

## GROWTH EXPERIMENTS WITH THE SHRIMP *METAPENAEUS* *MONOCEROS* (FABRICIUS)

J. R. B. ALFRED,\* SUMITRA-VIJAYARAGHAVAN, M. V. M. WAFAR,  
JOSEPH P. ROYAN and P JEYACHANDRAN\*\*  
National Institute of Oceanography, Dona Paula-403004, Goa

### ABSTRACT

The shrimp *Metapenaeus monoceros* was fed with five different types of compounded foods containing low protein and high carbohydrate. Gross growth efficiency ( $K_1$ ) ranged between 0.3 and 4.4% on dry weight basis and from 0.35 to 5.2% on caloric basis. All the diets used in this study gave high assimilation (A/C) and low conversion efficiencies ( $K_1$  and  $K_2$ ). The significance of moulting and its relation to production and consumption has been discussed. The advantage of detritus over plant origin source in compounded foods has been indicated.

Royan, Sumitra-Vijayaraghavan and Wafar (1977) have pointed out the culture potential of *Metapenaeus monoceros* in Goa waters and have indicated the importance of growth and food conversion studies as prerequisites for obtaining best results in culture programmes. Qasim and Easterson (1974) recorded a high conversion efficiency ( $K_1$ ) when these shrimps were fed with the estuarine detritus. Royan, Sumitra-Vijayaraghavan and Wafar (1977) fed *M. monoceros* using natural, processed and compounded diets and showed that an optimum level of protein (60%) in food gives a high conversion efficiency. The present communication gives the results of further studies wherein five different types of compounded foods have been tested on the food conversion efficiency of *M. monoceros*. All the feed used had low protein but high carbohydrate and were of plant origin.

Juveniles of *M. monoceros* (30-40 mm carapace length) were collected from the Mandovi estuary (Goa). After acclimatization for a week, they were divided into five different groups and grown in glass aquaria (40 × 20 × 20 cm) with 7 litres of 15‰ sea water at room temperature (28 ± 1°C). All other experimental details and methods employed in calculating the metabolic budget both on dry weight and caloric basis are the same as given by Sumitra-Vijayaraghavan, Wafar and Royan (1978). The foods used in these experiments were in the form of dry pellets and their composition is given in Table I. Each group of shrimps was tested with a particular food as detailed in Table II.

Dry weight balance of the shrimps is presented in Table II. It is interesting to note that in all the groups,  $K_1$  values (gross growth efficiency), relative growth rate and production were low while the assimilation was uniformly constant and high. In spite

\* School of Life Sciences, North-Eastern Hill University, Shillong-793 003.

\*\* Fisheries College, Tamilnadu Agricultural University, Tuticorin.

Table I. Composition of test diets used in the feeding experiments with *M. monoceros*.

TNAU Pellet 9	TNAU Pellet 10	TNAU Pellet 13	TNAU Pellet 20	TNAU Pellet 21
<i>Gliricidia</i> 6 parts	<i>Pleurotus</i> enriched maize cob 6 parts	Groundnut oil cake 4 parts	Groundnut oil cake 4 parts	Rubberseed oil cake 6 parts
Rice bran 3 parts	Rice bran 3 parts	Rice bran 3 parts Cow dung 2 parts	Rice bran 2 parts Silkworm pupae 1 part Fish meal 1 part	Rice bran 3 parts
Tapioca flour 1 part	Tapioca flour 1 part	Tapioca flour 1 part	Tapioca flour 2 parts Fe 200 mg/kg Mn 100 mg/kg Vitablenel 200 mg/kg K 100 mg/kg Vita 25 mg/kg	Tapioca flour 1 part

TNAU—Tamilnadu Agricultural University.

Table II. Dry weight balance of *M. monoceros* fed with TNAU pellets. (Values are in gram per animal)

*Expt. No. and food	No. of days	No. of animals	Initial weight $W_1$	Final weight $W_2$	Mean weight $W$	Production $P = W_2 - W_1$	Food consumed C	Faecal output F	Relative growth rate/day $F/W/day$	Assimilation A, CF	Metabolism R, A-P	Assimilation efficiency A/C %	Gross growth efficiency $K_1 = P/C$ %	Net growth efficiency $K_2 = P/A$ %	Consumption per unit wt/day
I <sub>6</sub>	33	25	0.0880	0.0920	0.0900	0.0040	1.188	0.190	0.0013	0.998	0.994	84.0	0.34	0.4	0.398
II <sub>10</sub>	34	25	0.0843	0.1132	0.0988	0.0289	0.656	0.103	0.0086	0.553	0.524	84.30	4.41	5.23	0.192
III <sub>13</sub>	33	20	0.1203	0.1267	0.1235	0.0064	0.759	0.121	0.0016	0.638	0.632	84.06	0.84	1.0	0.186
IV <sub>20</sub>	20	20	0.1785	0.2040	0.1913	0.0255	0.760	0.122	0.0067	0.638	0.613	83.95	3.36	4.00	0.199
V <sub>21</sub>	36	25	0.0662	0.0834	0.0748	0.0712	0.540	0.086	0.0064	0.454	0.437	84.07	3.19	3.79	0.201

\* Subscripts refer to food number.

Table III. Energy balance of *M. monoceros* fed with TNAU Pellets. (The values are in g cal per animal)

*Expt. No. and food	No. of animals	Initial cal $I_1$	Final cal $I_2$	Production $P=I_2-I_1$	Food consumed C	Faecal output F	Assimilation A C-F	Metabolism R A-P	Assimilation efficiency A/C %	Gross growth efficiency $K_1$ P/C %	Net growth efficiency $K_2$ P/A %
I <sub>9</sub>	25	333	361	28	5889	151	5738	5710	97.44	0.48	0.49
II <sub>10</sub>	25	324	441	117	2264	57	2207	2090	97.48	5.17	5.30
III <sub>13</sub>	20	468	523	55	3457	88	3369	3314	97.45	1.59	1.63
IV <sub>20</sub>	20	698	818	120	2630	68	2562	2442	97.41	4.56	4.68
V <sub>21</sub>	25	244	338	94	2051	52	1999	1905	97.46	4.58	4.70

\* Subscripts refer to food number.

Table IV. Relationship of moulting to production and consumption.

Expt. No. and food	Observed Moults	Dry wt moult/prawn (g)	Dry wt/day as a % of mean wt of prawn (g)	DRY WT				CALORIES			
				M as a % of C	P as a % of C	Ratio P:M	Caloric value of moults cal/g dry wt	Moult calories/prawn	M as a % of C	P as a % of C	Ratio P:M
I <sub>9</sub>	21	0.0109	0.37	0.34	2.71	1134	12.40	0.21	0.48	0.43	
II <sub>10</sub>	20	0.0118	0.35	4.41	0.40	1486	17.15	0.76	5.16	0.15	
III <sub>13</sub>	26	0.0117	0.29	0.84	1.83	1701	25.16	0.73	1.59	0.46	
IV <sub>20</sub>	19	0.0200	0.52	3.36	0.78	1247	24.52	0.97	4.56	0.21	
V <sub>21</sub>	17	0.0061	0.23	3.19	0.35	628	3.72	0.18	4.58	0.04	

M—moult; C—consumption; P—production.

of the high assimilation efficiency, the food conversion efficiency did not exceed 5%. In groups I and III, the  $K_1$  values were less than unity which indicate that the food conversion was probably just sufficient to meet the metabolic needs and hardly any surplus energy was available for body building. Among these, the group I consumed the most and converted the least for growth, whereas group III had the lowest consumption and low conversion. In other groups the conversion values were between 1 and 3 even though the consumption was much higher.

Table III summarises the energy balance of *M. monoceros*. The energy budget based on calories reflects the same results as obtained for dry weight. The assimilation was about 13% higher on caloric basis than on dry weight basis.

Throughout the experimental period, all the shrimps underwent moulting. Table IV gives the number of moults produced, dry weight of moult/prawn and energy value of moult/prawn and its ratio to production and consumption. The range of the dry weight of the moult was from 0.23 to 0.52% of the body weight of the prawn. Ratio of production to moult ranges from 0.35-2.71. In groups I and III the ratio is more than one whereas on the caloric basis it is less than one. Among the five groups, I and III showed ratios on par with dry weight basis.

All the feed used in the present study were low in protein and rich in carbohydrate content. The high assimilation in all the groups may probably be attributed to the easily assimilable nature of carbohydrate and the low conversion can be traced to low protein which may indicate that adequate nitrogen is not available for body building. It is possible that low consumption might result in high assimilation efficiency but this factor may not be as significant as the quality of food. Protein and its source is an important factor in food conversion and perhaps it is species specific. This has been dealt with in detail by New (1976) and for this species of shrimp, Royan, Sumitra-Vijayaraghavan and Wafar (1977) have shown that an optimum requirement of protein (60%) is essential and at levels above or below this, growth and conversion efficiency are suppressed. Andrews, Sick, Baptist (1972) noted reduction in growth and survival rates to be very significant at low protein levels but could not attribute it to suppressed metabolism, toxic effects, reduced consumption or poor digestibility. Scheer and Scheer (1951), Scheer, Schawbe and Scheer (1952), Neiland and Scheer (1953) and Sze (1973) observed protein as the sole source of energy for crustaceans. Carbohydrates on the other hand are known to be important in Krebs's cycle, glycogen storage, in chitin synthesis, in the formation of steroids and fatty acids. Andrews, Sick and Baptist (1972) found increased growth rate with lower protein content and a steady increase of starch upto 30%. It was also shown that glucose from digested polysaccharides was absorbed more slowly and effectively than dietary glucose which failed to express itself in energy metabolism. According to New (1976) when the protein content in the diet is reduced, the amount of carbohydrate and its source play an important role in the food conversion.

The high ratios of P : M in the moult, show that though the dry weight/moult when compared to growth is significant, it is not so in terms of caloric value (Table IV). This would probably mean that the nutritional advantage of moulting will become a debatable phenomenon, but since it represents a minimum value, the ratios P : M are food quality dependent. Katre and Reddy (1977) showed 1-8% conversion in

*Palaemon lamarrei*, when moult was added to the final body weight of the shrimp. The present work also confirms these conversion values when moult is taken as growth. But since moulting is only an index of growth, it is more reasonable to consider moult as excretory in nature. It was shown that plant extracts containing ecdysone increases moulting frequency but gave growth rates less than that of the control (Kanazawa, Tanaka, Kashiwada, 1972). This factor may have been one reason for a larger production of moults in all groups of shrimps, thereby increasing the dry weight since all the feed contained tapioca flour as a base and binder.

Though in laboratory experiments, loss of weight and calories by moulting is substantial, it is likely that this loss is probably compensated to a large extent in natural conditions by recycling. Moult, in natural conditions, contributes to detritus rich in protein and chitin. Extracellular digestion of cellulose and chitin from lost exuviae are known in prawns (New, 1976). Therefore, even though moulting rate is high, if it is recycled with the same food it may compensate the loss of dry weight by moulting. This suggests that detritus can be profitably incorporated as an ingredient in compounded foods. It becomes further evident that while carbohydrate can be utilised by prawns, the efficiency of utilisation depends to a larger extent on its source. Further works on carbohydrate rich foods from sources other than that of plant origin and low proteins may be rewarding.

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