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## Decapsulated Brine Shrimp Cysts—An Ideal Feed for Shrimps in Aquaculture

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Feeding experiments have been carried out with *Metapenaeus monoceros* using different stages of *Artemia salina* as feed. The importance of using decapsulated cysts to obtain greater food conversion efficiency has been indicated.

Brine shrimp, *Artemia salina*, is very widely used mostly as food of the larvae of atleast 25 organisms<sup>1</sup>. For some species of fish and crustaceans, it is the only suitable food during certain phases of larval life. Brine shrimp as a feed is given in different forms - newly hatched nauplii, metanauplii, juveniles and adults either singly or in combination with other artificial or compounded diets. Advantages of decapsulation of dormant cysts in aquaculture hatcheries have been given<sup>2</sup>. The decapsulation technique has been tried successfully on the Indian strain (Tuticorin) with a slight modification<sup>3</sup>.

To study the conversion efficiency, decapsulated cysts along with freshly-hatched nauplii, juveniles and adults of *A. salina* have been used as feed for the shrimp, *Metapenaeus monoceros* (Fabricius) and the

results obtained are presented in this communication.

Juveniles of *M. monoceros* (av. wet wt 80 mg) were collected from the backwaters of Mandovi estuary (Goa) and sorted into 4 groups. Group I to IV were fed respectively decapsulated cysts, freshly-hatched nauplii, juveniles and adults for 12-15 days. Other experimental details and methods employed in calculating dry weight balance were given elsewhere<sup>4</sup>. Carbohydrate, total protein and lipid for the 4 stages were estimated following the standard procedures<sup>5-7</sup>. Caloric content of the feeds was estimated with an adiabatic bomb calorimeter (Parr 1200).

A balance sheet of the shrimp in terms of dry weight is presented in Table 1. Group I shrimps showed a higher conversion efficiency, while low conversion efficiency was recorded in group III. Group II showed maximum assimilation (92.28%) and had a high relative growth rate as compared to the other groups. Group IV consumed most food (227.8 mg/ $\bar{W}$ /d) but their conversion into body tissue was low as compared to group I which ate less (62 mg/ $\bar{W}$ /d) and converted maximum into body tissue. Although group IV showed higher conversion efficiency than the group III their assimilation efficiency was lowest (77.79%). Thus, for the relative amount of food consumed, maximum growth was observed in the shrimps fed on decapsulated cysts. This could be attributed to the high caloric value of the decapsulated cysts (Table 2). Biochemical analyses revealed higher protein, lipid and carbohydrate content in the decapsulated cysts as compared with other stages of *A. salina* (Table 3).

It has been shown that of the 16 different types of feeds tried on *M. monoceros*, maximum conversion efficiency was found when the shrimps were fed adult *A. salina*<sup>4</sup>. The present study shows that the decapsulated

Table 1—Dry Weight Balance of *M. monoceros* Fed Different Stages of *Artemia salina* (g/animal)

Food given	Group I	Group II	Group III	Group IV
Initial wt ( $W_1$ )	0.0262	0.0261	0.0261	0.0262
Final wt ( $W_2$ )	0.1909	0.1054	0.0723	0.0717
Weighted mean ( $\bar{W}$ )	0.1086	0.0658	0.0492	0.0489
Consumption (C)	0.3588	0.2138	0.1732	0.1671
Faecal output (F)	0.0425	0.0165	0.0185	0.0371
Assimilation ( $A = C - F$ )	0.3163	0.1973	0.1547	0.13
Metabolism ( $R = A - P$ )	0.1516	0.118	0.1085	0.0845
Production ( $P = W_2 - W_1$ )	0.1647	0.0793	0.0462	0.0455
Assimilation efficiency ( $A/C \times 100$ )	88.15	92.28	89.32	77.79
Gross growth efficiency ( $P/C \times 100$ or $K_1$ )	45.9	37.09	26.67	27.22
Net growth efficiency ( $P/A \times 100$ or $K_2$ )	52.07	40.19	29.86	35
Relative growth rate ( $RGR = P/\bar{W}/\text{No. of d}$ )	0.1269	0.0803	0.0626	0.062
Consumption/unit wt/d	0.2753	0.2166	0.2347	0.2278

Table 2—Energy Content in Different Stages of *A. salina*

	kcal/g dry wt	kcal/g ash-free dry wt
Decapsulated cysts	5.146	5.424
Freshly-hatched nauplii	4.818	5.361
Juveniles	4.456	5.214
Adults	4.284	5.117

Table 3—Percentage Biochemical Composition in Different Stages of Brine Shrimp

	Ash	Carbohydrate	Lipid	Protein
Decapsulated cysts	5.12	9.13	23.12	61.23
Freshly-hatched nauplii	10.14	8.88	20.75	59.03
Juveniles	14.55	7.21	18.15	57.96
Adults	16.27	6.69	16.02	59.22

cysts when used as food lead to a greater food conversion efficiency in the shrimp than the other stages.

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## Blood Glucose in Marine Penaeid Prawn, *Parapenaeopsis hardwickii*: Circadian Rhythmicity & Influence of Salinity\*

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Blood glucose in *P. hardwickii* showed circadian rhythm and acclimation to photoperiod and temperature could not abolish the rhythm. There was a significant ( $P < 0.05$ ) increase in blood glucose level at 1600 and 0400 hrs preceding a significant ( $P < 0.05$ ) decrease between 0800 to 1200 and 2000 to 2400 hrs. After a 7-day acclimation to different salinities, significant ( $P < 0.05$ ) increase in blood glucose was observed in 30 and 28‰, which decreased greatly in 25‰ salinity.

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Rhythmicity in the physiological activities in marine invertebrates<sup>1-3</sup> is known. Circadian and/or circatidal rhythms have been demonstrated in a variety of species<sup>4-8</sup>. The present investigation on *P. hardwickii* is made to assess (i) whether there is any rhythmicity in the variation of circulating blood glucose level during a 24 hr period, and the possible influence of photoperiod and thermal acclimation on it; and (ii) the effect of acclimation to different salinities on blood glucose since no data are available on Indian penaeid prawns.

Adult, intermoult females of *P. hardwickii* of equal size, collected from the coastal water of Versova, Bombay, were maintained in glass aquaria, containing continuously aerated sea water (sal. 32‰, temp. 23-24°C), under normal day/night illumination (unless otherwise mentioned specifically for a particular experiment) for 5 days to acclimatize them to laboratory conditions. Food (frozen *Acetes indicus*) was provided *ad libitum* once in a 24 hr period for 5 hr and then water was replaced. Prawns were fasted for 24 hr before experimentation.

Experiments were run in 3 separate sets. Set one consisted of 2 groups of prawns, each of 45. One group was exposed to constant fluorescent illumination of 40 w adjusted 1 ft above the water surface; the other group was kept in a constant dark chamber for acclimation for 7 days. Second set also of 2 groups of prawns (45/group) was kept for thermal acclimation. They were kept in automatic BOD incubators for warm ( $32.0 \pm 0.5^\circ\text{C}$ ) and cold ( $17.0 \pm 0.5^\circ\text{C}$ ) acclimation separately for 7 days. Ten each of the 3rd set animals were acclimated to 5 different salinities, viz. 25, 28, 30, 32 (holding medium) and 34.0‰, for 7 days under normal laboratory conditions. For the estimation of blood glucose 0.25 ml of blood collected directly from the pericardium with hypodermic syringe was pooled. Exactly 0.1 ml was then transferred to a test tube, deproteinized and glucose estimated by the method of Oser<sup>9</sup>. Blood glucose concentrations were expressed in terms of mg/100 ml. The data were analysed statistically applying *t* test.

The results (Fig. 1) show a distinct rhythm in variation of blood glucose levels in the prawns of various groups. The blood glucose concentrations attained significantly ( $P < 0.05$ ) high levels at 1600 and 0400 hrs and reached low levels at 1000 and 2200 hrs.

Fig. 2 indicates significant ( $P < 0.05$ ) increase in blood glucose level after acclimation to salinities 30 and 28‰ as compared to 32‰. The levels at salinities 25 and 34‰ did not differ from the levels at salinity 32‰.

Daily fluctuations in the environmental parameters are known to induce adaptive changes in various physiological activities, and cyclic variations in these activities of decapod crustaceans are reported<sup>10</sup>. The