical change process of organic substrates which took place in the presence of catalysts of biochemical enzyme which is produced by certain microbes. Some research was done to eliminate toxic compounds and nutrition factor contained in kapok seed meal. Bani (2013) has been use kapok seeds meal fermented with rumen fluid of sheep as much as 30%, and can be used as a substitute for soybean meal in feed *Collosoma macropomum.* Kapok seed meal fermented using *Aspergillus niger* decreased content of crude fiber content of 25.67% to 18.23% (Akmal and Mairizal, 2003). This study aims to determine the effect of substitution of soybean meal with fermented kapok seed meal in the diet of white shrimp (*Litopenaeus vanamei*) juvenile.

MATERIALS AND METHODS

Time and place. This study was conducted for 3 months at the Laboratory of the Faculty of Fisheries and Marine Sciences Halu Oleo University, Kendari. The fermentation of kapok seed meal is done in the Chemistry Laboratory, Mathematics and Science Faculty , while the proximate analysis was caried out in the Faculty of Fisheries and Marine Sciences Halu Oleo University, Kendari.

Experimental diets. Five experimental diets were formulated, to substitute the soybean meal with the fermented kapok seed meal. The kapok seed used was originated from Pandaan Sub Didtrict, Pasuruan, East Java. Prior to the experiment, the kapok seed was fermented with yeast that commonly used for bread fermentation (Fermipan) for 3-5 days. The composition of feed ingredient is presented in Table 1. Diet 1 contained 300 g.kg-1 soybean meal (SBM) and 100 g.kg-1 kapok seed meal (KSM); diet 2 contained 200 g.kg-1 SBM and 200 g.kg-1 KSM; diet 3 contained 100 g.kg-1 SBM and 300 g.kg-1 KSM. Diet 4 is commercial feed as control.

Tabel 1. Formulation of the experimental diets and results of proximate analysis of the diet

Dietary Ingredients	Experimental diests (g.kg-1)		
	Diet 1	Diet 2	Diet 3
Fish Meal	240	240	24
Head shrimp meal	240	240	24
Soybean meal (SBM)	300	200	100
Fermented kapok seed meal (KSM)	100	200	300
Corn meal	10	10	10
Fine brain meal	50	50	50
Wheat flour	10	10	10
Tapioca meal	10	10	10
Sagoo meal	10	10	10
Fish oil	5	5	5
Squid oil	5	5	5
Mineral vitamin mix	20	20	20
Total	1000	1000	1000
Results of proximate analysis			
Moisture	116,1	118,4	101,1
Crude protein	350,9	340,6	339,8
Crude Lipid	123,1	114,1	108,8
Ash	94,3	94,4	100,1
Fiber	98,1	114,2	148,7
NFE	217,5	218,3	201,5

Source : Laboratory of the Faculty of Fisheries and Marine Sciences Halu Oleo University, Kendari, 2015

Diet analysis. All experimental diets were analyzed to determine the percentage of moisture, protein, lipid, fiber and ash. Moisture was determined by drying 2-g sample using a convection oven (135 °C) for 2 h, until the constant weight was achieved (AOAC 1995; procedure 930.15); protein was determined by the combustion method (AOAC 1995; procedure 990.03); lipid was determined by the acid hydrolysis method (AOAC 1995; procedure 954.02); fiber was determined by using the fitted-glass crucible method (AOAC procedure 962.09) and ash was determined by placing a 2-g sample in a muffle furnace (600°C) for 2 h (AOAC 1995; procedure 942.05). The nitrogen-free extract (NFE), i.e., carbohydrate, was determined by the deference [NFE ¼ 1000) (protein + lipid + fibre + ash)].

Experimental System and Feeding. Twelve aquarium (60x50x40 cm^3) was used to maintenance the shrimp for 42 days, by using water recirculation system. Every two days arround 30% of water in the reservoir was change. To provide comfortable rearing area for the shrimp, the aquarium was cover by black plastic. Water quality during the maintenance period were as follow: temperature range from 27.5 and 29.5 °C, dissolved oxygen content ranging from 4.5 and 5.0 ppm and a pH ranging from 7.5 and 7.8. The shrimp reared at a density of 15 shrimp/aquarium and fed for satiation 4 times a day (at 06.00 am; 12.00; 18.00 and 22.00 pm). Juvenils were obtained from the Kolaka district in South East Sulawesi and stocked at an average weight 2,54 ± 0,16 g. Sampling was conducted once in two weeks to measure weight gain, specific growth rate (SGR), feed convertion ratio (FCR), and survival rate (SR). To evaluate the quality of diet were calculate the parameters biology by equation as follow :

Weight gain (g) = final weight – initial weight
Specific growth rate, SGR (%) = (Ln final weight-Ln initial weight)/t x 100
Survival rate (%) = number of final shrimp/number of initial shrimp x 100
Feed convertion ratio (FCR) = dry feed intake/wet weight gain

Data analysis. The data were anaysis for mean gain (g), survival rate (%), feed convertion ratio (FCR). All data were analyzed statistically by using one-way analysis of variance (program SPSS version 17.0 for Windows). Differences between treatments can be seen through the test results using the F test (variance) with a confidence interval of 99% or 95%. If the F test provides significantly different results, it is continued with Duncan test.

RESULT AND DISCUSSION

Result. The results of weight gain, Specific growth rate (SGR), feed convertion ratio (FCR), and survival rate (S) were represented in Table 2 .

Table 2. Growth performance of juvenil white shrimp during experiment

Parameters	Treatments			
	Diet 1	Diet 2	Diet 3	Diet 4
Weight gain (g)	2,64 ± 0,02[a]	2,38 ± 0,32[a]	1,92 ± 0,33[a]	2,41 ± 0,03[a]
SGR (%)	1,69 ± 0,25[a]	1,54 ± 0,20[a]	1,31 ± 0,16a	1,63 ± 0,18[a]
FCR	2,44 ± 0,23[a]	2,35 ± 0,21[a]	2,28 ± 0,27[a]	1,70 ± 0,24[b]
Survival rate (%)	100	100	100	100

Note : diet 4 commercial diet containing crude protein 330 g.kg-1

The greatest weight gain was observed in the shrimp fed diet 1 (2.64 ± 0.02) and the lowest was in diet 3 (1.92 ± 0.33). The highest of SGR was obtained in the shrimp diet 1(1.69 ± 0.25), and followed by the shrimp fed diet 4 (,63 ± 0,18), diet 2 (,54 ± 0,20) and diet 3 (1,31 ± 0,16) respectively. The highest FCR was found in shrimp fed diet 1 (2.44 ± 0.23), while the lowest was obtained in shrimp fed diet 4 (1.70 ± 0.24). Based on the analysis statistically showed that no

significantly differences (P>0,05) between the shrimp fed diet 1, diet 2, diet 3 and diet 4 on the weight gain, SGR and SR. The shrimp fed diet 1, diet 2, diet 3 and diet 4 were significantly different for FCR (P<0,05).

Discussion. The use of kapok seed meal has been used in research on growth of white shrimp and fish, but its use is still very limited because the content gossypol and cyclopropenoic fatty acids contained in the kapok seed. Muskita (2012[c]) suggests the use of kapok seed meal in shrimp feed up to a limit of 5%, if exceeded will result in damage hepatopancreas, digestive enzyme activity, and changes in the composition of unsaturated fatty acids become to saturated fatty acids. Hendricks and Bailey (1989) states that the rainbow trout (*O. mykiss*) were fed a cyclopropenoic fatty acid can inhibit of system desaturation and its consequency affect fat metabolism. Various ways have been made to reduce the content of cyclopropenoic fatty acids and gossypol include physically and chemically. The reduction physically of gossypol and cyclopropenoic fatty acids is by heating, but it is feared could damage the protein content, while chemically using a solvent is a expensive and too dangerous if it remains can be contaminated with harmful organisms feed. The reduction biologycally is done by using microbial fermentation, and this method was more effectif and cheap.

In this study, not given how much content cyclopropenoic fatty acids and gossypol in kapok seed meal fermented. The analysis of laboratory chemistry Faculty of Mathematics and Science University of Halu Oleo on kapok seed meal (2015), indicate where the kapok seed meal fermented qualitatively show a color change from black to yellow. This indicates that there is a decrease gossypol content and cyclopropenoic fatty acids in kapok seed meal fermented.

This study shows that the feeding of diet 1 (300% SBM and 100% KSP) providing the best weight gain and SGR probably due to the better nutritionally quality of diet 1, especially containing higher dietary protein value contained compared to the others diets. Afrianto and Liviawaty (2005) and Mohsen & Lovel (1990) suggested utilization of optimum protein is important in fish culture to support the growth and survival rate. Increasing the number of kapok seed meal content in the feed gives a decrease of the weight gain and SGR. Because to increase the content of KSM can be contributed content cyclopropenoic fatty acids and gossypol in the diet, so the impact on growth of shrimp. Muskita (2012[c]) suggests an increase in the number of KSM content of more than 5% in the diet can inhibit the growth and resulted in a decrease in the activity of digestive enzymes, decreased palatability rate. Roehm et al. (1967) states that the rainbow trout were added 1% gossypol in feed cause fish growth declined by about 50% compared with controls. While the fish with the addition of 2% acetic gossypol in feed cause fish would not eat.

CONCLUSION

In white shrimp juvenile diet, the fermented kapok seed meal can be used as an alternative protein source to substitute the soybean meal as much as 20 percent.

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