

Role of salinity on food conversion efficiency and growth in juvenile penaeid shrimp *Metapenaeus dobsoni* (Crustacea/Arthropoda)

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Growth parameters of juvenile *Metapenaeus dobsoni*, fed with fresh squid meat were estimated in 5, 15, 25 and 35 ppt salinities for 4 weeks. Although no significant differences were noticed in food ingestion rates, higher body weight (68.9% over initial weight) was recorded in 5 ppt salinity. Moulting frequency and intermolt period did not vary with variation in salinity. However, gross growth efficiency ($K_1=76.1\%$) and net growth efficiency ($K_2=82.5\%$) values were high and food conversion ratio (FCR=1.31) was low in 5 ppt salinity suggesting that this is the ideal medium for growth of juveniles of this species.

In a recent review, Cuzon *et al.*¹ highlighted the importance of formulated diets in crustacean aquaculture, particularly penaeid shrimps. Presently, research is being carried out the world over to identify appropriate dietary and nutritional requirements for cultivable species of shrimps and their life stages so as to formulate cost effective and growth efficient feeds by incorporating suitable ingredients. However, some ecological factors are also responsible for regulating growth processes, particularly during the larval and juvenile phases. Salinity has been identified as an important factor because low saline conditions were found to improve growth in postlarval and juvenile shrimps²⁻⁵. Therefore, an experiment was designed to understand the role of salinity on food conversion efficiency and growth in juvenile *Metapenaeus dobsoni*, a commercially important Indian penaeid shrimp.

Materials and Methods

Juvenile specimens of *Metapenaeus dobsoni* Miers (Crustacea / Arthropoda) were collected from a nearby mangrove estuary (Chorao Island ; Lat. 15°30' N, Long. 75°50' E) and transported to the aquaculture laboratory. They were immediately transferred to a round-bottom fibreglass tank (100 liter capacity) containing filtered, aerated seawater (salinity 28 ppt, temperature 30°C). Experiments were conducted in 4 different saline media viz. 5, 15, 25 and 35 ppt. These concentrations were prepared by either adding common salt or diluting seawater while monitoring with a salinometer

(Beckman Induction Salinometer, US Pat. 2542057). Temperature and pH were maintained around 30°C and 8 respectively. Required quantity of each concentration was prepared, filtered and stored in plastic drums. Four acclimation tanks (20 liter capacity), each containing one concentration of prepared seawater was kept ready. Twenty actively moving healthy juveniles (290-380 mg body weight) were picked and five were transferred to each acclimation tank. They were starved for 24 h before commencing the experiment. All tanks were continuously aerated.

Experiments were conducted in round-bottom fibreglass tanks (10 liter capacity). Five tanks were maintained for each salinity and each tank contained only one specimen. All tanks were continuously aerated. Every morning shrimps were fed small pieces of fresh squid meat equivalent to 30% of body weight. This quantity was arrived at after several feeding trials. Before feeding, excess food was removed, washed with distilled water and weighed after blotting dry. Faecal pellets were siphoned out, washed with distilled water and stored in deep-freeze. Faecal pellets of each specimen were pooled weekly and dried in a hot air oven at 60°C to constant weight. Moulting day of each specimen was noted and moults removed. Shrimps were weighed once a week after dry blotting. Specimens were handled carefully so as to avoid stress and injury. Tanks were washed and water changed on the day of weighing.

Temperature, salinity, pH and dissolved oxygen were regularly monitored. Different sizes of juvenile

specimens and fresh squid meat were dried at 60° C to constant weight so as to determine wet weight - dry weight relationship for calculating growth parameters. Energy conversions were calculated following the method of Crisp⁶. The experiment lasted for 4 weeks. All values presented are averages for each salinity. Significance was tested by Students' *t* test⁷.

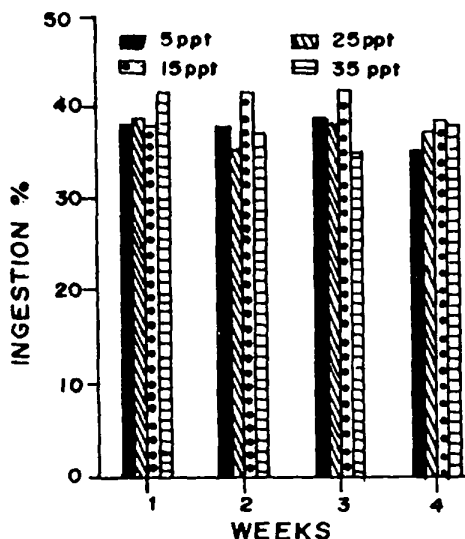


Fig.1—Weekly food ingestion rate (% wet wt) of juvenile *Metapenaeus dobsoni* in relation to body weight in different experimental salinities.

Results

Food ingestion rate—Average weekly food ingestion rate (% wet wt) in relation to wet body weight for each salinity is shown in Fig.1. Only marginal differences were noticed between salinities (35.3-41.9%, $P > 0.05$).

Growth rate—Weekly growth increment showed significant difference ($P < 0.05$) between salinities. It was comparatively high in 5 ppt (9.8-24.4%, Fig. 2a). There was however, a decline in growth rate in all experimental salinities during the fourth week which may be due to longer duration of confinement and/or lack of supplementary diet.

Average growth increment at the end of the experiment was 68.9% (wet wt) over initial weight in 5 ppt salinity compared to 28.3, 32.2 and 21.6% in 15, 25 and 35 ppt salinities, respectively (Fig. 2b).

Moulting frequency—Moulting frequency and inter-moult period did not vary significantly between salinities ($P > 0.05$). Inter-moult period had a duration of 5-7 days in all salinities. At the end of the experiment, 4 moultings were recorded per individual.

Faecal production—Weekly average faecal production is presented in Fig.3. While it was only 8.9% of the ingested food in 5 ppt salinity, it varied between 9.8 and 15.6% in other salinities and was consistently high in 35 ppt salinity (12.8-18.1%).

Growth factors—Different growth factors and conversion rates are given in Table 1. There was a

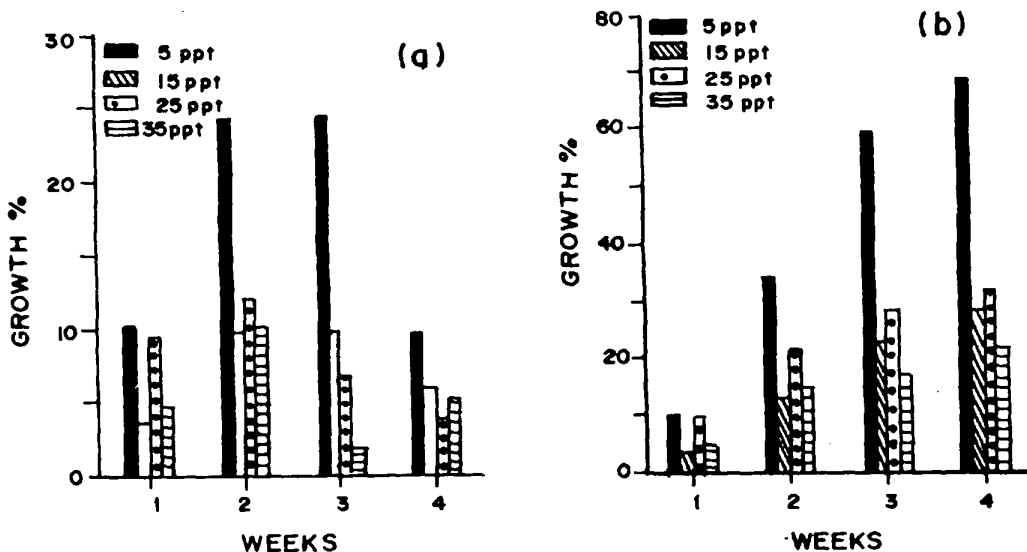


Fig.2—a) Weekly growth increment (% wet wt) over preceding week and b) weekly growth increment over initial weight of *Metapenaeus dobsoni* in different experimental salinities.

progressive increase in food consumption (82.4-185.1 mg dry wt) and faecal production (6.4-18.8 mg dry wt) with increasing salinity. But, a reversal of this trend was seen in weight attainment (production). Average weight gained was high (62.7 mg dry wt) in 5 ppt salinity with high gross growth efficiency (K1=76.1%) and net growth efficiency (K2=82.5%) and low food conversion ratio (FCR=1.31).

Discussion

Efficiency and suitability of a shrimp feed depend on a number of factors such as its composition, palatability, conversion efficiency and water stability⁸. After reviewing the composition, preparation and utilization of crustacean feeds, particularly those of penaeid shrimps, Cuzon *et al.*¹ opined that future research needs to be directed in areas such as formulation of diets, acceptability of feed and feed texture so as to make them growth efficient and cost effective. For this experiment however, fresh squid meat was chosen as the diet because it has been demonstrated that squid meat can accelerate growth processes in young penaeid shrimps⁹ due to high content of certain polyunsaturated fatty acids¹⁰ (PUFAs) and can also stimulate maturation processes in adults¹¹. Therefore, no supplementary feed was given.

Venkataramaiah *et al.*² observed that low salinity favours food ingestion rate in postlarval *Penaeus aztecus*. However, in the present case, ingestion rate was not influenced by salinity variations. On the other hand, there was a notable difference in growth

attainment with lowering of salinity and the highest growth was recorded in 5 ppt. Earlier, Raj & Raj⁴ observed better growth and survival of postlarval *P. monodon*, *P. indicus* (5-25 ppt) and *P. semisulcatus* (15-25 ppt) in low saline ranges. Bray *et al.*⁵ also reported that juveniles of *P. vennamei* grow efficiently in 5 and 15 ppt salinity compared to high saline media. All these findings clearly indicate that low saline environment induces growth processes in juvenile penaeid shrimps. Nevertheless, salinity preference may be species specific and size dependent too. In natural environment such as estuaries (natural nursery of penaeids), it is possible that different species may be inhabiting different salinity regimes which are most conducive for their growth. Therefore, it is imperative that optimum salinity requirement for various life stages of cultivable species of penaeid shrimps is identified so that necessary manipulations can be made to hasten growth processes in commercial culture ventures. Since efficient food utilization takes place under optimum saline condition, expenditure on feed can be considerably reduced.

As in other crustaceans, moulting is the process by which growth is manifested in penaeid shrimps. However, in the present study moulting frequency did not vary with salinity variations. All specimens moulted on an average 4 times during the course of the experiment with an inter-moult period of 5-7 days. This clearly demonstrates the fact that weight gained during the inter-moult period was significantly different between salinities and that 5 ppt salinity was ideal for growth of juvenile *M. dobsoni*.

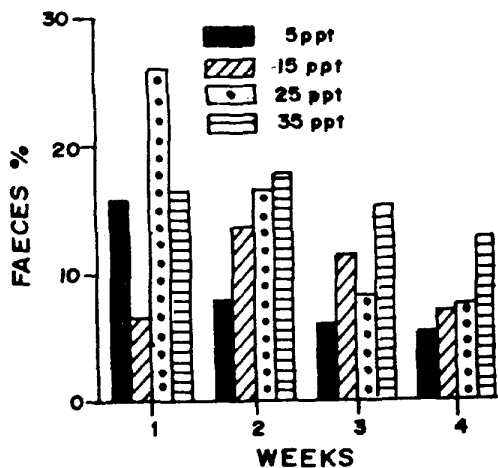


Fig 3—Weekly faecal production over weekly ingested food (% dry wt) of juvenile *Metapenaeus dobsoni* in different experimental salinities.

Table 1—Food energy partitioning in juvenile *Metapenaeus dobsoni* in different salinities (weights expressed as mg dry wt)

	Salinity (ppt)			
	5	15	25	35
Initial weight (W1)	67.3	62.8	69.1	64.4
Final weight (W2)	130.0	93.4	119.5	96.3
Production (P=W2-W1)	62.7	30.6	50.4	31.9
Consumption (C)	82.4	112.1	136.1	185.1
Faecal production (F)	6.4	10.4	17.8	18.8
Assimilation (A=C-F)	76.0	101.6	118.4	166.4
Metabolism (R=A-P)	13.3	71.0	68.0	134.5
Assimilation efficiency A/(Cx100)	92.2	90.7	87.0	89.9
Gross growth efficiency K1=P/(Cx100)	76.1	27.3	37.0	17.2
Net growth efficiency K2=P/(Ax100)	82.5	30.1	42.5	19.2
Food conversion ratio (C/P)	1.3	3.6	2.7	5.8

Growth efficiency factors are available for juveniles of some species of Indian penaeid shrimps fed different types of diets¹²⁻¹⁸. But, none of them are in relation to salinity and therefore comparisons are difficult. Nonetheless, in most of the cases assimilation efficiencies were quite high as in the present study, but gross growth and net growth efficiencies (K1 and K2) were low, indicating poor food utilization and conversion. This may probably be due to the fact that these studies were not conducted under optimum salinity conditions required for the species concerned. The present study provides evidence to this fact because K1 and K2 values were almost double in 5 ppt salinity compared to second highest values. Low faecal production (8.9% of ingested food) and efficient food utilization and conversion (FCR=1.31) also substantiate the fact that 5 ppt is the ideal saline environment for growth of juvenile *M. dobsoni*.

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