Effects of Stocking Density on Food Utilization in the Spiny Lobster Panulirus Homarus

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Abstract **- To study the optimum stocking density, spiny lobster *Panulirushomarus* was reared at different stocking densities (5, 10, 15, 20 &25 lobster / Glass tanks of 120 lit. capacity). The individuals were fed with natural feed like clam alone. Better feeding rate was found in the lobsters reared with 15 numbers / glass tank than maximum feeding rate (840 J/g live lobster / day) and absorption rate (731J/g live lobster/day) observed in higher density groups having 20 and 25 numbers / glass tank. The absorption efficiency was higher (98%) in the tank reared with 25 lobsters / glass tank. An increase in the stocking density also reduced the conversion rate and net conversion efficiency. Maximum conversion rate and net conversion efficiency of 569 J/g live lobster / day and 46% was recorded in the group having 15 individuals / glass tank and 25 numbers / glass tank showed minimum of 256 J/g live lobster / day and 31% respectively. Hence 15 individuals /glass tank was considered as optimum density for P.homarus.**

Keywords-Panulirushomarus, Stocking density, Food utilization, Conversion efficiency.

I. INTRODUCTION

The Indian spiny lobster *Panulirushomarus* occurs on the coast of Gulf of Mannar from Rameshwaram to Kanyakumari. The spiny lobster, *Panulirushomarus* and *Panulirusornatus* are suitable for culture, as they grow to the marketable size reaching an average weight of about 100g in a period of 4 months. Of the two species, *P.homarus* is quite suitable for growth and availability in Gulf of Mannar regions. Commercially viable hatchery production of spiny lobsters is still thought to be a long way off. Despite more than 30 years of research to develop a suitable compounded feed, it is not at all found out for rearing juvenilespiny lobster (Conklin 1980; Brown *et al* 1995). The juvenile spiny lobsters fed with mussel diets or clam diets have yielded superior growth and survivalrates compared to formulated diets (Crear*et al* 2000; Ward*et al*2003).Severalinvestigations have been conducted to determine optimal stocking densities for Palinurid and homarid lobsters (James et al 2001; Jones et al 2001). The present study was undertaken to assess the effect of stocking density on food utilization parameters of spiny lobster Panulirushomarus.

II. MATERIALS AND METHODS

The Indian spiny lobsters *Panulirushomarus* were collected from local merchants at sea shore area of Tuticorin. The individuals were acclimated for fifteen days. After acclimation period the length and weight were noted down. The average weights of the *P.homarus* were between 70 and 80g.

Experiments were conducted on lobsters using a set of glass tanks of 120 litre capacity connected in a flow through system. Aeration by means of two airlines promoted mixing of the water column.

In the density trial, the juvenile lobsters were stocked at 5, 10, 15, 20 and 25 individuals in 3 different tanks of same size. All treatments were run in triplicate. For the juveniles, shelters were provided in each tank. Lobsters were fed with live clam only (with shell) twice daily of about 5-10% of their body weight. Excess feed was removed after 3 hours of feeding. Water quality was monitored daily. The water quality parameters like temperature, Salinity and pH were maintained at 28 – 32^{o}C, 30 – 40ppt and6.5 – 8.5 respectively. In addition to the left feed the moulted shells of lobster was also removed periodically.

The weight and length of the lobsters were measured once in every week after introduction into the experimental tank. This was done by using mettler balance and scale. The total duration of the experiments was 60 days. All experimental lobsters were weighed and measured after the completion of the experiment.Calorific content of test lobster, food &faeces were determined by semi-micro bomb calorimeter.

1) Energetics **:** The scheme of energy balance followed in the present study is based on the IBP formula (PetruseWicz&Mac Fayden 1970) represented as

$$C = P + R + U + F$$

Where ‘C’ represents the food energy consumed, ‘P’ energy of growth, ‘R’ energy expended as total metabolism, ‘U’ energy of nitrogenous materials and ‘F’ energy of faecal matter. Absorption (A) was estimated by subtracting F from C. Food energy converted into body structure (P = growth) was estimated by calculating the difference between the energy contents at the beginning and at the end of the experiment.

The following formulae were used for calculation of the different parameters of energy budget.

$$\text{Feeding rate (Fr) (J/g live fish / day)} = \frac{\text{Average food consumed (J/day)}}{\text{Initial live weight of fish (g)}}$$

$$\text{Absorption rate (Ar) (J/g live fish / day)} = \frac{\text{Average food consumed (J/day)}}{\text{Initial live weight of fish (g)}}$$

$$\text{Conversion rate (Cr) (J/g live fish / day)} = \frac{\text{Average food consumed (J/day)}}{\text{Initial live weight of fish (g)}}$$

$$\text{Absorption efficiency (J/g live fish / day)} = \frac{\text{Food absorbed}}{\text{Food Consumed}} \times 100$$

$$\text{Net conversion efficiency (K2) (\%)} = \frac{\text{Food Converted}}{\text{Food absorbed}} \times 100$$

III. RESULTS AND DISCUSSION

Except absorption efficiency all food utilization parameters were affected by the increase in stocking density (Table 1). Feeding rate decreased significantly from 840 J/g live fish / day in control (15 individuals / glass tank) to 422 J/g live fish / day inthe density group of 25 individuals / glass tank. Maximumconversion rate and conversion efficiency were observed in lobsters reared in 15 individuals / glass tank and they averaged to 569 J/g live fish / day and 46% respectively. Minimum conversion rate and conversion efficiency of 256 J/g live fish / day and 31% respectively were observed in the highest density group of 25 individuals / glass tank

TABLE 1
Effects of stocking density on food utilizationEffects of stocking density on food utilization in spiny lobster Panulirushomarus

Parameters	Density (Number of Individuals / Aquarium)				
	5	10	15	20	25
	(a)		(a_1)		(a_2)
Feeding rate	685±7.1	820±9.2	840±10.5	624±9.4	422±9.9
Absorption rate	570±9.6	706±10.9	731±6.9	452±11.2	385±8.3
Conversion rate	321±10.5	459±8.6	569±8.3	298±9.8	256±6.7
	(b)		(b_1)		(b_2)
Absorption efficiency	90±1.8	94±1.9	94±0.7	96±0.6	98±0.6
	(c)		(c_1)		(c_2)
Conversion efficiency (K2)	38±2.1	39±1.6	46±1.3	34±0.8	31±0.9

a - Non Significant; Vs a_1 - Highly Significant; Vs a_2

b - Non Significant; Vs b_1 - Highly Significant; Vs b_2

c - Non Significant; Vs c_1 - Highly Significant; Vs c_2

Maximum absorption rate of 731 J/g live fish / day was observed in the control (15 individuals / aquarium) and a minimum rate of 385 J/g live fish / day was observed in the highest density group of 25 individuals / aquarium. The absorption efficiency increased from 94% inthecontrol group (15 individuals / aquarium) to 98% in the highest density group (25 individuals / aquarium) (Table 1). Analysis of variance for the data on conversion rate indicated that the changes were significant (Table 2).

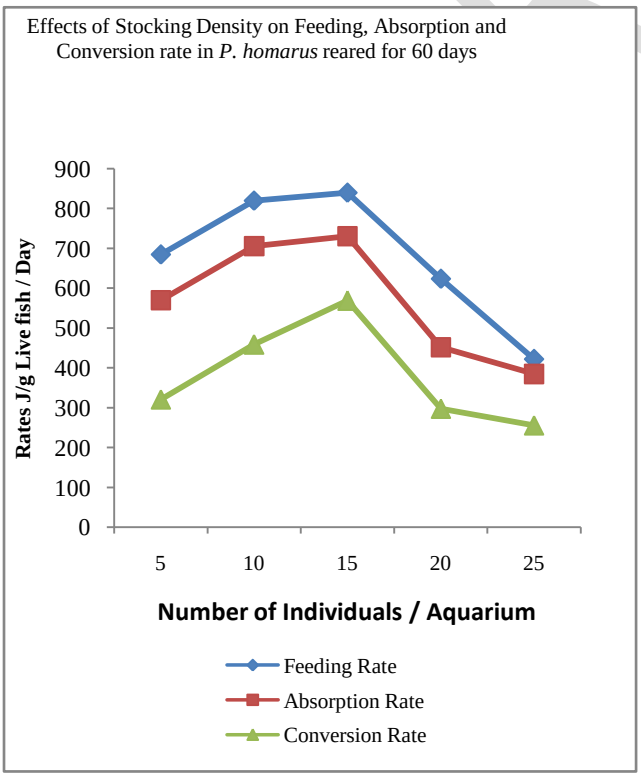
In this result, the growth rate was higher in low stocking density animals than higher stocking density, Van olst*et al*(1976) and Whale *et al*(2001) reported that the spiny lobsters are adversely affected in high stocking densities regarding their survival and moulting frequency. Ford *et al*(1988)also reported the hypothesis to be tested was that high population densities of juvenline lobsters limit the growth and survival of the western rock lobster. Rayns (1991) showed that stocking density affects the growth rate, feeding rate differently in the early and late juvenile stages of *Jasusedwardsii*. Crowding is considered a common aquaculture related obessor and produces a wide variety of effects on fish such as reduced growth, health and feed conversion ratios (Wedemeyer 1997). The results obtained from the experiment on density effects indicates that the increase in stocking density of *Panulirushomarus* has a significantimpact on food consumption and growth.

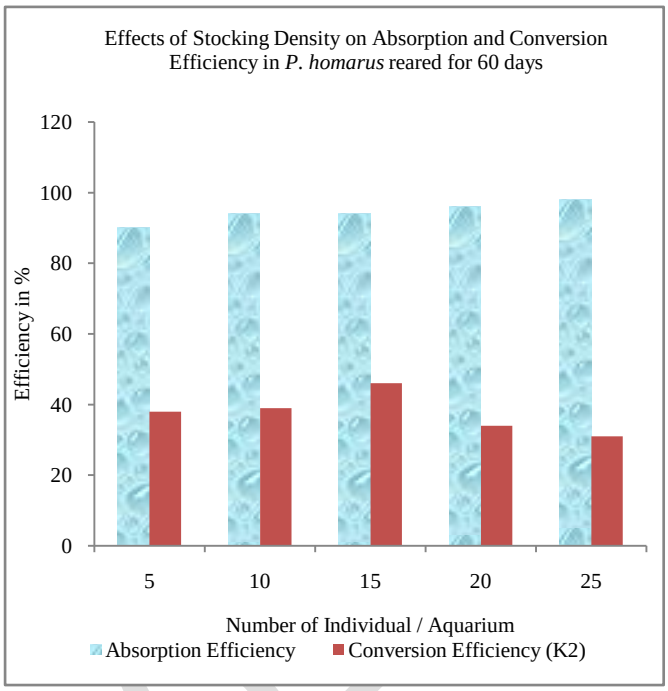
TABLE 2
Summary of analysis of variance for the date on the rates of feeding, absorption and conversion in relation to stocking density in *Panulirushomarus*.

Parameter	Source of Variance	SS	DF	MS	F	P*
Feeding rate	Between Samples	230224	4	57556	1.399	<.000
	Within Samples	205	5	41		
	Total Variation	230430	9			
Absorption rate	Between Samples	184650	4	46162	1.083	<.000
	Within Samples	213	5	42		
	Total Variation	184863	9			
Conversion rate	Between Samples	136968	4	34242	1.041	<.000
	Within Samples	164	5	32		
	Total Variation	137132	9			

P* - Highly significant

In this study maximum growth has been observed in the density of 15 individuals / aquarium. Space available per individual can influence the feeding rate and conversion efficiency. A lobster in the control group enjoyed a volume of 12 litres compared to 3 litres by a lobster in the highest densities. The lobster in the higher densities consume less and convert less efficiency when compared with the fish in the smaller density groups. Two factors can affect lobster physiology under crowded conditions. The rate of oxygen consumption and ammonia excretion are the factors that limit the carrying capacity of water.





The optimal stocking densities for maximum growth and survival of different lobsters were assessed by the Lee and Wickins (1992) and Waddy and Aiken (1995). The availability of appropriately sized crevice sheltershave been demonstrated as thepossible 'bottle necks' to future population size (Whale &Steneck 1991). These studies have demonstrated that the appropriately placed and optimum sized artificial structures can increase the local abundance of shelter limited species through greater survival rate of the juveniles (Beck 1997).

This study revealed that lobsters reared in 15 individuals / aquarium showed better rate of food intake and growth,whereas the lobsters reared in the highest stocking density (25 individuals / aquarium) showed poor rate of food intake and growth.

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