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EFFECT OF THE REPLACEMENT OF FISH MEAL WITH GOLDEN SNAIL MEAL ON THE GROWTH AND FEED EFFICIENCY OF CATFISH, *Clarias gariepinus*[1]

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Abstract

This study was conducted to determine the effect of replacing fish meal (FM) with snail meal (SM) in the diet on the growth and feed efficiency catfish. Five diets were prepared based on percentage of replacement between FM and SM from 0 to 100%. A total of 300 juvenile were distributed into 15 tanks (20 juveniles/tank) and they are reared for 45 days. Results showed the catfish fed on diet A (100% FM), diet B (75% TM; 25% SM) and diet C (50% FM: 50% SM) had higher weight gain compared with the catfish fed diet D (25% FM: 75% SM) or diet E (100% SM). Protein retention was found highest in the catfish fed diet E. In conclusion, FM could be replaced up to 50% with SM in the diet without compromising the growth and feed efficiency of catfish.

Keywords: *Replacement, fish meal, golden snail meal, catfish, Clarias gariepienus*

INTRODUCTION

In semi-intensive and intensive culture of fish, including catfish, artificial feeds are an important nutrient source. . The feeds must be nutritionally adequate and economical for the system culture. Feed is the major cost variable in shrimp aquaculture representing up to 60% of total costs (Akiyama et al., 1992; Sarac et al., 1993). Until now, fish meal (FM) has been known as not only being in high presentation in the formulated diet but also as an expensive ingredient of protein source. Fish meal is an excellent but costly protein source for a formulated diet because it has a higher level of protein, digestible amino acid, vitamin and mineral than other protein sources.

Since fish meal is the most expensive of feed ingredients, research in feed formulation is currently concentrated on investigations of various economical protein sources and reducing fish meal level is the key to reducing feed cost for commercial fish farming and ensuring sustainability of this enterprise. It is essential to evaluate the suitability of alternate plant or animal protein meals as dietary protein sources for economically fish species cultured.

One of the alternative protein sources that can be used in the formulated diet is golden snail meal (GSM). The golden snail, locally known as " keong mas" . The snails found their way into rice fields in Indonesia and have caused alarming losses in newly transplanted rice seedlings (Madamba and Lamaya, 1987). Similar damage has also been reported in Barbados, Bolivia, Brazil, Columbia, Guadeloupe, Surinam, Taiwan, Trinidad, and Venezuela (Tanzo and Barroga, 1989). Chemical control of golden snails is hazardous to the environment; hence their economic utilization should be further explored. They grow and reproduce very rapidly and one snail can produce 1000-1200 eggs/month with 80% hatchability. The golden snail meal contain 61% protein, 7% lipid and 4.5% fiber (Murtidjo, 2001), while Koswara (2008) found that the protein content of golden snail was 59.3%. However, the information of using golden snail meal as a protein source in artificial diet is restricted. The present study used golden snails in the diet of catfish growth, survival, production, and feed efficiency, as well as the costs and returns.

MATERIALS AND METHODS

Experimental diets

The five experimental diets were formulated to contain decreasing amounts of FM and increasing amounts of GSM. The ingredient compositions of the diets are presented in Table 1. Diet 1 was formulated to be similar with a commercial diet containing 0 $g.kg^{-1}$ GSM and 600 $g.kg^{-1}$ FM; diet 2 contained 150 $g.kg^{-1}$ GSM and 450 $g.kg^{-1}$ FM; diet 3 contained 300 $g.kg^{-1}$ GSM and 300 $g.kg^{-1}$ FM; diet 4 contained 450 $g.kg^{-1}$ GSM and 150 $g.kg^{-1}$ FM and diet 5 contained 600 $g.kg^{-1}$ GSM and 0 $g.kg^{-1}$ FM. Because of the differences in the proximate composition of the dietary ingredients from tubular values, diets varied somewhat in actual chemical analysis from calculated values, especially in dietary protein value of the diet.

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

Dietary ingredients	Experimental diets (g.kg-1)				
	A	B	C	D	E
Sardine fish meal	600	450	300	150	0
Golden snail meal	0	150	300	450	600
Rice brain meal	100	100	100	100	100
Sago meal	200	200	200	200	200
Fish oil	50	50	50	50	50
Top mix	50	50	50	50	50
Total	1000	1000	1000	1000	1000
Results of proximate analysis					
Moisture	3.95	4.11	4.36	2.93	5.37
Crude protein	42.4	38.8	37.9	36.7	35.8
Crude lipid	9.50	9.50	9.40	8.57	6.59
Ash	10.3	9.74	8.91	6.21	5.78
Fiber	19.3	22.8	24.9	26.3	36.5
Phosphorus	368.1	277.2	167.6	215.9	230.3

(Source : Analytic Laboratory, Faculty of Mathematics and Science Halu Oleo University)

Diet analysis

Diets were analyzed to determine percentage moisture, protein, lipid, fiber, and ash. Moisture was determined by placement of a 2-g sample into a convection oven (135 ^{o}C) for 2 h until 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 ^{O}C) for 2 h (AOAC 1995; procedure 942.05).

EXPERIMENTAL SYSTEM AND FEEDING

The feeding trial was conducted in 15 glass tanks (50 x 30 x 40 cm3) located in the Wet Laboratory, Faculty of Fisheries and Marine Science, Halu Oleo University. Water was replaced and filled manually to approximately 40% of water volume the day before. Juveniles were obtained from Center of Fish breeding, Department of Fisheries and Marine Affairs, Kendari Southeast Sulawesi and stocked at an average weight (±SD) of 3.2 ± 0.04 g. Twenty fish were randomly stocked into each tank with three replicates per treatment. Fish were reared for 42 days and fed the fish meal till satisfaction in three times a day (08.00; 12.00; 16.00).

The five experimental diets consisting of the five treatments were arranged using a completely randomized design technique with three replications (tanks) per treatment. Sampling was conducted once in two weeks to measure weight gain, specific growth rate (SGR), feed conversion ratio (FCR), feed efficiency (FE) and survival rate (SR). Biological parameters used to evaluate the quality of diets were calculated by equations as follows:

Weight gain (g) = *final weight - initial weight*
Survival (%) = *number of final fish/number of initial fish X 100*
Feed conversion ratio (FCR) = *dry* feed intake/wet weight gain

Data analysis

The data were analyzed for mean weight gain (%), survival (%), dry matter feed intake (g/fish), feed conversion ratio (FCR),. All data were statistically analyzed using one-way analysis of variance and multiple comparisons among treatment means were made with the Tuckey test method using the Interactive Statistical Analysis Pro- gram, (Statistics 4.O/PC program, Analytical Software, USA). Covariate ANOVA was produced with SPSS/PC fv 4.0.1. Results were considered statistically significant at $P < 0.05$.

RESULTS AND DISCUSSION

Results

After 42 days of rearing, the results of weight gain, specific growth rate (SGR), feed conversion ratio (FCR), feed efficiency (FE), protein retention (PR) and survival rate (SR) were represented in Table 2 as follow:

Table 2 Growth performance and feed efficiency of catfish during experiment

Para-meters	Treatments				
	A	B	C	D	E
Weight gain	18.9±0.07[a]	18.6±0.35[a]	18.5±0.05[a]	18.2±0.19[ab]	18.1±0.09[b]
SGR	4.38±2.61	4.22±2.59	4.28±2.68	3.76±2.63	4.12±2.60
FCR	0.30±0.00[a]	0.29±0.00[b]	0.28±0.00[c]	0.27±0.00[d]	0.26±0.00[e]
FE	3.28±0.02[e]	3.35±0.06[d]	3.50±0.01[c]	3.59±0.05[b]	3.81±0.04[a]
PR	1.64±0.21[a]	1.63±0.06[a]	1.62±0.01[a]	1.44±0.26[a]	0.74±0.03[b]
SR	100	100	100	100	100

No significant difference was observed in the weight gain caused by feed treatments. The greatest weight gain was observed in the fish fed diet A at 19.8 g weight gained and followed in the fish fed diet B (18.5g), diet C (18.5 g), diet D (18.2) and diet E (18.1 g), respectively.

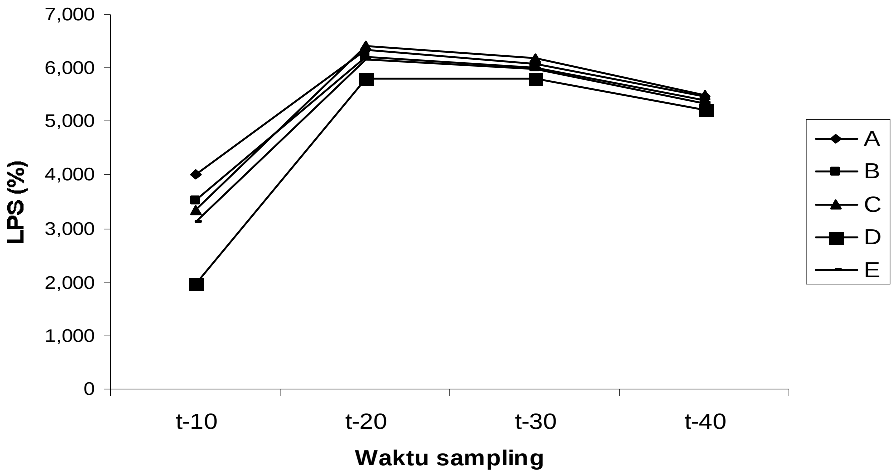

Fig.1 Specific growth rate (SGR) of the catfish during the experiment

The highest of feed conversion ratio was obtained in the fish fed diet A (0.30), and followed by the fish fed diet B(0.29), diet C(0.285), diet D(0.28) and diet E (0.26), respectively. There were significantly different results found in the feed conversion ratio caused by different diets. Feed conversion ratio in the fish fed diet A was significantly different with the fish fed diet C, the fish fed diet D or the fish fed diet E, however, it was not significantly different with the fish fed diet B.

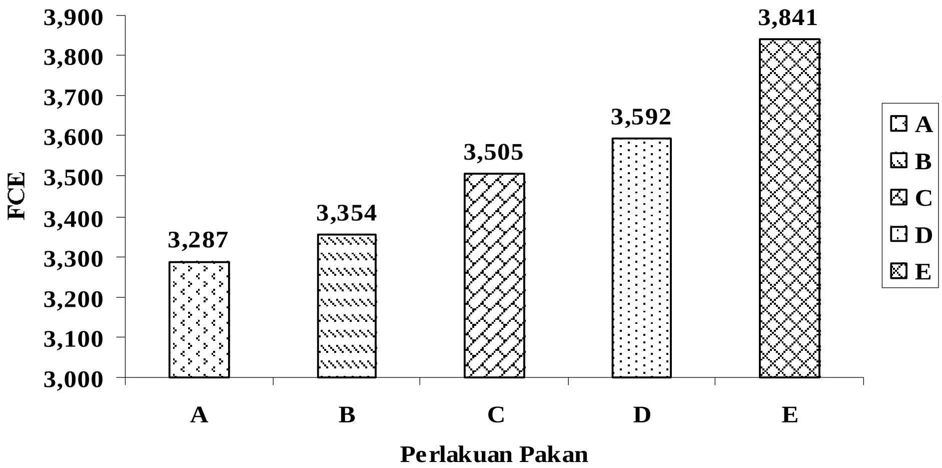

Fig.2 Feed efficiency of the catfish during the experiment

The fish fed diet E has the highest feed efficiency compared to the others. In addition, results of ANOVA showed that FE was significantly different between treatments. The fish fed diet E was significantly different compared to the fish fed diet A, diet B, diet C and diet D. The highest of protein retention was observed in the fish fed diet A (1.64%) and followed in the fish fed diet B (1.63%), diet C (1.61%), diet D (1.44%) and diet E (0.75%), respectively.

DISCUSSION

Most studies have showed that the growth performances of fish decreased when the fish meal was replaced by another animal protein sources meal such as golden snail meal because of their low palatability, poor use of protein and some anti-nutrition factors (Mohsen & Lovell 1990; Boonyaratpalin et al. 1998; Xie and Cui 1998). In the present study, the results of proximate analysis of test diet showed the dietary protein (DP) ranged between 35.8 % to 42.4% which containing of optimum levels for optimum growth of catfish (Mangalik, 1982). Catfish fed the diet E exhibited higher SGR than fish fed the diet D, but showed lower than fish fed diet A, diet B and diet C containing higher in DP than diet E.

The fish given 100% FM attained significantly (diet A) better weight gain, SGR and FCR probably due to the better nutritionally quality of diet A especially containing higher dietary protein value contained compared to other diets. Afrianto and Liviati (2005) suggested utilization of optimum protein is important in fish culture to support the growth and survival rate. But high protein was not enough and snails alone did not support good fish growth.

This study shows that golden snail is a useful alternative source of protein that is cheap and locally available. Snails with cassava yield a higher net income and a higher ROI than maize, which the local fish farmers use. A kilo of golden snail meat costs P5.80, which is cheaper than "trash fish" which costs P8-15. Golden snails are now considered as pests in rice fields. DA-FAO (1989) recommends some physical, mechanical, and biological measures to control snails. However, snail infestation still poses a threat to rice farmers. Enough snails are available in rice fields only during the rainy season. But there are other sources, like rivers. Only existing sources must be tapped. The culture and mass production of golden snails to be used as catfish feed must not be encouraged otherwise the problem of infestation will never be solved. Feeding snails to catfish may not be a long-term solution, but in meantime the farmers can use these pests while seeking for more efficient eradication techniques. Collection of snails can be an additional or alternative livelihood for rice farmers or fisher folk, and also employ out-of-school youth. Since insecticides are applied to rice fields, studies should be done to determine the safest time to collect the snails. In conclusion, feeding catfish with golden snails meal as protein source to replace fish meal in the diet could increases catfish production and improve the feed efficiency.

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