

Food intake, growth and conversion efficiency in *Macrobrachium rosenbergii* (de Man) and *M. lanchesteri* (de Man)

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ABSTRACT

The effects of body size on the food intake, growth and conversion efficiency of two freshwater prawns, *Macrobrachium rosenbergii* and *M. lanchesteri* were studied. Three size groups were selected and they were fed daily *ad libitum* on *Tubifex* worms. Triplicates were maintained for each set. The absolute quantity of food consumed by the prawns increased with increase in size. The decrease in growth of larger prawns in both the species may be due to the inverse size metabolism relationship and advance in age.

Introduction

The culture potential of freshwater prawn is well known. Growth rate, an important parameter in the culture of prawns, is primarily influenced by the body size. Prediction of growth rates of prawns of different sizes are particularly required to construct life history tables of species as well as to plan the feeding schedules during their intensive culture practices. Several studies have reported that with increase in size, there is a gradual decrease in the growth rate of the animals, evidences for which were conclusively drawn from feeding trials on penaeids (Sick *et al.*, 1973; Colvin and Brand, 1977; Clifford and Bricks, 1978, Lee and Lawrence, 1986) and few carideans (Katre and Reddy, 1977; Ponnuchamy *et al.*, 1984). An investigation was undertaken to test the influence

of body size on the physiological energetics of feeding and growth of these prawns.

Materials and methods

Individuals of *Macrobrachium rosenbergii* were procured from a private hatchery in Kerala and *M. lanchesteri* were collected from the local habitats of Bangalore. They were maintained in plastic pools containing freshwater. Experimental individuals were segregated based on body length and weight. Three different size classes were selected for each group as shown in the Table 1.

The prawns were maintained at a density of 5 per 20L of freshwater. After acclimatization to lab conditions they were fed daily *ad libitum* with *Tubifex* worms for 45 days. Three replicates were maintained for each set. Feeding and col-

TABLE 1. Size classes of the two species of prawns used for the experiment

Group No.	<i>M. rosenbergii</i>		<i>M. lanchesteri</i>	
	Length (cm)	Wet weight (g)	Length (cm)	Wet weight (g)
1	1.0-1.5	0.01-0.014	1.0-1.5	0.10-0.14
2	1.6-2.0	0.015-0.019	1.6-2.0	0.15-0.19
3	2.1-2.5	0.02-0.025	2.1-2.4	0.20-0.25

lection of uningested food were undertaken daily between 1200 & 1400 h. Since no qualitative analysis of the faecal matter was undertaken, fortnightly collection of faecal matter by filtration provided adequate quantitative data on the production of faeces by the experimental prawns.

Growth in terms of length and weight was recorded every 15 days. Initial dry weight was estimated from a random sample and the prawns were sacrificed on termination of the experiment to record the final dry weight. Total length gain (TLG%), percentage wet weight gain (WWG%), percentage dry weight gain (DWG%), food conversion ratio (FCR), assimilation, assimilation efficiency (%), net growth efficiency (K_1 %) and gross growth efficiency (K_2 %) were calculated as follows:

$$\text{Total length gain, TLG (\%)} = \frac{L - L_0}{L_0} \times 100$$

L_0 = initial length of prawns; L = final length of prawns

$$\text{Wet weight gain, WWG (\%)} = \frac{W - W_0}{W_0} \times 100$$

W_0 = initial wet weight of prawns; W = final wet weight of prawns

$$\text{Dry weight gain, DWG (\%)} = \frac{D - D_0}{D_0} \times 100$$

D_0 = initial dry weight of prawns; D = final dry weight of prawns

Food conversion ratio, FCR = $\frac{\text{Food intake}}{\text{Weight gain}}$

Assimilation = Food consumption - Faecal output

Assimilation efficiency (%) =

$$\frac{\text{Food consumption} - \text{Faecal output}}{\text{Food consumption}} \times 100$$

Net growth efficiency, K_1 (%) =

$$\frac{\text{Production} \times 100}{\text{Assimilation}}$$

Gross growth efficiency, K_2 (%) =

$$\frac{\text{Production} \times 100}{\text{Consumption}}$$

The data were subjected to one way analysis of variance.

Results and discussion

M. rosenbergii

The daily food intake depended on the size of the prawn. Prawns in S3 group consumed 0.14 g of food as compared to 0.036 g consumed by S1 group. Prawns in S2 group consumed 0.055g food. Daily food intake was found to be proportional to body size.

Considerable growth occurred at the end of 45 days trial in the smaller size group (Table 2). The increase in length being 1.2 cm and wet weight 0.08 g. Growth in terms of length and wet weight recorded in S2 group was 0.063 cm and 0.059 g respectively. The prawns in S3

TABLE 2. Influence of body size on growth and conversion efficiency in *M. rosenbergii*

Size groups	TLG (%)	WWG (%)	DWG (%)	K ₁ (%)	K ₂ (%)
S1	78.4	322.4	743.5	46.9	67.9
S2	25.4	157.15	365.7	28.2	42.2
S3	6.92	18.77	216.4	12.27	29.1

group had a length gain of 0.034 cm and wet weight gain of 0.0208 g. Dry weight gain also showed a similar trend. The values obtained with S1, S2 and S3 were 0.0171, 0.01537 and 0.02057 g respectively. One way analysis of variance conducted to test the effects of size groups on TLG (%), WWG (%), DWG (%), growth and assimilation efficiencies indicated the effect to be highly significant ($P>0.05$). These factors were found to decrease with increasing size. Smaller size groups recorded the maximum values. FCR values (Fig.1) of S1, S2 and S3 were 1.89, 2.79 and 5.58 respectively. The assimilation efficiency value (Fig. 1) was highest (69.03%) in S1 group while the lowest value (42.17%) was in S3 group.

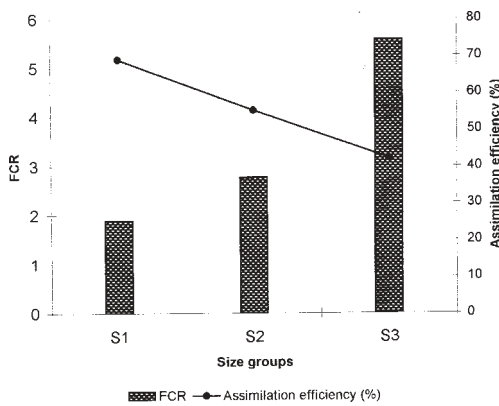


Fig. 1. Effect of body size on FCR and assimilation efficiency in *M. rosenbergii*

M. lanchesteri

Similar to *M. rosenbergii*, daily gross food intake was proportional to body sizes. Prawns in S3 consumed 0.384g

day⁻¹, closely followed by S2 group which consumed 0.378 g day⁻¹. FCR values (Fig. 2) were generally very high. the smaller size group recorded the maximum assimilation efficiency (Fig. 2), similarly the smallest group showed highest K₁ and K₂ values (Table 3.)

Growth recorded in terms of length increment was highest (0.66 cm) in S1 and lowest (0.25 cm) in S3, whereas S2 showed a gain of 0.42 cm. The increase in wet weight was maximum (0.09 g) in S1 and minimum (0.046 g) in S3. S2 showed a weight gain of 0.07 g. The dry weight gain also showed a similar trend, the value being maximum (13.67 g) in S1, least (11.9 g) in S3 and intermediate in S2 (12.97 g).

From the above data, TLG (%), WWG (%) and DWG (%) were calculated (Table 3). One way analysis of variance carried

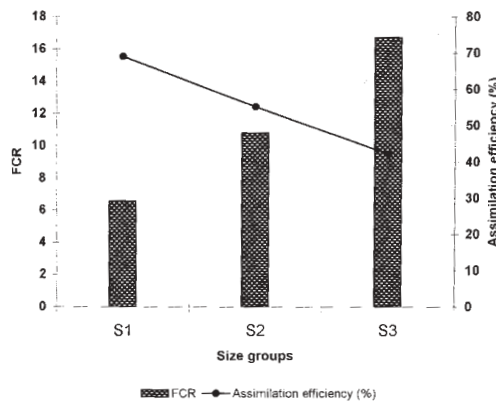


Fig. 2. Effect of body size on FCR and assimilation efficiency in *M. lanchesteri*

TABLE 3. Influence of body size on growth and conversion efficiency in *M. lanchesteri*

Size groups	TLG (%)	WWG (%)	DWG (%)	K ₁ (%)	K ₂ (%)
S1	43.37	46.5	96.2	15.24	22.04
S2	18.55	19.57	66.13	9.25	16.07
S3	7.32	9.35	50.77	5.99	17.45

out to test the influence of size variation on these parameters gave highly significant results ($P > 0.05$). The values were found to decrease with increase in the size of the animals.

Food utilization expressed as growth efficiency is known to be affected by a number of factors which include body weight (Pandian, 1967). Generally food utilization becomes less efficient with increasing weight (De Silva *et al.*, 1986). The general trend for food utilization to decrease with increasing body weight is to be expected because metabolic processes are known to diminish and energy expenditure unit⁻¹ body weight to decline with increasing body weight and / or age and be reflected in the growth efficiency. The food intake (g) unit⁻¹ weight of prawn day⁻¹ was found to be relatively high for small prawns. Deshimaru and Kuroki (1972) and Sahadevan (1992) have made similar observations in *Penaeus japonicus* and *M. rosenbergii* respectively. The relatively high feed intake unit⁻¹ weight of smaller animals may be attributed to the higher metabolic activity. Since the energy requirement of an animal is directly proportional to its metabolic activity, the feed intake will be gradually declining with increasing size.

In both the species of prawns growth rate was relatively high in smaller groups. Growth rates can assist in evaluating the nutritional responses of the prawns and in detecting difference be-

tween species and size groups, thereby providing a more comprehensive description of crustacean physiology and nutrition (Lee and Lawrence, 1986). Smith *et al.* (1985) reported depression in growth with increase in size of *Penaeus vannamei*. Similar observations have been made by Ponnuchamy *et al.* (1984) in *M. lanchesteri* and *Caridina weberi*.

The dependence of metabolism on the body size has long been recognized a variable of importance when comparing physiological activity of animals (Menzel, 1959). The decrease in growth of larger individuals of *Macrobrachium lanchesteri* and *Caridina weberi* observed by Ponnuchamy *et al.* (1984) may be due to the inverse size metabolism relationship and advance in age. The present investigations also indicate that body size has a profound influence on the physiological energetics of feeding and growth of *M. rosenbergii* and *M. lanchesteri*.

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