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Food utilization, growth and lactate dehydrogenase activity of the prawn, *Metapenaeus dobsoni* (Miers) fed with commercial diet

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An assessment of commercial diet and its impact on conversion efficiency, growth parameters and an enzyme, lactate dehydrogenase (LDH) activity in the eye was made. The test organisms (*Metapenaeus dobsoni*) were grown in the laboratory using commercial diet (low protein, high carbohydrate and no lipid). It was observed that the growth rate using this diet was not encouraging and could not transform energy at optimum level resulting into low protein and high carbohydrate levels in the edible tissue of the prawns. LDH activity decreased with the growth of the prawns fed on this diet. Three isozymes of LDH were observed in the eye tissue. No effect of this diet could be noticed on the isozyme patterns. The commercial diet used in the present study showed marked effect on the activity of LDH in the eye but could not influence the isozyme patterns of LDH.

Semi-intensive culture systems are widely practised to increase aquatic production and maximum emphasis are laid on prawn cultivation[1]. In such culture systems apart from proper management strategies quality and utilization of food are the key factors to determine the success. Published reports[2-4] indicate that quality of food in terms of energy components and stability of diet in water determine the food uptake, conversion and growth rate.

The growth rate in prawns depend on the dietary inputs and various metabolic processes which are responsible to influence food conversion efficiency and have a direct impact on different biochemical components and calorific value of the edible tissue. Earlier studies[5,6] reported that diets with different protein content had significant effect on the growth rate of prawns. Growth hormones are also known to play an important role in enhancing the growth rate in crustaceans. Prawns contain growth inhibitory hormone (GIH) in the eye which affect the function of vitellogenesis stimulating hormone (VSH). Moreover, eye also contains moult inhibiting hormone (MIH) which effects the moulting frequency[7].

Nutritional studies in prawns[8,9] have been confined to dietary trials, whereas, investigations on bioenergetics and digestive physiology have received less significance. In the present investigation, laboratory experiments were designed to asses the role of commercial diet on growth and to have an insight into the conversion of bioenergy from food to edible tissue of prawns with the advancement of growth. Further, an attempt was also made to study the lactate dehydrogenase (LDH) activity in the eye and its possible role in influencing digestive physiology and growth.

Material and Methods

Samples of the prawn *Metapenaeus dobsoni* (Miers) were collected from an estuarine creek located at Shiridao (lat. 15° 24'N; long. 73° 52' E) where traditional stake net fishery is being practiced during the major period of the year. The live prawns after transportation to the laboratory were transferred to the rearing tanks and fed with squid and clam meat diet for about one week, which also served as a period of acclimatisation for the prawns before the onset of the experiment. Feeding was done twice a day at the rate of 10% of body weight. The water quality was maintained by addition of good quality seawater every alternate day.

The test diet was obtained from Hindustan Lever Pvt. Ltd., Bombay, one of the large scale prawn feed producer. The diet was analysed for its biochemical constituents and found to contain high amount of carbohydrate, low in protein and with no lipid content.

The glass tanks (1 cubic feet capacity) with a fine mesh substratum were used. These containers had a tapering end connected with a siphon tube to remove excreta and unutilized food material. Ten prawns were kept in each tank during the experimental period of 35 days. All the experiments were carried out in triplicates. The samples for the assessment of growth were collected at an interval of 5 days. At this time each prawn was removed and weighed for growth increment. Then, the edible tissue was dried at 60°C and used for biochemical (protein[10], carbohydrate[11] and lipid[12]) estimation. Simultaneously, another prawn was removed and stored at –20°C to study the enzyme activity in the eye of the prawn. The total energy content of the body tissue was calculated on dry weight[13].

LDH activity was assayed with lactate as the substrate[14]. Polyacrylamide gel electophoresis (PAGE) was conducted wherein, the protein extract was loaded in 12% starch gel prepared in histidine buffer (0. 005 *M* histidine hydrochloric acid adjusted to *p*H 7.0 with 0.1 *N* NaOH). Electrophoresis was carried out at 25 mA and 150 V for 12 hours.

Results and Discussion

The selection of a diet in aquatic cultivation should basically consider some of the aspects like stabilty, acceptability, conversion efficiency, assimilation efficiency, etc. The changes in weight gain as a function of growth displayed an increasing trend (Fig. 1). A direct relationship between the faecal output and the weight gain was observed (Table 1). Assimilation efficiency was also very less in the initial period of the experiment, however during the later stages higher values were observed which showed a sign of stagnation during the end of the experimental period as the supplied food was the only source of nutrient in the tanks Due to poor stability of the food, its availability to the cultured prawns was not at an optimum level[2]. On the other hand the acceptability was also not satisfactory.

The values of consumption rate per unit weight per day ranged from 0.082 to 2.349, with minimum values in the initial period and attained maximum value at the termination of the experimental period, which reflects the poor acceptability of the food[2]. Observations on relative growth indicate that the

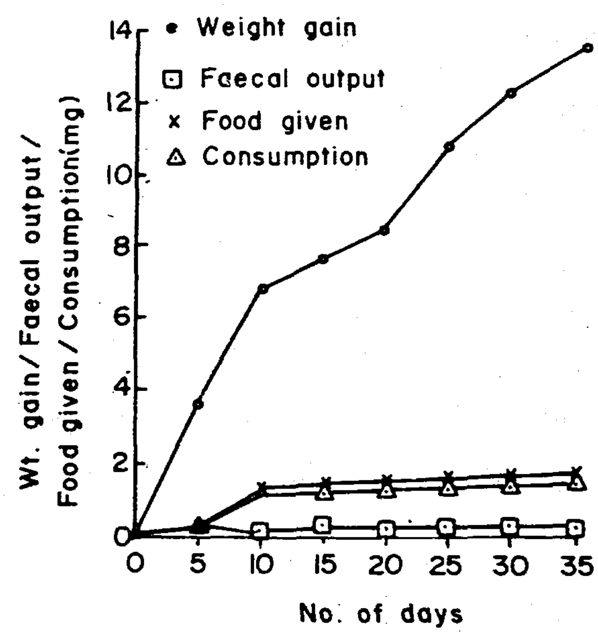

Fig. 1—Variation in the weight gain, food given, faecal output and consumption in the prawn *Metapenaeus dobsoni*.

Table 1—Regression analysis alongwith correlation coefficient(r) of various parameters with the weight gain (Y)

Regression equation	r value	F ratio	p value
Y=–0.3489 + 6.7112 Food given	0.9507	56.4634	0.00029
Y= 0.3599 + 44.99 Faecal output	0.9717	101.8815	0.00005
Y=–0.1129 + 7.5439 Food consumed	0.9259	36.0502	0.00096
Y= 63.2167-0.725 Protein	0.9658	83.3294	0.00010
Y=–11.9213 + 0.9722 Carbohydrate	0.9056	27.3870	0.00195
Y=23.1264-4.3179 Lipid	–0.9595	69.7698	0.00016
Y= 83.2167-13.7488 Energy	–0.8888	22.5712	0.00316

growth rate was not satisfactory. The values of gross growth efficiency (K1) and net growth efficiency (K2) were also very low (Table 2).

The consumption of feed was very less in the beginning of the experiment. A rapid increase for the first ten days was observed and then a steady increase at low magnitude up to the end of the experiment was noticed (Fig. 1). No much differences in the values of gross and net food conversion efficiency were observed, thus indicating that the organisms were adjusting themselves to the quality of the food supplied. It is evident from the observations made in the present investigation, that the quality of food given was not adequate and hence the cultured prawns could not assimilate at an optimum level[15].

Although an increase in consumption, assimilation and metabolism was observed, no marked increase in the weight gain was noticed. In the present experiment as the environmental factors and the food supply were kept constant probably the quality of food was the major factor affecting the growth rate[2,4].

The variations in the biochemical composition of the edible tissue of the prawn during the experimental period (Fig. 2) indicate that the protein level in the tissue was decreasing whereas the carbohydrate level was increasing. New[4] reviewed the influence of the protein level and its source on the growth of several prawn species and opined that 53.5 % protein as the optimum level in the diet for culture of *Penaeus monodon*. Cuzon, *et al*[2]. suggested that high protein content in the diet is responsible for the increased growth rate in the prawns. In the present study, the lipid level of edible tissue was constant for first five days and then decreased gradually. The percentage of carbohydrate and protein in the diet through its role in metabolic pathways affect the body lipid level[16].

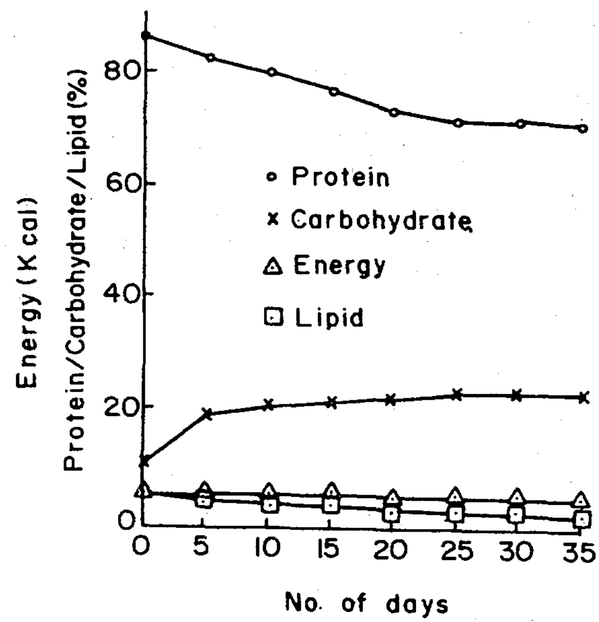

Fig. 2—Variation in the biochemical constituents and energy in the prawn *Metapenaeus dobsoni*.

Table 2—Growth parameters bassed on dry weight basis of *Metapenaeus dobsoni* during the experimental period

	Experimental period (days)							
Parameters	0	5	10	15	20	25	30	35
Initial weight W1 (mg)	93.5	93.5	97.0	100.3	101.1	101.9	104.3	
Final weight W2 (mg)	93.5	97.0	100.3	101.1	101.9	104.3	105.8	107.3
Mean weight W (mg)	93.5	95.25	98.65	100.7	101.85	103.05	105.05	106.55
Consumption C (mg)	38.2	170.2	1086.1	1092.7	1131.7	1171.5	1210.3	1257.3
Faecal output F (mg)	31.1	69.5	101.7	145.3	185.0	226.1	265.9	304.9
Assimilation A (mg)	7.1	100.7	984.4	947.4	946.7	945.4	944.4	946.4
Assimilation efficiency (%)	18.6	59.2	90.6	86.7	83.7	80.7	78.0	75.6
Consumption\ unit weight (c/w/d)	0.082	0.357	2.202	2.17	2.23	2.273	2.304	2.349
Production P =W2-W1 (mg)	0.0	3.5	6.8	7.6	8.4	10.8	12.3	13.8
Gross growth efficiency(K1)	0.0	0.020	0.006	0.007	0.0074	0.0092	0.0101	0.011
Net growth efficiency (K2)	0.0	0.034	0.007	0.008	0.009	0.011	0.013	0.014
Relative growth rate (p/w/d)	0.0	0.0073	0.0138	0.0151	0.0165	0.0210	0.0234	0.0259
Metabolism (R=A-P)	7.1	100.7	984.4	947.4	946.7	934.6	932.1	932.6
Dry weight increase/day	0.0	0.73	0.66	0.16	0.16	0.30	0.28	0.28

The energy content increased initially but later, it followed a decreasing trend which could be mainly due to lack of proportionate increase in carbohydrate to compensate the fall in protein content as carbohydrate is the primary source of energy in the crustaceans[17].

The protein concentration in the eye decreased throughout the experiment however, the decrease was steep in the initial stages whereas later the decrease was at low magnitude (Fig. 3). Such observations could be mainly related to the dietary input wherein the diet contained low protein and no lipid. During the experimental period as the supplied diet was the only source of nutrition, the prawns in the later phase of the experiment were used to take up this diet thus showing very low value (0.04 %) rate of decrease in the protein which highlights the important role of carbohydrate to compensate the protein defficiency[15]. Thus we report that the nutrition could affect even the eye tissue which are involved in the growth of prawn.

The specific activity and the activity of LDH in the eye increased for the first few days and then showed a decrease during the remaining period. As far as the intensity of isozyme bands was concerned, no marked changes could be observed (Fig. 4) either in the starch and the native PAGE. In the present study the LDH activity in the eye tissue was observed to be very less (20 μmol/min) as compared to the muscle tissue (186 μmol/min). However LDH activity in the eye increased for the first five days. Such increase in the initial period could be due to high catalytic efficiency of LDH. During the later period of the experiment the LDH activity in the eye decreased. Such changes in the enzymatic activity with time might be due to true alterations in the amount of enzyme or to the variation in catalytic activity of an enzyme. Lee *et al*[18]. and Sridhar, *et al*[19]. stated that decrease in some of the enzymatic activities may be due to low content of protein in the diet. Thus the activity of LDH not only in the muscle tissue but also in the eye could reflect the digestive physiology of the prawn.

Three isozymes of LDH were detected in the eye tissue (Fig. 4). In natural environment the development of the tissue is dependent on the quality and availability of food. Although the LDH activity in the prawn eye was affected by the diet, no change in its isozymes were observed.

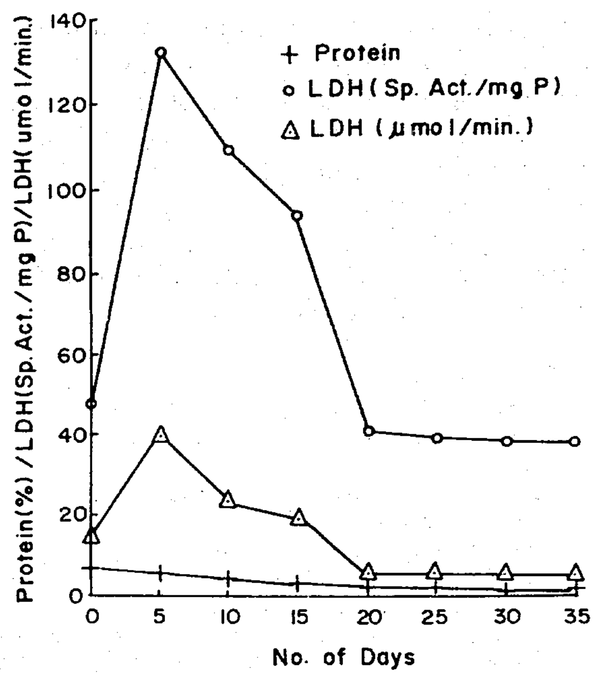

Fig. 3—Variation in the protein content, LDH activity in the eye of the prawn *Metapenaeus dobsoni*.

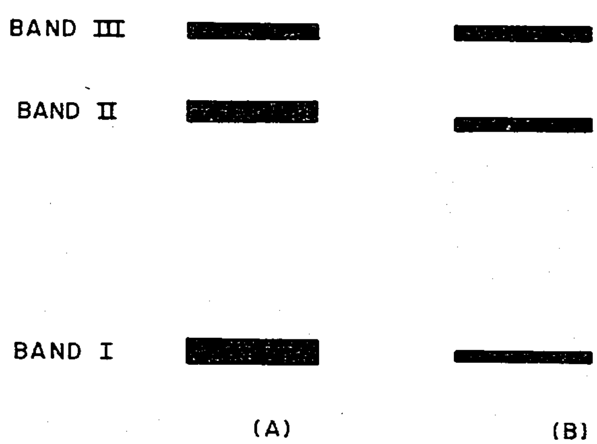

Fig. 4—Isoenzymes of LDH on native PAGE and starch gel from the eye of the prawn *Metapenaeus dobsoni*.

Although the food provided was not acceptable to the cultured prawns, they could utilise and assimilate the diet during the later stages of the experiment as it was the only source of nutrition. The calorific values of the edible tissue were observed to follow a declining trend. The diet showed pronounced effect on the activity of LDH in the eye but could not influence the isozyme patterns of LDH. Thus it can be stated that there was no effect of the food given on the isozymes of the LDH in the eye. Further, it appears that change in the catalytic efficiency of LDH might be governed by the composition of the food. The present study although throws some light on the LDH activity in the eye of the prawn, no much information is available on this enzyme and its possible role in the growth of this species.

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