



## Short Communication

# Effect of dietary protein on the growth of spiny lobster *Panulirus homarus* (Linnaeus)

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### Abstract

Feeding experiments were conducted on the spiny lobster *Panulirus homarus* (Linnaeus) with pellet diets containing three protein sources viz., fish meal (diet A), squid meal (diet B) and clam meal (diet C). The protein (%) and digestible energy levels ( $\text{kJg}^{-1}$ ) were 34.2, 35.8, 35.5 and, 13.75, 13.95, 13.94 respectively for diet A, diet B and diet C. The results indicate that the clam meal diet gave the highest growth of 10.9% ( $\pm 1.99$ ), followed by squid meal 7.3% ( $\pm 0.97$ ) and fish meal 6.9% ( $\pm 0.56$ ). The protein energy ratio was almost equal for all the diets. The one - way ANOVA indicated that weight gain, protein efficiency ratio (PER) and food conversion ratio (FCR) were significantly different ( $p < 0.05$ ) among the groups receiving different diets but the food consumed was not significantly different.

**Keywords:** Dietary protein, pellet diet, growth, spiny lobster

### Introduction

The spiny lobster *Panulirus homarus* is an important omnivorous species occurring predominantly along the east coast of India. Good growth is obtained under captive rearing with conventional diet like meat of the clam *Meretrix casta* (Vijayakumaran and Radhakrishnan, 1984; Radhakrishnan and Devarajan, 1986). Mohamed and George (1968) and Thomas (1972) have reported the growth of *P. homarus* by feeding with brown mussel *Perna indica*. This study was undertaken to test the efficiency of formulated dry pellet diet for rearing the spiny lobster *P. homarus* under captivity.

### Material and methods

Using dry packing, healthy spiny lobsters collected from the wild were transported to the laboratory at Kovalam, near Chennai. The initial mean weight of the lobsters was  $165.8 \pm 5.18\text{g}$  (carapace length:  $55.5 \pm 1.34\text{mm}$ ). They were stocked in one tonne FRP tank with seawater (salinity 37 ppt; pH 8.0; dissolved oxygen  $3.5\text{ml L}^{-1}$ ; temperature  $20^\circ\text{C}$ ) and provided continuous aeration.

Three isoproteic experimental diets with  $35.2 \pm 0.39\%$  protein with fish meal (mainly, silverbellies: diet A), squid meal (mainly *Loligo* sp.: diet B) and clam meal (*Meretrix casta*: diet C) were prepared (Table 1) following Johnston *et al.* (2003), Garcia-Ulloa *et al.* (2003) and George *et al.* (1973). The other ingredients were starch (refined wheat flour-18.0g), de-fatted ground nut oil cake powder (30.0g), fish oil (Seven Seas cod liver oil-4.0g) and vitamin and mineral mixture 3.0g in 1:1 ratio (Villarreal *et al.*, 2006). The ingredients were mixed thoroughly and the dough was prepared by adding water (Kandasami *et al.*, 1987; Easterson *et al.*, 1989), introduced into a hand extruder for 3 mm pellets. The pellets were dried at  $50^\circ\text{C}$  for 48 h, and stored at  $-20^\circ\text{C}$ . The proximate composition (Table 1) of the diet was determined following Oser (1979) and Chow (1980). The hydro-stability was tested by weighing 5 g of each experimental diet in pre-weighed net pouches in triplicate and immersed in filtered sea water. The pouches were removed at an interval of 15, 30, 45 and 60 min., rinsed carefully in double distilled water and dried in a hot air oven at  $60^\circ\text{C}$  and weighed. The dry matter loss was

calculated in percentage (Table 2). The energy levels, food conversion ratio (FCR), protein efficiency ratio (PER), apparent digestibility coefficient (ADC) and specific growth rate (SGR) were estimated following Cortes-Jacinto *et al.* (2004), Jover *et al.* (1999) and Bureau *et al.* (1999).

Digestible energy (kJ) = 23.0 kJg<sup>-1</sup> for protein, 16.7 kJg<sup>-1</sup> for carbohydrate and 37.6 kJg<sup>-1</sup> for lipid.

Food assimilation = 100 x (Food consumed (g) – faecal matter (g)) / Food consumed (g).

Apparent digestibility co-efficient (ADC) = 1 – (F / D x Di / Fi) where F = % nutrient (or kJg<sup>-1</sup> gross energy of faeces); D = % nutrient (or kJg<sup>-1</sup> gross energy of diet). Di = % digestion indicator (acid insoluble ash of the diet); Fi = % digestion indicator (acid insoluble ash) of the faeces.

Food conversion ratio (FCR) = food intake (g dry weight) / weight gain (g wet weight).

Specific growth rate (SGR) =  $\ln W_r - \ln W_i \times 100 / T$ ; where  $W_r$  = final individual weight;  $W_i$  = initial individual weight and T = feeding period.

Protein efficiency ratio (PER) = Weight gain (g) / protein intake (g) (Bureau *et al.*, 1999; Jover *et al.*, 1999 and Cortes-Jacinto *et al.*, 2004).

Table 1. Composition of pellet diet offered to the lobster *P. homarus* using three different protein sources for 45 days

Ingredients	Diet A	Diet B	Diet C
Starch (maida)(g)	18.0	18.0	18.0
Ground nut oil cake (g)	30.0	30.0	30.0
Fish Oil (Cod Liver Oil) (g)	4.0	4.0	4.0
Vitamin and mineral mix (g)	3.0	3.0	3.0
Proximate composition			
Crude Protein %	34.2	35.8	35.5
Crude Fat %	7.6	7.2	7.1
Ash %	7.8	8.2	6.3
Carbohydrate %	31.2	31.8	32.2
Digestible Energy (DE) kJg <sup>-1</sup>	13.75	13.95	13.94
P:E (mg J g <sup>-1</sup> )	1:2.4	1:2.34	1:2.36

Each treatment was experimented with four replicates. The volume of water in each tank was 50 litres and water was exchanged completely every day. Following acclimation, lobsters were individually blotted dry with tissue paper, weighed and tagged with small circular tabs of water proof

paper glued to the carapace. The lobsters were fed at the rate of 5% body weight per day. The diet was split into the following two meals: 30% fed at 08.30 h and 70% at 17.30 h. Uneaten pellets were collected at 10.30 h and 19.30 h, siphoned on to a 1 mm mesh screen, rinsed with fresh water to remove residual salt and stored at 40°C. Uneaten feed was dried at 100°C for 16 to 20 hours. Growth trial was conducted for 45 days. Animals were weighed every eighth day and daily rations were altered based on the biomass. Molts were recorded and the molted lobsters were retagged again. The pH of seawater during the experiment ranged from 8.0 to 8.3, salinity 39.0 ppt, dissolved oxygen 3.9 to 5.0 ml L<sup>-1</sup> and temperature from 27.5°C to 29.2°C. Difference between treatments was determined using one-way analysis of variance (ANOVA) at 0.05 significant levels (Snedecor and Cochran, 1967).

## Results and Discussion

The survival rate at the end of the 45-day experiment was 100%. Crear *et al.* (2000) obtained a survival rate of 98% for *Jasus edwardsii* while Saez-Rouela *et al.* (2002) reported survival rate of only 50.5% for the juvenile white-clawed crayfish fed with pelleted feed. The hydro-stability test indicated that the weight loss of the pellets was maximum (9.8%) after one hour. However the lobsters started collecting the pellets soon after these were dispensed in water. The duration of consumption was only 30 minutes from the time of dispensing. Therefore the loss of nutrients during the consumption time was only ≈ 4.0% (Table 2).

Table 2. Dry matter loss (%) in the test diets at different time intervals (values are mean of the three replicates)

Duration (minutes)	Fish meal	Squid meal	Clam meal
15	2.1	2.3	2.4
30	3.6	3.9	3.8
45	5.2	5.0	5.2
60	9.8	10.0	9.7

The results (Table 3) indicated that food consumption of *P. homarus* was more in the group fed on fish meal diet (31.1 ± 2.0 g) followed by clam meal (28.6 ± 1.9 g). Even though the digestible energy of the diet was almost equal (13.75 to 13.95 kJg<sup>-1</sup>), the efficiency of the diets differed from one another. The ADC was high (≈ 90.0%) for all the

diets. Jones and De Silva (1997) reported ADC of 80.2% to 94% for the Australian crayfish *Cherax destructor* Clark. The clam meal fed group showed higher growth per day (0.38 g), followed by other two groups (0.25 to 0.27 g). Radhakrishnan and Vijayakumaran (1984) and Vijayakumaran and Radhakrishnan (1984) have reported the growth of clam meat fed *P. homarus* (eye stalk ablated) as 0.30 g per day. Mohamed and George (1968) reported the growth of *P. homarus* as  $0.21 \pm 0.02$  g per day by mark-recovery experiment. In the present study, lobsters fed with pelleted feed showed a mean growth rate of 0.3 g per day.

of *P. ornatus* was significantly greater ( $p < 0.05$ ) on shrimp feed than on pellet diet.

Among the three pelleted dry feeds prepared from locally available protein ingredients, the feed prepared with clam meal was found to be better than feeds prepared with other sources of protein viz., fish meal and squid meal.

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Table 3. Nutritional evaluation of the lobster *P. homarus* using three different protein sources for 45 days; all values are based on four replicates; values in parentheses are standard deviation.

Parameters	Fish meal	Squid meal	Clam meal
Food consumed (g)	31.14 (2.04)	28.53 (1.25)	28.63 (1.9)
Faecal matter (g)	2.88 (0.36)	3.35 (0.53)	2.68 (0.23)
Food assimilation (g)	28.26	25.18	25.95
Apparent Digestibility Co-efficiency (ADC)	90.08 (0.70)	90.55 (2.65)	90.39 (1.37)
Food Conversion Ratio (FCR)	2.49 (0.7)	2.48 (0.19)	1.64 (0.14)
Relative growth rate (%)	6.94 (0.56)	7.30 (0.97)	10.93 (1.99)
Absolute growth (g)	0.27 (0.03)	0.25(0.01)	0.38 (0.02)
Specific Growth Rate (% body weight/day)	0.15 (0.01)	0.15 (0.02)	0.23 (0.4)
Protein consumed (g)	6.67 (0.61)	9.22 (0.62)	10.49 (0.85)
Protein Efficiency Ratio (PER)	1.21 (0.17)	1.14 (0.08)	1.75 (0.13)

Crear *et al.* (2000) have reported SGR of 1.20 -1.32, survival of 98% and FCR of 1.26-1.29 for the southern rock lobster *Jasus edwardsii* at 18°C. In the present study, the SGR was high in the clam meal fed group  $0.23 \pm 0.04\%$ . The FCR of the diets A, B and C were 2.49, 2.48 and 1.64 respectively. The PER was 1.21, 1.14 and 1.75 for the diets respectively for A, B and C. Vijayakumaran and Radhakrishnan (1984) reported that the FCR of the lobster *P. homarus* fed with fresh clam meat ranged from 2.2 to 6.6 (mean: 4.92).

The one way ANOVA indicated that weight gain, protein efficiency ratio and food conversion ratio were significantly different among the three groups ( $p < 0.05$ ). On the other hand, food and protein consumption were not significantly different ( $p > 0.05$ ). Smith *et al.* (2003) reported that the growth

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