

Growth, Survival Rate and Feed Conversion Ratio of Juveniles of *Macrobrachium rosenbergii* (de Man) Fed with Farm made and Commercial Feeds

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Feeding trial was conducted in *M. rosenbergii* to compare efficiency of the farm made feed (diet FMF) with commercial feeds like CP feed (diet A), Higashi feed (diet B), and Rosen feed (diet C). Dried clam meat was used as the control feed (diet D). Water stability of FMF is found well comparable with the above feeds. Higher specific growth rate was recorded in diet FMF (2.02) that did not vary significantly ($p>0.05$) among the dietary treatments except in diet D (1.15). Higher survival was recorded in diet FMF (91.07%) followed by diet A (90.48%), diet B (89.68%) and diet C (82.14%) while the survival of the juvenile of *M. rosenbergii* fed with control diet (37.5%) was significantly ($p<0.05$) lower compared to other treatments. Feed conversion ratio recorded for diet FMF was comparable with that of diets A and B. Protein efficiency ratio was significantly higher ($p<0.05$) in diet B (0.86), A (0.78) and FMF (0.77) when compared to diet D (0.31). Cost of diet A and B (200%), C (185%) and control diet (169%) was significantly higher than diet FMF. Results of the present study revealed that the growth, survival and feed conversion ratio of *M. rosenbergii* fed with farm made feed prepared from the locally available feed ingredients were comparable with those of commercial scampi feeds. As the farm made feed preparation was found very cost effective it can be recommended to the scampi farmers of Kerala to make farming more economically viable and feasible.

Key words : *Macrobrachium rosenbergii*, farm made feed, commercial scampi feed.

The giant freshwater prawn *Macrobrachium rosenbergii* is gaining importance for large-scale freshwater culture. Commercial farming of freshwater prawn can become successful when supplementary feeding is done with the help of efficient and cost effective feeds (New & Singholka, 1985). Supplementary feeds accounts for a major share of input in the farming of *M. rosenbergii* due to its prolonged culture period (8-10 months) compared to that of the penaeids for attaining prawns of marketable size. Development of artificial diets for *M. rosenbergii*, which is capable of producing satisfactory growth, has been a subject of in depth investigations in recent years (Menesveta *et al.*, 1984; Rao, 1995; Ravishankar & Keshavanath, 1986; Tidwell *et al.*, 1994). A variety of factory made feeds

are available for scampi culture. However, farm made feeds will be advantageous to the small-scale farmers as they are formulated taking into consideration the actual feed requirements, availability of feed ingredients and the financial soundness of the farmer. It will also facilitate the use of local feed ingredients of both plant as well as animal origin available in the vicinity. An attempt was made to compare the efficiency of the farm made feed prepared from the locally available feed ingredients with that of commercial feeds available in the domestic markets.

Materials & Methods

The feed ingredients (Table 1) were purchased from the local market. Wet ingredients were cooked for 15-20 minutes,

chopped dried and ground in an electric grinder and sieved through 300-micron sieve. They were weighed according to the feed formula (Table 1) and thoroughly hand mixed in large plastic basin. Then 10-20% (v/w) hot water was added and mixed well. The moist diet mixture was pelleted through 2.5 mm diameter die of a 2 HP electric motor-driven mini feed mill unit. The pellets were steam cooked for 10 minutes and then sun dried for 5-6 hrs and stored in plastic bags. Water stability of the pellets was determined for 2, 4 and 6 h period following the method of Maguire *et al.* (1988). Data were expressed as the loss of dry matter during 2, 4 and 6 h in fresh water.

Table 1. Percentage use of ingredients in the farm made feed (diet FMF) of *Macrobrachium rosenbergii*

Feed ingredients	inclusion level (g/100 g diet)
Clam meal	5
Beef meal	20
Shrimp head meal	5
Ground nut oil cake	15
Coconut oil cake	5
Rice bran	10
Vitamin and Mineral mix ^a	1
Vitamin C	0.1
Maida	38.9

^a Mineral and vitamin mix (mg/g mineral and vitamin mix) Vitamin A, 625 IU; Vitamin D3, 6.25IU; Vitamin E, 0.25 IU; niacinamide, 225 mg; thiamin mononitrate, 30 mg riboflavin, 30 mg; Folic acid, 50 mg; Biotin, 10 mg; pyridoxin HCL, 9 mg; D panthionate, 37.5 mg; Cynocobalamin, 0.045 mg; Ca, 280 mg P, 120 mg; Cu 0.2 mg; I, 1 mg; Fe, 6 mg; Mn, 1.2 mg; Se, 0.01 mg; Zn, 2 mg

Samples of three commercial scampi feeds such as CP Feed (Starter grade), supplied by CP Aquaculture, Thailand;

Higashi Feed (Higashi Fresh), Higashimaru Feeds (India) Ltd, Alapuzha, Kerala and Rosen Feed, Rosen Fisheries, Thrissur were used for the experiment. These feeds were procured during 1998-99 and tested with a view to examine their proximate composition and biological efficiency. The feed samples were packed in airtight containers and were stored in a freezer at -10°C till their use for feeding experiment. A farm made feed (diet FMF) was prepared using the locally available feed ingredients and dried clam (diet D) was used as control. Moisture, crude protein and crude fibre content were determined by AOAC (1990) methods. Crude fat was estimated by Soxhlet extraction with petroleum ether (BP 60-80°C) and the ash content was determined from the residue, which remained after the incineration of sample at 550°C in a muffle furnace. The nitrogen-free extracts (NFE) were computed by difference (Crompton & Harris, 1969). The energy was calculated on the basis of 9 kcal/g for fat, 4 kcal/g for protein and 4 kcal/g for carbohydrate (Maynard *et al.*, 1979).

M. rosenbergii juveniles, reared in the Prawn Hatchery Complex of the School of Industrial Fisheries, with an average weight of 0.106±0.03 g were used for the study. For each set of treatment triplicates were maintained. Following initial acclimation, prawns were randomly placed in experimental tanks @ 10 prawns/tank. In all the experimental groups the animals were fed *ad libitum* for the first week of the experiment at four times a day at 8 AM, 11 AM, 8 PM and at 11 PM to avoid feed wastage and deterioration of water quality. 50 % water was exchanged daily at 10 AM. From second week onwards the pre weighed experimental diets (approximately 15% of the body weight) were placed in petri-dishes and unconsumed feed was siphoned out and washed gently with distilled water and filtered through a pre

weighed filter paper and dried to constant weight in an electric oven at 60°C. Experiment was terminated on 42nd day. Water temperature and pH were estimated using a mercuric thermometer and pH meter respectively. Dissolved oxygen and ammonia were estimated following the standard procedures of APHA (1985)

The initial and final total length of the experimental animal was measured using a vernire caliper from the tip of the rostrum to the tip of the telson. The initial and final live weight of the animals were determined to the nearest 0.0001g by weighing the individual group of animals in each treatment after removing the adherent water in their body with tissue paper. The growth of the animal in length and live weight was measured by using the following formula

$$\text{Specific growth rate (SGR)} = \frac{(\ln \text{ mean final weight} - \ln \text{ mean initial weight})}{\text{duration of experiment (days)}} \times 100$$

$$\text{Feed conversion ratio (FCR)} = \frac{\text{feed consumed (dry weight)}}{\text{live weight gain (wet weight)}}$$

$$\text{Protein efficiency ratio (PER)} =$$

$$\frac{\text{Live weight gain}}{\text{protein consumed in dry weight}}$$

$$\text{Survival (\%)} =$$

$$100 - \frac{(\text{Initial No. of prawn} - \text{Final No. of prawn})}{\text{Initial No. of Prawn}} \times 100$$

The data obtained in the feeding experiments on various parameters were subjected to analysis of variance (ANOVA) and Duncan's multiple range test to determine the difference between the treatment means (SPSS 7.5 for WINDOWS). Results were treated as statistically significant at 0.05 probability level.

Results & Discussion

Water stability of the experimental diets expressed as the percentage of dry matter loss in different time intervals is given in Fig 1. The results showed that control diet (diet D) showed lowest dry matter loss (5.34%) after 6 h. Among the other diets, in 6 h the diet A recorded a loss of 14.29% followed by diet FMF (15.34%), diet B (15.68%) and diet C (19.35%). It would thus appear that the water stability of farm made

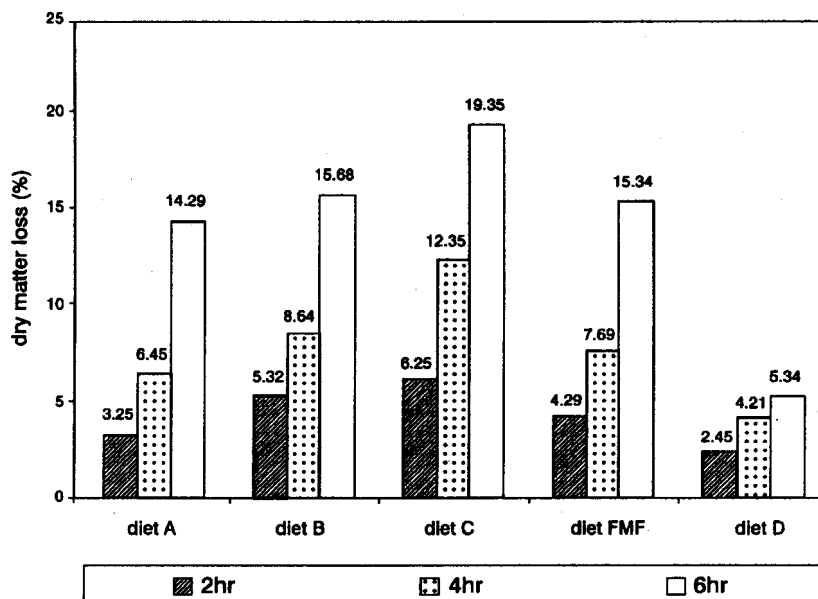


Fig. 1. Percentage dry matter loss of commercially available feeds, farm made feed and control diet of *M. rosenbergii*

Table 2. Proximate composition, digestible energy and protein to energy ratios of experimental feeds of *Macrobrachium rosenbergii*

	diet A	diet B	diet C	diet FMF	diet D
Protein (%)	35.61	28.30	24.92	30.94	58.11
Crude lipid (%)	5.47	3.46	9.31	8.20	11.41
Moisture (%)	10.12	11.43	12.10	8.65	7.49
Ash (%)	8.74	10.31	15.16	9.73	5.49
Crude fiber (%)	3.93	4.64	6.82	6.34	0.47
N.F.E. ¹	36.13	40.96	31.69	36.14	17.04
Dietary energy (kcal/100g) ²	336.17	316.30	310.19	342.12	403.31
P/E ratio (mg/kcal)	105.93	89.47	80.34	90.44	144.08

¹ By Difference

² Calculated apparent digestible energy = [4(% protein) + 9(% lipid) + 4 (% carbohydrate)]

feed is not only comparable to two of the above factory made feeds but also performed superior when compared to another commercial Scampi feed C. The coagulation of starch and wheat gluten present in the feed mix of the farm made feed before pelleting might have caused a better pellet formation and retention of the shape during post pellet handling prior to steam cooking. The steam cooking facilitated better steam penetration to the individual pellet and resulted in better coagulation of the starch and this can be

attributed as a reason for achieving good water stability in the farm made feed. It is reported that feeds of shrimp and prawn require good stability in order to prevent disintegration through the exposure to water and the manipulation by the animal during ingestion (Boonyaratpalin & New, 1982). In the present study, maida (refined wheat flour), which is a good source of starch as well as wheat gluten, might have served as the binder in the farm made feed. The proximate composition of the experimental feeds used for the growth experiment is presented in Table 2. The water quality parameters recorded during the present study showed that D.O, pH and ammonia ranged from 5.3 to 7.1 mg/l, 7.2-8.4 and < 0.1 ppm respectively. The water temperature varied from 26-28°C.

Initial and final live weight, weight gain, percentage weight gain and specific growth rate of *M. rosenbergii* juveniles fed with different dietary treatments are given in Table 3. Diet FMF showed significantly higher weight gain ($p < 0.05$) than other dietary treatments except diet A. Higher specific growth rate was recorded in diet FMF which did not vary significantly ($p > 0.05$) among the dietary treatments except

Table 3. Initial weight, final weight, weight gain, percentage increase in weight, SGR, FCR, PER and survival % of juveniles of *Macrobrachium rosenbergii* fed with commercial feeds, farm made feed and dried clam (mean $\pm$ SD) Means with similar super script do not vary significantly ($p > 0.05$)

	diet A	diet B	diet C	diet FMF	diet D	F value	Probability
Initial weight (g)	0.109 $\pm$ 0.020	0.108 $\pm$ 0.008	0.102 $\pm$ 0.006	0.104 $\pm$ 0.016	0.107 $\pm$ 0.018		
Final weight (g)	0.251 $\pm$ 0.016	0.217 $\pm$ 0.022	0.185 $\pm$ 0.028	0.270 $\pm$ 0.024	0.171 $\pm$ 0.005		
Weight gain (g)	0.142 $\pm$ 0.035 ^{bc}	0.109 $\pm$ 0.027 ^{ab}	0.084 $\pm$ 0.023 ^a	0.0.166 $\pm$ 0.040 ^c	0.064 $\pm$ 0.019 ^a	5.866	$p > 0.05$
Increase in weight (%)	137.78 $\pm$ 56.26 ^{ab}	102.15 $\pm$ 30.73 ^{ab}	82.09 $\pm$ 17.97 ^a	165.04 $\pm$ 58.56 ^b	63.65 $\pm$ 29.88 ^a	2.909	$p > 0.05$
SGR	2.02 $\pm$ 0.572 ^{ab}	1.66 $\pm$ 0.36 ^{ab}	1.42 $\pm$ 0.24 ^{ab}	2.28 $\pm$ 0.562 ^b	1.15 $\pm$ 0.42 ^a	3.065	$p > 0.05$
FCR	3.68 $\pm$ 0.94 ^a	4.16 $\pm$ 0.47 ^a	7.16 $\pm$ 1.42 ^b	4.04 $\pm$ 0.67 ^{ab}	5.68 $\pm$ 0.61 ^{ab}	8.559	$p < 0.05$
PER	0.78 $\pm$ 0.20 ^{bc}	0.86 $\pm$ 0.10 ^{ab}	0.58 $\pm$ 0.12 ^c	0.77 $\pm$ 0.13 ^{bc}	0.31 $\pm$ 0.04 ^{bc}	10.611	$p < 0.05$
Survival (%)	90.48 $\pm$ 8.25 ^a	89.68 $\pm$ 9.01 ^a	82.14 $\pm$ 6.19 ^a	91.07 $\pm$ 7.78 ^a	37.50 $\pm$ 21.65 ^b	5.869	$p > 0.05$

in control diet (diet D). Results of the present study indicate that the growth performance of *M. rosenbergii* juveniles fed with diet FMF was higher than that of commercial scampi feeds available in Kerala.

Higher survival was recorded in diet FMF followed by diet A, B and C (Table 3). Survival of the juvenile of *M. rosenbergii* fed with control diet was significantly ($p < 0.05$) lower when compared to other treatments. Feed conversion ratio was significantly higher in diet C; however, there exists no significant variation among the other dietary treatments (Table 3) studied. Feed conversion ratio registered for diet FMF was comparable with that of diet A and B. Feed conversion ratio in *M. rosenbergii* juveniles in the present study was found to be on a higher side (4.03-7.16) when compared to the results obtained in prawns fed with different feeds in pond conditions which varied from 1.66 – 2.33 (Smith & Sandifer, 1980), 2.35 – 4.06 (Boonyaratpalin & New, 1982) and 1.92 – 3.61 (Moore & Stanley, 1982).

Protein efficiency ratio was found inversely proportional to the protein content in the feed. Protein efficiency ratio was significantly higher ($p < 0.05$) in diet B, A and diet FMF when compared to diet D (Table. 3). The protein efficiency ratio recorded among the commercial and farm made feeds were not statistically significant and was comparable with findings of Ashmore *et al.* (1985) in *M. rosenbergii*. Sherief (1989) reported the usage of clam meat alone as a good protein source in the diet for *M. rosenbergii*. On the contrary, results of the present study reveals that *M. rosenbergii* fed with dry clam meat showed a lower survival and protein efficiency ratio when compared to the prawns fed with compounded diets like commercial feeds and farm made feed. Kinne (1977) and Menesveta *et al.* (1983)

are of the view that the survival and growth of prawns were better when they were fed with a multi-component diet than with a single component diet. Moreover, the lower protein efficiency ratio of clam meat reflected the low utilisation of high protein feed stuff which resulted in the wastage of valuable protein which in turn leads to the degradation of water quality and further deterioration of the pond ecosystem. Ali (1982) observed frequent moulting and high incidence of cannibalism in prawns fed with fresh clam meat. Contrary to the result obtained in *P. indicus*, Kanazawa *et al.* (1970) reported superior growth in *P. japonicus* fed with the meat of short necked clam (*Tapes philippinarum*). However, clam meat by itself may not be considered as a nutritionally balanced feed for prawn. Nair & Sherief (1993) found that dried clam and tapioca flour in 1:1.5 combination produced better prawn growth and survival in *M. rosenbergii* than clam meat alone. Further more, its high cost (Rs. 22/Kg) and availability in sparse quantity in some season would not permit to recommend it as a sole feed material for large-scale farming of *M. rosenbergii*.

The results of the present study showed that there exist no significant differences in overall growth performance of *M. rosenbergii* juveniles fed with diet A, B and FMF. This point out the feasibility of farm made feed prepared from the locally available feed ingredients of both plant and animal origin for commercially viable culture practices of *M. rosenbergii*. The costs of the feeds tested have also showed significant difference and the diets A and B (Rs. 26/kg) accounted for 200% higher cost than diet FMF (Rs.13/kg). Similarly, the cost of diet C (185%) and control diet (169%) were also higher than that of diet FMF. The costing of diet FMF @ Rs.13/kg will accommodate the cost of raw material,

fuel cost and labour cost. The production cost of farm made feed is only Rs. 13/- per kg, which is significantly low when compared to that of commercial scampi feeds available and this finding fully corroborates with the findings of Asha *et al.* (2000) who reported that 50% feed cost can be minimised in monoculture of *M. rosenbergii* when the farm made feed are used against commercial feeds.

Another interesting feature is that the feed ingredients used for preparation of the diet FMF are locally available on a year round basis at a cheaper rate. Wood (1991) suggested the usage of meat meal in farm made feed for *P. monodon*. Bostock (1991) also demonstrated the usage of trimmed beef (buffalo) for the preparation of farm made feed for tiger shrimp. Presently, there is no organised collection of waste from slaughter houses, however, due to the good nutrient content of such wastes and the increasing demand for animal protein it is anticipated that they will be having good demand in aquaculture in large quantities (Nandeesh, 1993). Meat of black clam (*Villorita cyprinoides*) was included as one of the ingredient in the FMF diet as it is available (either as fresh or dried) along the coastal as well as brackish water bodies of Kerala and are widely used as protein source in prawn and fish feeds (Kripa & Gopakumar, 1996). The usage of clam meat as a good protein source in the diet of *M. rosenbergii* has been reported earlier by Sherief (1989) and Nair & Sherief (1993).

In conclusion, results of the present study showed that it is technically feasible and viable to develop an on farm made feed for *M. rosenbergii* from the locally available ingredients, which would be highly cost effective and at the same time, characterized by better FCR and PER values comparable with that of factory made feeds which are

presently being used in the grow outs of *M. rosenbergii*. The usage of a low cost farm made feed will surely enhance the production and profitability of *M. rosenbergii* and thus make farming operation more economically viable and cost effective. Ready availability of farm made feed can be ensured by way of transferring the technology of feed preparation among the rural women, which would also be useful in providing them an avocation for employment and also generating some income for their lively hood.

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