The Fourth Indian Fisheries Forum, Proceedings

24-28 November, 1996

held at

School of Marine Sciences
Cochin University of Science and Technology
Kochi 682 014
Kerala, India

Asian Fisheries Society, Indian Branch

1999

The Fourth Indian Fisheries Forum Proceedings
24-28, November, 1996. Kochi p. 193-195.
Published in 1999.

Effect of Salinity and Quality of Feed on Food Conversion Efficiency in the Post Larvae of the Prawn *Penaeus indicus* (H. Milne Edwards)

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Abstract

Food conversion efficiency of the postlarvae of *Penaeus indicus* was studied in three salinity regimes (low saline - 16.48 ppt., ambient sea water - 33.05 ppt. and high saline - 44.90 ppt.) using clam meat, a compounded feed and a combination of both as feeds. The survival ranged from 97.5 to 100% in low, 80 to 95% in ambient and 62.5 to 85% in high saline conditions. Maximum weight increase was recorded in clam-fed postlarvae in 33.05 ppt. The highest net energy conversion efficiency (19.1%) was recorded in clam-fed postlarvae in 33.05 ppt. salinity. Protein conversion efficiency was more than net energy conversion efficiency in pellet and mixed food fed postlarvae and lower in the clam fed ones. Protein efficiency ratio varied significantly between salinities and more so between feeds. The study shows that it is energetically expedient to grow postlarvae of *P. indicus* in salinities ranging from low (16.48ppt) to normal sea water.

Introduction

Among various parameters to study the effect of salinity extremes, food conversion efficiency has been described as a very sensitive indicator of changes, especially before attaining sexual maturity (Kinne, 1962). A change in metabolic rate due to the influence of salinity is assumed to be reflected in an increase or decrease in food conversion efficiency. In both fishes (Kinne, 1962) and crustaceans (Venkataramiah *et al.*, 1972), food intake and conversion were maximum at intermediate salinities and lowest values were recorded at both extremes of low and high salinities. Postlarvae of the Indian white prawn, Panaeus indicus, that migrate to estuaries, are subjected to wide fluctuation in salinity - very low during monsoon and extremely high in summer months, particularly in the east coast. Food conversion efficiency of *P. indicus* postlarvae have been evaluated under three salinity regimes, low, ambient (normal sea water) and high, using a compounded feed, clam meat and a combination of both. The three salinity regimes were chosen to simulate the saline conditions during monsoon, normal period and during summer months in most of the backwater regions along the east coast of India.

Materials and Methods

Hatchery reared postlarvae of *P. indicus* were exposed to three feeds (meat of the clam, *Meretrix casta*, a compounded feed and a combination of both) under three salinities - low: 16.48 ± 1.51; normal: 33.05 ± 0.48 and high : 44.90 ± 5.75 ppt. The compounded diet (Pellet) was made with fish meal, prawn head meal, wheat flour, tapioca powder and vitamin and mineral mixture. Crude protein content of the clam, pellet and the mixed food were 63.97, 32.46 and 44.78% respectively. IBP scheme of energy balance (Petrusewicz and McFadyen, 1970) was followed and the experiments lasted 28 days. Feeds were given *ad libitum* in the evening and the uneaten food and faeces were collected in the morning of the subsequent day. Ammonia excretion was estimated biweekly using phenol-hypochlorite method and the energy equivalent of 20.5 J for 1 mg of ammonia (Brafield, 1985) was used to estimate energy excreted as ammonia. Standard methods were followed for estimations of protein (Biunet) and calorific values (semi-microbomb calorimeter). Metabolic rate was calculated by difference since all other parameters of energy budget were estimated.

Results and Discussion

Survival was maximum (97.5 - 100%) in low and minimum (62.5 to 82.0%) in high saline water, with ambient sea water recording 80-95% survival. Highest weight increase was recorded for clam-fed postlarvae in normal saline and lowest for the pellet-fed ones in high saline waters. Weight increase for all feeds were significantly low ($p<0.05$) under high salinity. Weight increase varied significantly between salinities and also between feeds.

Feeding rate of *P. indicus* postlarvae does not seem to be affected under low and normal salinity. Maximum feeding rate (Table 1) was recorded in high saline water for all the three feeds, with the highest recorded for the pellet.

Conversion rate (Table 1) was highest in clam-fed prawns, followed by the mixed food and the pellet-fed ones in all salinities. Clam-fed postlarvae in low saline water had the highest net energy conversion efficiencies (19.15% without exuvia and 20.17% with exuvia) while the minimum (4.84% without exuvia and 4.97% with exuvia) was recorded in the pellet-fed ones in high salinity. For the same feed, conversion efficiencies did not vary much in low and normal saline conditions, but were significantly low ($p<0.05$) in high salinity. Analysis of variance (ANOVA) revealed that the food

Table 1. Rates of feeding, assimilation conversion and metabolism (jg^{-1} day^{-1}) and assimilation efficiencies (%) in postlarvae of *P.indicus* under different salinities and feed.

Salinity/Feed	Rate and Efficiency							
				Conversion rate			Metabolic rate	
	Feeding rate	Assimilation rate	Assimilation efficiency	Exuvia (E)	Growth (P)	P + E	Energy	ml/O_2g live body wt/hr
Clam								
Low saline	2156.12±	2101.93±	99.49±	21.31±	402.54±	423.85±	1672.79±	3.48±
	70.05	67.18	0.12	0.21	22.7	22.76	44.41	0.09
High saline	2379.23±	2366.59±	99.46±	20.75±	359.19±	379.94±	1986.51±	4.12±
	4.64	4.11	0.17	0.16	2.76	2.81	1.35	0.03
Normal saline	2156.06±	2144.78±	99.48±	18.98±	409.95±	428.93±	1715.85±	3.56±
	67.33	67.10	0.06	0.22	18.47	18.48	48.64	0.10
Clam + Pellet								
Low saline	2785.82±	2762.64±	99.17±	20.48±	386.60±	407.08±	2355.56±	4.88±
	32.02	30.60	0.08	0.21	54.52	54.67	23.91	0.05
High saline	3122.79±	3060.36±	98.00±	17.14±	330.70±	347.84±	2712.52±	5.62±
	314.04	319.96	0.22	0.12	3.77	3.81	316.19	0.66
Normal saline	2804.20±	2757.15±	98.32±	18.73±	379.12±	397.87±	2359.30±	4.89±
	180.24	187.90	0.32	0.19	0.27	0.34	187.68	0.31
Pellet								
Low saline	3980.30±	3804.56±	97.80±	8.01±	253.57±	261.58±	3542.98±	7.35±
	307.88	316.92	1.20	0.02	4.57	5.13	317.79	0.65
High saline	5228.49±	4912.68±	93.96±	6.07±	237.95±	244.02±	4668.66±	9.68±
	10.21	91.32	2.30	0.21	95.86	95.86	4.55	0.01
Normal saline	4490.10	4263.47±	94.95±	6.37±	264.62±	270.99±	3992.47±	8.23±
	83.09	88.95	1.98	0.12	43.24	45.17	0.09	

conversion efficiency is highly variable between salinities and more so between feeds.

Food conversion efficiency was observed to be maximum at 50% sea water for early juveniles of *Penaeus aztecus* (Venkataramiah *et al.*, 1972a,b) and between 20-25 ppt. in *P. indicus* postlarvae (Kalyanaraman and Paulraj, 1984). In this study, no significant variation was observed in food conversion efficiency of *P. indicus* postlarvae in low (50% seawater) and normal (sea water) saline conditions. The food conversion efficiency recorded for clam-fed postlarvae is comparable with those recorded for other species of penaeid prawns which varied from 22-30% with an average of 23.94% (Capuzzo, 1982) and for *Metapenaeus monoceros* (18.02%: Sumitra *et al.*, 1982). The food conversion ratio (FCR) obtained for clam and mixed food in low and normal saline conditions (1.26-1.9) is in the lower range of all values for penaeid prawns summarised by Capuzzo (1982).

The protein conversion efficiency (PCE) was maximum (21.37%) for mixed food in normal salinity and minimum for pellet in high saline conditions. The PCE was higher than net energy conversion efficiency in all treatments except in clam-fed postlarvae in normal salinity. This is in contrast to the observation in the juveniles of spiny lobsters which had lower PCE compared to net conversion efficiency (Vijayakumaran, 1990). The PCE in *P. indicus* postlarvae decreased with increase in protein content of food. The protein efficiency ratio (PER) was maximum in clam-fed prawns in all salinities and not so different for mixed food. The PER for clam and mixed food for all salinities (0.92-1.27) is well within the range for a number of crustaceans (0.5-2.7) reported by capuzzo (1982).

Ammonia excretion was low (9.41-21.47 $\mu gN\ g^{-1}h^{-1}$) in normal salinity and in both low and high salinities it increased irrespective of feed. Clam fed prawns excreted more ammonia (20.14-30.86$\mu gN\ g^{-1}$-h^{-1}) in all salinities. The trend in nitrogen excretion closely followed FCE/PCE ratio which increased with increase in protein content of feed as a result of more protein being catabolised for metabolic process.

The metabolic rate of pellet-fed prawns were significantly higher than those of clam-fed ones in all salinities and the maximum metabolic rate was in pellet-fed prawn in high saline water. Food, rather than salinity was the main factor for increasing the metabolic rate in low and normal salinity. In high salinity, metabolic rate was significantly more for all feeds, due to high feeding rate and the resultant calorigenic action (specific dynamic action) of food.

Partitioning of energy for various activities is best expressed by formulating total energy budgets for the organism. The energy budget for postlarvae of *P. indicus* (table 2) clearly demonstrates the effects of salinity and food on various energy utilization parameters. Energy loss as faeces and urine (F+U) increased with salinity for pellet and mixed food, but not for

Table 2. Energy budget for postlarvae of *P.indicus* fed on natural and pelleted feed and reared under different salinities

Treatment	Energy Parameters				
	C	F + U	E	P	R
Clam					
Low saline	100	0.67	1.01	19.02	79.30
High saline	100	0.53	0.87	15.10	83.50
Normal saline	100	0.52	0.88	19.01	79.59
Pellet					
Low saline	100	2.20	0.20	6.52	91.08
High saline	100	6.04	0.12	4.55	89.39
Normal saline	100	4.18	0.14	5.99	89.39
Clam + Pellet					
Low saline	100	0.83	0.73	13.88	84.55
High saline	100	2.00	0.55	10.59	86.86
Normal saline	100	1.68	0.67	13.52	84.13

C = Consumption; F = Faeces; U = Urine; E = Exuvia
P = Production (growth); R = Respiration

clam due to low faecal output. High values recorded for pellet in all salinities are due to increased feeding rate and comparatively low absorption efficiency. The result indicates that it is energetically expedient to grow postlarve of *P. indicus* between 15-35 ppt and exposure to high salinity condition should be avoided.

Acknowledgements

The author wishes to express his gratitude to Dr.M.Devaraj, Director, Central Marine Fisheries Research Institute, Kochi and to Dr.P.V. Ramachandran Nair, retired Joint Director of CMFRI for their advice and encouragement in the study.

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