EFFECT OF DIETARY CASSAVA MEAL ON GROWTH OF MUD CRAB, *Scylla paramamosain*

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ABSTRACT

It is widely recognized that a major constraint to development of a mud crab aquaculture industry is the availability and formulation nutritionally adequate but relatively low cost diets. Development of artificial diets, which seek to minimize inclusion of expensive feed ingredients such as fish and terrestrial meals, is considered to be a priority for improving the profitability of this emerging industry. Typically, carbohydrates such as starches are relatively cheap and therefore offer opportunity to supply dietary energy at low cost. The study examines the capacity of mud crab, *Scylla paramamosain* to utilize a range of dietary cassava meal as carbohydrate source. Four levels of cassava meal were used at inclusion levels of 0%, 10%, 20%, and 30% in diets. Mud crabs will readily accept the diet containing relatively high levels of cassava meal. This experiment proved that mud crab which fed 10% dietary cassava meal gains weight more than the one fed diet without dietary cassava meal. The increasing level of cassava meal to more than10% in diet reduced final weight and weight gain. To some extent, mud crab, *Scylla paramamosain* is capable to use dietary carbohydrate from cassava meal. The finding raises the possibility to include 10% cassava meal in formulation low cost diet for mud crab.

KEYWORDS: cassava meal, mud crab, growth

INTRODUCTION

The scylla genus provides a source of income and fresh food for many coastal fishery communities in the Indo-Pacific region and is viewed as luxury item in many places where it is appreciated for taste and texture. Development of mud crab aquaculture is encouraged in its fisheries that can provide growth while reducing impacts on wild stocks (Pavasovic *et al.*, 2004).

Mud crab aquaculture has been traditionally practiced from long time ago in Indonesia, and for at least 100 years in China (Yalin & Quingsheng, 1994). At present, constrain to develop mud crab culture is the availability of low cost diets (Fielder, 2004). Although mud crab aquaculture has been practiced for long time ago, information of nutritional requirement for mud crab is still limited (Quinitio, 2004). Therefore, research feed development for mud crab should be encouraged the research institutions belong to government and feed industry.

Some report showed that crustaceans could digest key nutrients in their diets such as protein, lipid, and carbohydrate. Carbohydrate is cheaper energy source compared to protein. Plants carbohydrate has been identified as the least expensive potential source of dietary energy for human and domestic animal (Edward *et al.*, 2004). Inclusion of dietary carbohydrate in aquafeeds can reduce in operating costs in mud crab culture. In Indonesia, potential source of dietary carbohydrate in development of feed for mud crab is cassava meal. The aim of the current study was to examine the capacity of the mud crab, *Scylla paramamosain* to use the carbohydrate from cassava meal for the growth.

MATERIALS AND METHODS

The study was conducted at Gondol Research Institute for Mariculture. Mud crab juveniles (crablets) were produced in a hatchery with oval tanks of 5 m^3 volume. 112

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juveniles with average initial body weights of 0.32 ± 0.01 g and carapace widths of 1.32 ± 0.09 cm were reared individually using 3 inch pvc with 30 cm length in 30 L tanks equipped with flow through system and aeration. Seven juvenile mud crabs were reared in each tank. The experiment was done in complete random design (CRD) with 4 treatments and 4 replications.

Cassava meal was prepared in laboratory. Raw cassava was cut in thin peaces and dried in 80°C oven. After it dried and made meal. Particle size of cassava meal was d" 250µ. Levels of cassava meal in experimental diets were 0%, 10%, 20%, and 30%. All diets were dried in a freeze dryer. The composition of experimental diets is shown in Table 1. Crabs were fed 8% body weight in first 4 weeks and 5% in second 4 weeks. Those crab were feed twice a day for 8 weeks. Crabs were measured for body weight individually each week. All data were analyzed by one-way ANOVA and differences between means treatment were considered significant at $P<0.05$ (Steel & Torrie, 1980).

RESULTS AND DISCUSSION

Figure 1 presents the response of mud crab juveniles, in term of average body weight, to diets containing different levels of cassava meal. The trend of lower growth in crabs fed the experimental diets with 20%—30% of cassava meal was evident after 4 weeks. Mud crab fed diet with 10% cassava meal had trend better growth than it fed diet without cassava meal. This experiment showed that mad crab could utilize dietary cassava meal and require carbohydrate to support its growth.

Initial, final body weight and weight gain are shown in Table 2. Final body weights varied from 2.289 g to 2.884 g after 56 days. Analysis of variance showed that average weight gain and final body weights were significantly influenced by the amount of cassava meal in diets ($P<0.05$). This experiment showed that mud crab fed 10% dietary cassava meal (diet 2)

Table 1. Composition of experimental diets

No	Ingredients	Experimental diets			
		1	2	3	4
1	Cassava meal	-	10	20	30
2	Fuller earth	30	20	10	-
3	Fish meal	46.2	46.2	46.2	46.2
4	Squid liver meal	5	5	5	5
5	Head shrimp meal	2	2	2	2
6	Casein	5	5	5	5
7	Lecithin	1	1	1	1
8	Fish oil	2.7	2.7	2.7	2.7
9	Vitamin mix	2.5	2.5	2.5	2.5
10	Mineral mix	2	2	2	2
11	Gluten	1.6	1.6	1.6	1.6
12	CMC	3	3	3	3
Dietary analysis					
1	Protein (%)	42.19	41.72	42.3	42.8
2	Lipid (%)	7.69	7.57	7.86	7.75
3	NFE[1] (%)	3.74	13.18	19.84	28.25
4	Fiber (%)	34.08	25.08	17.45	8.23
5	Ash (%)	12.3	12.45	12.55	12.97

[1] Nitrogen free extract = 100 - (% crude protein + % crude lipid + % crude fiber + % ash)

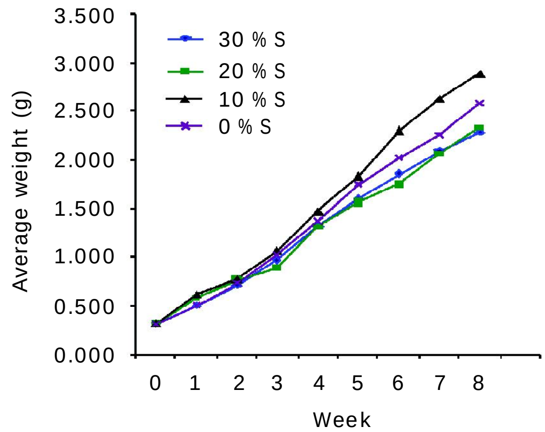

Figure 1. Developments of body weigh of mud crab juvenile

had higher weight and weight gain than without dietary cassava meal (diet 1). The increasing level of cassava meal > 10% in diet reduced final weight and weight gain. This result shows that the level of cassava meal for growth of mud crab is not more than 10% percent in the diet. The other hand, mud crab, *Scylla paramamosain* might utilize dietary carbohydrate from cassava meal.

Mud crab fed diet with level of 0%, 10%, 20%, and 30% of cassava meal had not significantly different weight gain (P<0.05). This experiment showed that all experimental diets could be except by juvenile of mud crab (Table 3).

Cassava meal in diet affected feed conversion rate of mud crab, *S. paramamosain* (Table 3). This experiment showed that mud crab fed 10% dietary cassava meal had the better FCR than its fed 30% dietary cassava meal but increasing level of cassava meal > 10% in diet had trend increased FCR. This result shows that the level of cassava meal in diet for mud crab is not more than 10% percent.

Protein efficiency was affected by cassava meal content in diets (Table 3). Analysis of variance (Table 3) showed that protein efficiency values of some levels of cassava meal in diets were significantly different (P<0.05). Dietary cassava meal of 30% had lower protein efficiency than 0% and 10% of dietary cassava meal. While 0%, 10%, and 20% of dietary cassava meal had the similar protein efficiency (P<0.05).

This experiment showed that mud crab, *Scylla paramamosain* can utilize dietary cassava meal (Table 2). Cassava meal is potential to use as carbohydrate source in mud crab diet. Some researcher found that mud crab belong to omnivores or carnivores base

Table 2. Initial, final body weight (g) and weight gain (%) of mud crab fed experimental diets

Treatments	**Average of initial body weight (g)**	**Average of final body weight (g)**	**Weight gain (%)[1]**
30% cassava meal	0.34	2.289 ± 0.162[a]	603.25 ±10.688[a]
20% cassava meal	0.34	2.322 ± 0.195[a]	638.83 ± 62.058[a]
10% cassava meal	0.34	2.884 ± 0.073[c]	817.95 ± 23.045[c]
0% cassava meal	0.34	2.577 ± 0.055[b]	720.20 ± 17.64[b]

Mean in column with same superscript are not statistically different (P>0.05)

[1] Weight gain (%) = [(final body weight - initial body weight)/initial body weight)] x 100

Table 3. Feed conversion rate and protein retention on mud crab fed experimental diets

Levels of cassava meal in diets (%)	Survival rate (%)	FCR[1]	Protein efficiency[2]
30	100[a]	1.30 ± 0.08[b]	1.81 ± 0.05[a]
20	96.4[a]	1.29 ± 0.10[ab]	1.87 ± 0.07[ab]
10	96.4[a]	1.16 ± 0.08[a]	2.29 ± 0.13[b]
0	100[a]	1.19 ± 0.19[a]	2.27 ± 0.43[b]

Mean in column with same superscript are not statistically different (P>0.05)

[1] FCR = Total feed intake (g)/biomass gain (g)

[2] Protein efficiency = [(body weight at the end – initial body weight)/protein intake]

on the presence of plant-based materials in foregut (Hill, 1976; Tacon & Akiyama, 1997) and preference for natural diets containing mollusks, crustaceans, and dead fish (Hill, 1976). The other reports showed that mud crab could digest carbohydrate that was shown relatively high levels of amylase activities in digestive tissues (Brethes *at al*., 1994; Willson, 1994; Pavasovic *et al*., 2004). And also Catacutan *et al*. (2003) found that mud crab can digest fiber and ash very well. Previous results have also demonstrated that the dietary requirements of this species are not nearly as stringent as those of most penaeid prawns, with good growth occurring over a wide range of protein and lipid levels (Catacutan, 2002).

The most content of cassava meal is starch. Starch's have been used in previous studies, especially for shrimp (Gaciola *et al*., 2005), lobster (Johnston *et al*., 2003) and mud crab (Catacutan *et al*., 2003). Digestility of starch varied with botanical origin and starch treatment (Cousin *et al*., 1996; Stone *et al*., 2003).

Table 2 showed that increasing level of cassava meal > 10% reduce weight gain. This result indicated that level of cassava meal might affect absorbed ratio of nutrient. Some result of experiments (Causin *et al*., 1996; Sales & Britz, 2002) showed that digestibility of protein is affected by the inclusion of starch in diets, although the effect of starch varies among species and sources. Pavasovic *et al*. (2004) reported that mud crab highly digested dietary carbohydrate in formulated diets.

Inclusion of digestible dietary carbohydrate in aquafeeds can reduce in operating costs in mud crab culture as diets account for about 40%—50% of the total operating cost (Quinitio, 2004). Based on previous study, inclusion digestible carbohydrate has been recommended up to 20% in diet for many carnivorous species of salmonids, marine fish and crustacean and up to 40% for warm water omnivorous species (Wilson, 1994; Catacutan & Coloso, 1997).

Considering the increasing cost of fish meal and doubt concerning its long-term availability, much research has been carried out to find alternative feed ingredient for feed formulation that it could be more efficiently used fish meal in mud crab diet. Based on its' growth, it is proposed that cassava meal is a suitable ingredient to use in formulated diets for mud crabs.

ACKNOWLEDGEMENTS

Financial assistance was provided through Assessing the Potential for Low Cost Formulated Diets for Mud Crab Aquaculture in Australia, Indonesia & Vietnam (Project No. FIS/2000/065) from ACIAR for which we are most grateful.

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