

Effects of Different Feeding Levels on Moulting, Growth, Food Conversion Efficiency & Biochemical Composition of the Prawn, *Metapenaeus monoceros* (Fabricius)

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Growth efficiency (K_1 and K_2) increased from 7 to 15% feeding levels. Maximum water content was recorded in starved prawns and the minimum at 20% feeding level. On theoretical basis, average daily feeding level of 45, 120 and 170 mg dry food/g prawn/day represented the maintenance, optimum and maximum feeding levels. Specific dynamic action increased twice at the observed maximum feeding level (20%) than at optimum feeding level (12%), indicating that the energy cost of converting food into body tissue increased at higher feeding levels.

Growth rates of prawns are known to be influenced by the amount of food available¹⁻³ and reduced quantity of food causes heavy mortality⁴. Hence, a precise knowledge of the relationship between food requirement and body weight of a particular species of prawn would be necessary to avoid overfeeding or restricted growth through sub-optimum feeding levels⁵. While information on the influence of feeding levels on the bioenergetics of fishes is available⁶⁻¹², very little is known about prawns, more so of the Indian species^{3,13}. In view of this, the present work has been undertaken to study the effects of feeding levels on moulting, growth, food conversion efficiency and biochemistry of the prawn, *Metapenaeus monoceros* (Fabricius).

Juveniles of *M. monoceros* (350-400 mg live wt) collected from Mandovi estuary (Goa) were maintained in glass aquaria under laboratory conditions (sal., 15‰; temp., $30 \pm 2^\circ\text{C}$). A series of 10 feeding levels (0, 2, 5, 7, 10, 12, 15, 18, 20 and 22) calculated as percentages of initial live body weight were offered. The experimental prawns were fed once a day with a formulated diet offered in a dry, pelleted condition (percent composition: *Acetes*, 60; rice bran, 20; groundnut oil cake, 8; tapioca flour, 10; and cellulose, 2). The feed was water stable for nearly 6 hr. The prawns were found to feed to the maximum within 3-4 hr. In all the experimental series, except the last two (20 and 22%) all the food offered was consumed. Thus these 2 series had surplus food.

All the experimental details and methods employed in calculating the energy budget on dry weight basis are the same as detailed elsewhere¹⁴. Biochemical analyses of the prawns were made following the standard procedures¹⁵⁻¹⁷. Carbon and nitrogen were estimated with a Perkin-Elmer elemental analyser (240B). Energy values were determined with a Parr adiabatic

microbomb calorimeter (Parr 1200). The values represent the average of 3 estimations.

Moult of each experimental set up was collected as and when produced. Each moult was dried overnight in an oven at 90°C and the dry weight determined. The experimental duration was 15 days. Increase in weight was taken as the index of growth excluding moult weight.

M. monoceros showed 100% survival at 7% feeding level and above. Total mortality of the starved prawns was observed around 12th day. Prawns fed at 2 and 5% feeding levels showed 60 and 80% survival rates respectively.

Starvation inhibits moulting (Table 1) as observed in *Palaemon lamarrei*², *Macrobrachium lanchesteri* and *Cardina weberi*¹³. *M. monoceros* fed below 5% of their body weight showed decrease in their final body weights and still underwent moulting. This indicates that moulting is probably a metabolic necessity and occurs even at the expense of organic reserves².

Table 1—Data on Moults at Different Feeding Levels in *M. monoceros*

Feeding level as % of initial live body wt/day	Observed No. of moults/ 15 days	Mean dry wt/moult (mg)	Per moult dry wt as % of initial dry body wt
0	2	4.8	5.44
2	4	5.4	5.64
5	6	5.1	5.42
7	10	4.1	5.05
10	14	2.9	3.36
12	16	3.5	3.73
15	18	3.8	3.95
18	20	2.9	3.28
20	13	3.2	3.40
22	11	3.6	3.29

Number of moults increased with increase in the feeding level up to 18% feeding level. Decrease in per moult weight as a percent of initial body weight with increase in feeding levels was evident in the present study. Similar observation has been made in *P. lamarrei*². However, no significant relationship could be established between per moult weight and feeding levels in *M. lanchesteri* and *C. weberi*¹³.

Table 2 gives dry weight balance of *M. monoceros*. The maximum amount of food that *M. monoceros* consumed under laboratory condition was 185 mg dry food/g prawn/day which is close to 20% of the animal's initial live body weight. This is close to the feeding level reported for *P. lamarrei*². Assimilation efficiency in general was high (>80%) in the prawns fed between 2 and 15% feeding levels than those fed at 18, 20 and 22% feeding levels.

Growth was recorded only in prawns which received a feeding level of 7% and above. Below these feeding levels, there was decrease in the final body weights. Maximum growth occurred at 15% feeding level

(Table 2). At this level, assimilation efficiency was also maximum. At higher feeding levels, growth decreased. This may probably be due to high faecal output and low assimilation efficiency. Food conversion efficiency

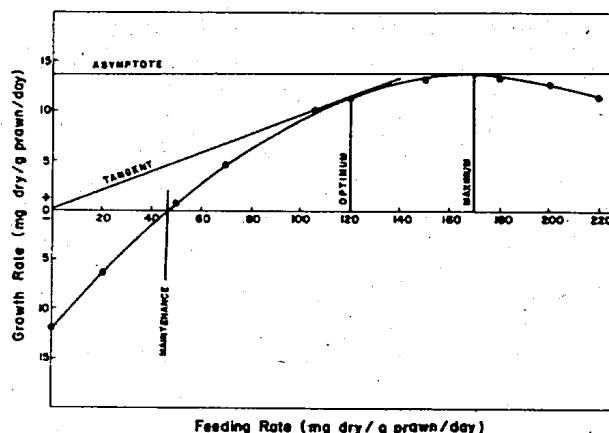


Fig. 1—Geometric derivation of maintenance, optimum and maximum feeding levels in *M. monoceros*

Table 2—Bioenergetics of *M. monoceros* Calculated on Dry Weight Basis

Feeding level as % of initial live body wt/day	Food accepted C (mg/d/p)	Initial dry wt I ₁ (mg)	Final dry wt I ₂ (mg)	mg/d/p			Assimilation efficiency A/C(%)	Gross growth efficiency G/C or K ₁ (%)	Net growth efficiency G/A or K ₂ (%)
				Faecal production F	Growth G (I ₂ -I ₁)	Assimilation A = C-F			
0	—	88.3	40.6	—	-3.2	—	—	—	—
2	7.7	95.8	56.9	1.5	+2.6	6.2	80.52	—	—
5	18.8	94.1	72.3	3.8	+1.5	15.0	79.79	—	—
7	25.5	91.1	119.3	4.6	+1.9	20.9	81.96	7.45	9.09
10	34.6	84.6	122.1	6.9	+2.4	27.7	80.06	6.94	8.66
12	45	93.8	153.9	6.8	+4.0	38.2	84.89	8.89	10.47
15	57.7	96.1	231.9	7.2	+9.1	50.5	87.52	15.77	18.02
18	63.4	88.3	146.7	15.9	+3.9	47.5	74.92	6.15	8.21
20	69.5	94.1	151.4	18.2	+3.8	51.3	73.81	5.47	7.4
22	60.4	85.2	138.4	14.0	+3.5	46.4	76.82	5.79	7.54

Table 3—Changes in the Percentage Biochemical Composition and Caloric Content of Control and Experimental Prawns Reared on Different Feeding Levels

Feeding level as % of initial live body wt/d	Water content	Dry matter	Ash	Lipid	Carbo hydrate	Protein	Carbon	Nitrogen	C:N	Caloric content cal/g dry wt
Control	75	25.00	17.65	23.83	2.51	55.46	36.23	8.59	4.22	4614
0	87.49	12.50	20.26	21.64	2.01	56.12	34.63	8.40	4.12	4491
2	83.34	16.66	19.85	22.07	2.31	55.26	34.24	8.74	3.92	4515
5	78.44	21.56	18.27	21.42	2.84	56.72	35.59	8.86	4.02	4431
7	77	23.00	19.14	22.05	3.21	55.92	36.27	8.88	4.08	4573
10	77.49	22.51	16.81	17.62	3.26	60.67	35.85	9.28	3.86	4353
12	76.88	23.12	15.27	21.13	2.86	61.67	34.18	8.94	3.82	4691
15	76.22	23.78	14.51	19.69	2.94	63.45	32.17	9.83	3.27	4653
18	77.78	22.22	16.38	20.95	3.48	58.69	32.46	9.21	3.52	4595
20	75.01	24.99	18.02	20.42	2.75	54.06	33.43	8.90	3.76	4675
22	76.29	23.71	17.94	21.54	3.15	56.48	34.24	8.45	4.05	4713

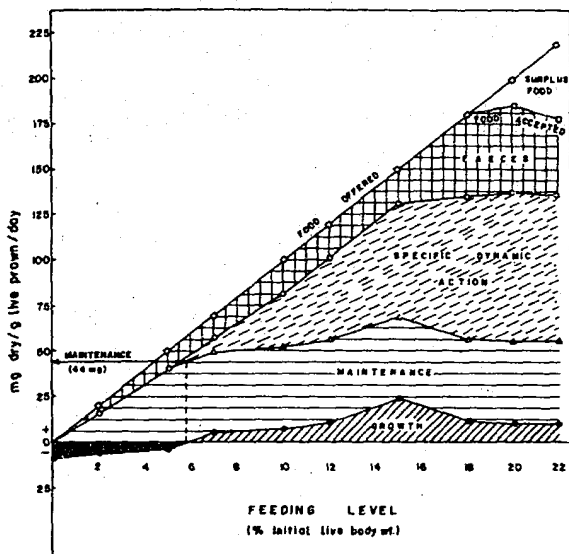


Fig. 2—Energy budget at different feeding levels in *M. monoceros*

(K_1 and K_2) increased from 7.45 and 9.09% in prawns receiving 7% feeding level to 15.77 and 18.02% in those receiving 15% feeding level. Prawns fed at 20% of their body weight recorded the lowest conversion efficiency. In *Penaeus japonicus* Shigueno *et al.*¹⁸ reported high rate of food intake and a lower conversion efficiency. For *P. lamarrei* maximum conversion efficiency was recorded at 10% feeding level², while, it was at 15 and 30% feeding levels for *M. lanchesteri* and *C. weberi*¹³ respectively.

Growth rate increased from 5.21 mg for the prawns which received 69.95 mg food/g prawn/day to 23.67 mg for the group of prawns which received 150 mg food/g prawn/day (Fig. 1). From the geometric derivations¹⁹, of growth-feeding rate obtained for *M. monoceros*, it is evident that 45, 120 and 170 mg food/g prawn/day represents maintenance, optimum and maximum feeding rates respectively. When compared with this, the maximum feeding rate of 185 mg food/g prawn/day observed in the present study is rather high.

Changes in the biochemical composition of the experimental prawns and that of initial prawn are shown in Table 3. While the wet weight and dry weight contents are represented as percentages of live matter all other constituents are expressed as percentages of the dry matter.

Fig. 2 gives quantitative relation between different feeding levels and the food assimilated, metabolised for body functions and converted into body substance in *M. monoceros*. From the maintenance level worked out for *M. monoceros*, assuming that the energy required for maintenance always remains the same, the level of specific dynamic action (SDA) could be calculated²⁰. SDA increased twice at the observed maximum feeding level than at the optimum feeding level. This shows that the energy cost of converting food into body substance increases twice at higher feeding levels, therefore, it is advisable to use optimum feeding level for efficient growth and food conversion and avoid over feeding in culture practices.

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