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L.H. SIPAÚBA-TAVARES *is from Universidade Estadual Paulista (UNESP, Centro de Aqüicultura), Rodovia Carlos Tonanni km 14870-000, Jaticabal, SP, Brazil.* **F.M. DE S. BRAGA** *is from Universidade Estadual Paulista (UNESP, Depto. De Zoologia), Av. 24 A 1515, 13500-000, Rio Claro, SP, Brazil.*

Preliminary Observation on Culture of *Penaeus monodon* in Low-Saline Waters

S.B. Saha, S.B. Bhattacharyya and A. Choudhury

Abstract

The feasibility of semi-intensive culture of *Penaeus monodon* in low saline environment was investigated by comparing the growth and production in low (0.16 - 6.52 ppt) and high (4.60 - 19.42 ppt) saline areas at two stocking densities (10.5 and 16 individuals/m^2). After 135 days of culture, yield of shrimp in low and high stocking densities was 1 563.37 kg/ha and 2 274 kg/ha, respectively, in low saline ponds, and 1 173.00 kg/ha and 1 974.00 kg/ha, respectively, in high saline ponds. Food conversion ratio (FCR, 1.31 - 1.58) and specific growth rate (SGR 21.04 - 21.19%) were higher in low saline ponds as compared to high saline ponds (FCR, 1.35 - 1.68; SGR, 19-22 - 19.88%). Growth of shrimp was satisfactory in low saline ponds even when salinity decreased after 60 days of culture to almost freshwater level (0.16 ppt) indicating the viability of semi-intensive culture of *P. monodon* in low saline environment.

Introduction

There has been a considerable increase in the culture of brackishwater shrimp, due to its export potential. The traditional shrimp culture methods have given way to extensive, modified extensive and semi-intensive systems, categorized according to stocking densities and input use. Muthu (1980) and Karthikeyan (1994) recommended a salinity range of 10 - 35 ppt, while Chanratchakool et al. (1994) and Rajyalakshmi (1980) recommended a salinity range of 10-30 ppt and 15-20 ppt, respectively, for culture of *P. monodon*. Chen (1984) opined that a salinity range of 15-22 ppt is optimal for culturing *P. monodon* in high saline coastal areas. But it is generally accepted that *P. monodon* can grow as well in almost freshwater condition (ASEAN 1978). There are about 850 brackishwater *bheries* (impoundments) covering an area of about 25 460 ha in the northern Sundarbans of West Bengal, India, where salinity ranges from 0.3 - 16 ppt. These *bheries* are being used for traditional culture of fresh/brackishwater shrimp/fish with paddy (CIFRI

1986). Most of these *bheries* have now been transformed into extensive culture systems, with *P. monodon* being stocked along with fresh/brackishwater shrimp/fish. A preliminary study was undertaken to assess the growth and production of *P. monodon* in low and high saline waters.

Materials and Methods

The study was undertaken in two ponds in each of the low (0.27-15.8 ppt) and high saline (4.1-27.3 ppt) areas in West Bengal, India (Table 1).

Culture practices followed in both the areas were similar and included the drying of ponds, tilling and liming at the rate of 500 kg/ha, filling ponds with tidal water to a depth of 50 cm, application of mohua (*Bassia latifolia*) oil cake at the rate of 400 kg/ha to kill predators and stocking postlarvae one month after application of piscicide. Stocking was done with *P. monodon* postlarvae (average weight 0.02 g) at two stocking densities—10.5 and 16.0 individuals/m^2. Supplementary feed containing 38-40% protein, 5% fat and 3% fiber was applied to the ponds at rates ranging from 2% to 20% of the standing biomass, with higher feeding rate during the initial stages of rearing. Quantity of feeding was adjusted based on estimation of the biomass (average body weight x survival) of standing crop and checking the feeding tray. Average body weight (ABW) was estimated by considering the mean weight of 500 shrimps collected by cast netting from different areas of the pond. The survival was estimated by considering the average number of shrimp per netting of 10 m^2 average spread area and the area of the pond, as suggested by Saha et al. (in press). The shrimps were harvested after 135 days culture and production was estimated. The specific growth rate (SGR) was calculated fortnightly following Dash and Patnaik (1994).

Table 1. Particulars of the selected areas and ponds.

	Low saline area		High saline area	
	Pond 1	Pond 2	Pond 1	Pond 2
Location	Haroa, north Sundarbans, WB		Sagar, 24-Parganas (S) Sundarbans, WB	
Geographical position	Lat. 22.61°N Long. 88.03°E		Lat. 21.62°N Long. 88.17°E	
Annual salinity (ppt)	0.27-15.8		4.05-27.27	
Culture period	16 Jun-27 Oct		14 Jun-25 Oct	
Area of pond (m^2)	7 603	7 205	4 843	3 024
Stocking density (Individuals/m^2)	10.50	16.00	10.50	16.00

Water quality parameters, i.e., temperature, pH, dissolved oxygen and salinity, were monitored daily in the morning and transparency at noon following standard methods (APHA 1981). At every lunar phase, 20-25% of the pond water was changed with the tidal water and a water depth of 85-95 cm was maintained in the ponds.

Results and Discussion

There were no significant differences in the physico-chemical characteristics of the water in both the environments, except for salinity. Ambient morning temperature ranged from 27.9 to 31.6°C and 28.2 to 30.2°C in low and high saline areas, respectively, while pH was alkaline throughout the culture period, ranging from 8.11-8.67 in low saline ponds and 8.16-8.58 in high saline ponds. Mean dissolved oxygen ranged from 4.64-6.40 ppm and 5.03-6.14 ppm in the low and high saline ponds, respectively. Secchi-disc transparency in the ponds was 24.21-43.40 cm and 24.35-51.75 cm in the low and high saline ponds, respectively. The salinity (average of both the ponds) of the low saline area was in the range of 0.19-6.39

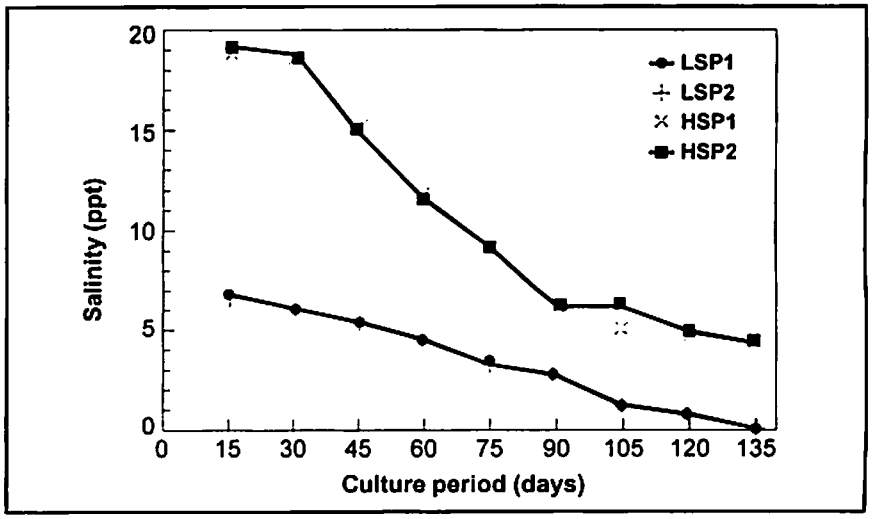

Fig. 1. Water salinity in semi-intensive P. monodon *culture ponds: LSP - low saline pond; HSP - high saline pond; P1 - 10.5 individuals/m^2 stocking density; P2 - 16.0 individuals/m^2 stocking density.*

Table 2. Growth and production of P. monodon *in low and high saline ponds.*

Location	Av. wt. at harvest (g)	SGR[1] (%)	Survival (%)	FCR[2]	Increase in biomass (kg/d/ha)	Yield (kg/ha)
Low saline area						
a. Pond 1	28.64	21.19	52.00	1.31 ± 8.57	11.56 ± 0.57	1 563.37 ± 3.88
b. Pond 2	28.43	21.04	50.00	1.58 ± 10.30	16.81 ±0.87	2274.40 ± 7.52
Higher saline area						
a. Pond 1	25.98	19.22	43.00	1.35 ± 8.96	8.67 ± 0.61	1 173.00 ± 3.19
b. Pond 2	27.00	19.88	45.00	1.68 ± 9.36	14.38 ± 0.80	1944.00 ± 5.24

[1]SGR, specific growth rate; [2]FCR, food conversion ratio; a. stocking density = 10.5 individuals/m²; b. stocking density = 16 individuals/m².

ppt, which was significantly different ($t = 3.56$; $p < 0.01$) from higher saline area at 4.69-19.21 ppt (Fig. 1).

Average body weight of *P. monodon* at harvest after 135 days of culture was higher (28.64 g and 28.43 g) in low saline ponds as compared with the high saline ponds (25.98 g and 27.00 g) (Table 2). SGR of shrimp in all the ponds increased steadily up to 45 days of culture and again from 60 days onwards (Fig. 2). This may be due to the fact that larval shrimp generally depend on planktonic food at the early stage, after which they gradually acclimatize to the supplementary feed. Growth declines during this transition period. SGR at both the stocking densities in high saline ponds was higher as compared with that of the low saline ponds up to 30 days of culture. This might have been influenced by the observed production of lab-lab in higher saline ponds, which is utilized by *P. monodon* up to a size of 10 cm (about 7 g). After that, survival is reduced greatly in ponds managed for lab-lab (ASEAN 1978). SGR of shrimp was 21.19 and 21.04 in low saline area and 19.22 and 19.88 in high saline water, with the initial value in lower stocking ponds (Table 2). Low survival of shrimp was significantly related to SGR in all the ponds at 1% level of significance.

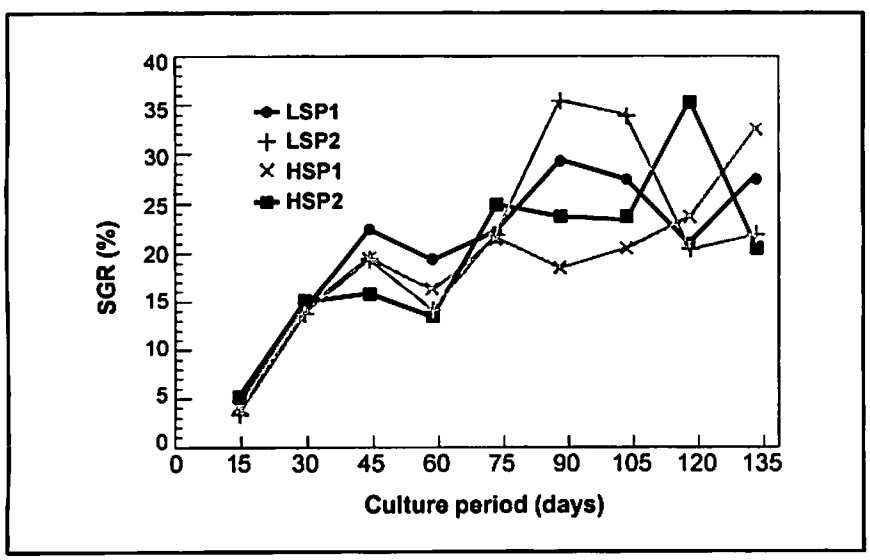

Fig. 2. Specific growth rate (SGR) of P. monodon *reared in semi-intensive ponds. LSP - low saline pond; HSP - high saline pond; P1 - 10.5 individuals/m² stocking density; P2 - 16.0 individuals/m² stocking density.*

The gross production after 135 days of culture was 1 563.37-2 274.40 kg/ha in low saline ponds and 1 173.00 - 1 944.00 kg/ha in higher saline ponds, with the initial value at lower stocking densities. The average of the fortnightly FCR was 1.31 and 1.58 in the low saline ponds and 1.35 and 1.68 in higher saline ponds, with the initial value at lower stocking densities. This reflects the higher food conversion efficiency in a low saline environment.

The conclusion is that the growth and production of *P. monodon* is not only feasible in a low saline environment, but better than in a high saline environment. Guru et al. (1993) observed a growth of 26.30 g after 135 days of culture at 3/m² density and a salinity range of 4.00-10.80 ppt. They assumed that further growth of shrimp may be possible beyond the lower salinity level of the range. Manik et al. (1978) reported that growth of *P. monodon* is possible in low saline water, indicating a wide salinity tolerance of the species.

Though production of lab-lab accelerated the growth of *P. monodon* in the initial stages of culture period in high saline areas, the unconsumed lab-lab later floated on the surface of pond and deteriorated the water quality. The culture of shrimp in low saline areas did not have infestation of dike boring and predatory fish like eel, which were observed to create problems in shrimp culture ponds in high saline water.

It can be concluded that the vast low saline areas of Sundarbans can be successfully utilized for the culture of *P. monodon*.

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S.B. SAHA *is a Senior Scientific Officer of Bangladesh Fisheries Research Institute, Rangamati - 4500, Bangaldesh;* **S.B. BHATTACHARYYA** *is Farm Manager, Mari-Gold Aqua, Haroa, 24-Parganas (N), WB, India and* **A. CHOUDHURY** *is General Secretary, S.D. Marine Biological Research Institute, Bamankhali, Sagar Island - 743 373, 24-Parganas (S), WB, India.*