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What is the Best Proportion of Fish Meal and Soybean Meal for Better Growth and Survival of *Macrobrachium rosenbergii* Post Larvae?

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ABSTRACT

The effect of partial and complete substitution of fishmeal (FM) for Soy Bean Meal (SBM) on the growth and survival of *Macrobrachium rosenbergii* were studied. Post larvae (PL 28) with an average individual length (16.20±0.20 mm) and weight (0.032±0.002 g) were stocked in aquarium filled with 5.0 L of water for a period of eight weeks. Six types of diets with different percentage of FM:SBM ratios were formulated and fed to the test animals at the ratio of 0:100, 20:80, 40:60, 60:40, 80:20, 100:0 (diet 1-6, respectively). Significant differences in terms of body weight and orbital length of animal were observed between diets 2, 3, 4, 5 and diets 1 and 6. Larvae fed with diet 3 produced the highest mean weight gain 0.711 g. There was no significant difference in weight gain observed in experiment provided with diet 2, 4 and 5 (~0.4-0.5 g). Larvae fed with diet 1 and 6 showed less weight gain (~0.2 g) with highest percentage of survival (70%) in diet 6 experimental tank. Food Conversion Ratio (FCR), Protein Efficiency Ratio (PER) and Specific Growth Rate (SGR) were also calculated for each experimental diets besides analyzing their proximate composition. It can be concluded that soy bean (diet 3) could be used for the better growth of *M. rosenbergii* post larvae. It was also understood that complete removal or absolute utilization of fish meal (100%) in diet would directly affect the weight gain in fresh water prawn ($p<0.05$).

Key words: Fresh water prawn, soybean meal, experimental diets

INTRODUCTION

Macrobrachium rosenbergii, is one of the extensively studied fresh water prawn having received considerable attention for its utilization in aquaculture as a candidate species (New, 1995, 2002; Soundarapandian *et al*., 2008). These giant water prawns commonly inhabits low saline water bodies in tropical and subtropical zones and are benthophagic omnivore in feeding nature (Saifullah *et al*., 2005). Global aquaculture production of *M. rosenbergii* has increased about 9.5 fold during the past two decades (1987-2009) from 24058 tons to 229417 tons (FAO South West Indian Ocean Fisheries Commission, 2009). Shrimp feed is one of the factors to be considered to reduce shrimp production costs and thereby increasing profitability in aquaculture

practices to achieve this, high quality plant based protein by replacing fish meal is the promising approach to increase overall profitability (Oraporn *et al*., 2009).

Among plant protein sources, soybean meal probably give the most effective results in the replacement of fish meal in aquatic animal feeds and highly preferred due to its cost effective and worldwide availability. Moreover, soybean meal can give a balanced amino acid profile and more consistent composition (Tacon and Akiyama, 1997). However, soybeans can contain many anti-nutrients such as protease inhibitors, lectins, antigenic or estrogenic factors, oligosaccharides, which could cause low digestibility in animals (Montazer-Sadegh *et al*., 2008; Hung *et al*., 2008; Riyazi *et al*., 2009). Numbers of studies were attempted to replace Fish Meal (FM) with Soy Bean Meal (SBM) in fishes and crustaceans (Tidwell *et al*., 1993; Tacon and Akiyama, 1997; Jalal *et al*., 2000; Sivanandavel *et al*., 2007; Goda, 2007). However, the studies on its utilization as a formulated feed in fresh water giant prawn larvae are still scanty (Bello-Olusoji *et al*., 2006; Chowdhury *et al*., 2008). The present study was aimed to investigate the effect of different concentration of soy bean meal over the growth and survival of *M. rosenbergii* post larvae (PL28) in *in vitro* condition.

MATERIALS AND METHODS

M. rosenbergii with an average orbital length 16.2±0.20 mm and weight 0.03±0.002 g were collected from Gopeng, Perak and introduced into 60×30×30 cm concrete tanks containing fresh water. The experiment was conducted with six treatments with three replications per treatment. Each replicate contained 35 active post larvae of similar size and weight. Precautions were taken to reduce the error by adopting complete randomized design in all treatments. Initial body weight and orbital length of the prawns were recorded prior to commencement of the experiment. All the prawns were weighted individually every 2 weeks interval. Specific growth, survival rate were estimated following the method given by Jain *et al*. (2008). Food Conversion Ratio (FCR), Protein Efficiency Ratio (PER) and proximate composition were estimated following the method described by AOAC International (2003). Experimental diets were formulated to contain 40% crude protein. The compositions of the six experimental diets are presented in Table 1. Prawns were fed a percentage of body weight based on a feeding schedule reported by D'Abramo *et al*. (1989). All data on growth, survival, FCR, PER and carcass composition were analyzed using Analysis of Variance (ANOVA) test and the differences between the means were tested using Duncan's New Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The utilization of soybean meal (SBM) to replace high cost commercial feeds in various poultry fields were studied extensively (Ekenyem and Onyeagoro, 2006; Rowghani *et al*., 2007; Kalbande *et al*., 2009). However, the utilization of SBM for the better growth and survival of aquatic animals are still scanty (Adeniji, 2008). Hence, we studied the best proportion of fish meal with soybean meal for the better growth and survival of economically important giant water prawn larvae (*Macrobrachium rosenbergii*). Growth, survival, food conversion ratio and protein efficiency ratio of *M. rosenbergii* fed with varying percentages of soy bean meal after 56 days of feeding is presented in Table 2. During the period of study, the post larvae fed with diet 2, 3 and 4 showed significant increase in their body weight compared to the post larvae fed with diet in the body weight between diet 1 and 6 ($p<0.05$). Diet 3 showed the highest mean final body weight with the value of 0.71 g followed by diet 4, 2, 5, 1 and 6 with values of 0.53, 0.5, 0.41, 0.26 and 0.22 g,

Table 1: Proximate composition of feed ingredients used in this study

	Diet					
Ingredient	1	2	3	4	5	6
Fish meal (55%)	0.00	17.02	32.65	47.06	60.38	72.73
Soy bean meal (45%)	88.89	68.09	48.98	31.37	15.09	0.00
Palm oil	1.50	1.50	1.50	1.50	1.50	1.50
Vitamin mix	1.00	1.00	1.00	1.00	1.00	1.00
Vitamin C	0.50	0.50	0.50	0.50	0.50	0.50
Mineral	1.00	1.00	1.00	1.00	1.00	1.00
CMC	3.00	3.00	3.00	3.00	3.00	3.00
Celufil	4.11	7.89	11.89	14.57	17.53	20.27
Protein	40.12	40.25	40.03	40.26	40.43	40.48
Lipid	1.38	2.93	4.74	4.45	5.39	6.35
Ash	23.44	23.14	18.41	17.95	24.75	24.77
Moisture	11.52	16.06	13.53	16.78	14.35	13.44
Fiber	0.62	0.79	0.83	0.81	0.76	0.68

CMC: Carboxymethyl cellulose

Table 2: Growth, survival, food conversion ratio, protein efficiency ratio and specific growth rate of *M. rosenbergii* fed with formulated experimental diets

Diet	Initial wt. (g)	Final wt. (g)	Total wt. gain (g)	Survival (%)	SGR (%/day)	FCR	PER
1	0.034	0.294±0.012	0.26	50.56^{b}	0.464±0.160^{b}	3.01±0.32^{a}	0.971±O.053^{a}
2	0.030	0.532±0.013	0.502	48.89^{b}	0.896±0.413^{a}	2.46±1.31^{a}	1.020±0.256^{a}
3	0.033	0.744±0.022	0.711	61.11^{a}	1.270±0.403^{a}	2.16±2.12^{a}	1.140±0.161^{a}
4	0.035	0.565±0.003	0.53	46.67^{b}	0.946±0.104^{a}	2.39±0.67^{a}	1.000±0.025^{a}
5	0.034	0.448±0.042	0.414	50.67^{b}	0.739±0.179^{a}	2.59±1.16^{a}	1.187±0.273^{a}
6	0.032	0.257±0.027	0.225	70.00^{a}	0.400±0.228^{b}	3.07±0.06^{a}	0.997±0.092^{a}

SGR: Specific growth rate, FCR: Food conversion ratio, PER: Protein efficiency ratio, Values in each column having the different superscripts are significant different ($p<0.05$)

respectively (Table 1). The specific growth rate of *M. rosenbergii* provided with diet 3 was higher and showed significant difference compared to other diets ($p<0.05$). The survival rate in diet 3 was similar to the post larvae fed with diet 6 which signifies the addition of SBM with fish meal has no significant role in enhancing the post larvae survival ($p>0.05$). Similar observation was recorded by Tidwell *et al.* (1993) and Hasanuzzaman *et al.* (2009) they observed higher survival rate during the utilization of soybean meal by replacing fish meal. Although, their study was primarily on adult *M. rosenbergii,* similar results were reflected in our study where sensitive post larvae were used. Recently, Cuvin-Aralar *et al.* (2007) found that post larvae of *M. rosenbergii* attained higher growth and survival rate in cage culture than those of ponds and tanks. There was no significant difference were observed in Food Conversion Ratio (FCR) and Protein Efficiency Ratio (PER) for all the treatments ($p>0.05$). It was also noted that the combination of soy bean meal and fish meal produced higher growth and survival rate in post larvae compared to the individual feeds. However, Forster and Beard (1973) have found that there was an increase in weight of *Palaemon serratus* when a complete substitution of fish meal with soy bean meal. They also observed that the decline in weight gain when the level of soy bean in formulated feed is increased or reduced by less than 40%. Abdel Rahman *et al.* (2010) found that the level of soy bean meal of 20-50% in diet have the ability to substitute fish and shrimp meal without any effect on the growth and survival of *Penaeus schmitti*, *P. setiferus* and *P. vannamei* during their study about replacement of fish meal

by soy bean meal. Similar observation was observed in present study where 3:2 (FM:SBM) gave better weight gain together with significant survival rate in *M. rosenbergii* post larvae in *in vitro* study.

CONCLUSION

In conclusion, 3:2 (FM:SBM) combination in formulated meal would give notable survival and better growth rate in *M. rosenbergii* post larvae together with better specific growth rate. The low price and local availability of SBM made the Diet-3 more potential for dietary cost savings. However, the maximum inclusion or complete adoption of SBM would substantially reduce the growth rate in post larvae. An extensive attempt should be made to replace regionally available fish meal with low coast plant based protein in order to achieve higher profit in *M. rosenbergii* culture.

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