

Species diversification in coastal aquaculture: Production potentials of shrimp (*Penaeus monodon*) with mono and mixed sex tilapia

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Abstract

An experiment of 120 days of culture was conducted in brackishwater earthen ponds having an area of 0.2ha each. The hatchery produced shrimp (*Penaeus monodon*) post larvae were stocked in the 40m² fine meshed nylon net nursery enclosures were fed with commercial pellet feed. After two weeks of nursing, juveniles were allowed to spread in cultural pond by opening the fence. Fingerlings of three different strain of tilapia were stocked as shrimp and Strain-1 all male (monosex) (T₁), shrimp and Strain-2 all male (T₂), shrimp and Strain-3 mixed sex population (T₃) @ 20,000/ha and 10,000/ha, respectively and shrimp only (monoculture) (T₄) @ 20,000/ha. The shrimp and fish were fed with farm made feed consisting of a mixture of fishmeal 29%, MOC 15%, rice bran 30%, soybean meal 16%, wheat flour 9% and vitamin premix 0.1%. The average final weight of shrimp was 24.9±1.13g, 23.41±3.26g and 26.67±1.89g that stocked with tilapia in treatments T₁, T₂, and T₃ respectively. The final average weight of shrimp in monoculture (T₄) was 27.41±0.76g, apparently higher but insignificant in treatments. The survival of shrimp was 42.17%, 32.38%, 39.45% and 61.98% in treatments T₁, T₂, T₃ and T₄ respectively. The production of shrimp in concurrent culture was 193.67, 154.26 and 210.41kg/ha in T₁, T₂ and T₃, respectively, while in monoculture (T₄) was 339.77 kg/ha. The growth and survival of tilapia among the treatments was insignificant. The growth of monosex tilapia ranged 225.29 and 291.31g and survival 62.77 and 72.20% in T₁ and T₂, respectively, in mixed sex was 193.0g and 83.20% (T₃). The production of tilapia monosex strains was 1676.69kg/ha (Strain-2 all male) and 1668.98 kg/ha (Strain-1 all male) while that of Strain-3 mixed sex population was 1622.92 kg/ha.

Key words: Species diversification, *Penaeus monodon*, Monosex tilapia

Introduction

Due to onset of viral disease and environmental degradation, the vertical productions of shrimp (*Penaeus monodon*) are interrupted. Diversification of culture with other than brackishwater but some hyposaline suitable species in shrimp farming might be an important tool to safeguard crop loss of shrimp. Appropriate species culture practices,

that could suit to shrimp farming for better output. The growth and production of shrimp with some species (*Liza parsia*, *Rhinomugil corsula*, *Mugil cephalus*, *Pangasius hypophthalmus*, *Barbados gonionotus*) have been tried (Hossain *et al.* 1994, Ali 2000, Shofiquzzoha *et al.* 2001, 2003, Yang and Fitzsimmons 2007) while, the culture of tilapia (*Oreochromis* sp.) particularly GIFT with *P. monodon* in shrimp farms seems to be potentials (BFRI 2007).

Except GIFT, some other genetically improved strains of tilapia monosex all male *viz.*, Thai BD-1, GenoMar Supreme Tilapia™, BanglaFISHGEN etc. which are commercially marketed by some private firms and demanded successfully culture in freshwater. These strains were not yet been assessed on production and growth in brackishwater environment in coastal shrimp farms. The present experiment dealt with comparison of growth and production of mixed and mono sex tilapia strains *viz.*, BanglaFISHGEN all male (Strain-1), GenoMar all male (Strain-2) and BFRI-GIFT mixed sex population (Strain-3), in concurrent culture with shrimp.

Materials and methods

The experiment was conducted during March to June 2007 at the Brackishwater Station of the Bangladesh Fisheries Research Institute, Paikgacha, Khulna. Eight ponds of 2,000 m² each in the pond complex were selected and made ready. A 40m² nursery area encircled with nylon net fastened with bamboo fence was setup in each pond for nursing shrimp post larvae. The ponds were prepared by sun drying followed by liming with CaO @ 400 kg/ha and by fertilizing with mustard oil cake (MOC) @ 250 kg/ha and TSP and urea (2:1) @ 35 kg/ha, respectively. After 7 days, the ponds were filled up to a depth of 80cm with tidal brackishwater from nearby the Sibsha river was entered into the ponds through a feeder canal and awaited for a week period for suitable water conditions.

Hatchery produced PCR tested shrimp (*P. monodon*) post larvae (PL) were stocked in the nursery enclosure and fed with commercial shrimp starter feed. After two weeks of nursing, at the 15th day, juveniles were allowed to spread in cultural pond by opening the fence. Fingerlings of different strains of tilapia were stocked at the 5th week of shrimp stocking. Under four different treatments, each two ponds were stocked with shrimp and Strain-1 (BanglaFISHGEN) all male (T₁), shrimp and Strain-2 (GenoMar) all male (T₂), shrimp and Strain-3 (BFRI GIFT) mixed sex population (T₃) @ 20,000/ha and 10,000/ha, respectively while two ponds with shrimp only (T₄) @ 20,000/ha. The initial weight of shrimp was 0.005±0.001g and for Strain-1, Strain-2 and Strain-3 were 1.34±1.13g, 0.21±0.05g and 0.74±0.13g, respectively.

The shrimp were fed commercial pellet feed (Soudi-Bangla) and fish were fed with common prepared feed (approx. protein content, 30%) consisting of a mixture of fishmeal 29%, MOC 15%, rice bran 30%, soybean meal 16%, wheat flour 9% and vitamin premix 0.1%. Feed together was supplied twice daily @ 5-3% of shrimp and fish standing crop/day; twice at dawn and dusk.

The physicochemical parameter *viz.*, air and water temperature, salinity, pH and transparency (Secchi-disk reading) of the ponds were monitored weekly during the experimental period and growth of shrimp and fish were monitored fortnightly.

After 120 days of culture, both shrimp and fishes were harvested by de-watering the ponds and the growth, survival and production were estimated.

Data was compiled and analyzed using software MS Excel and following Zaman *et al.* (1982). The specific growth rate (SGR%) was estimated as per Dhawan and Kaur (2002) following the formula given below.

$$\text{SGR\%} = \frac{\ln \text{Final weight (g)} - \ln \text{Initial weight (g)}}{\text{Number of culture days}} \times 100$$

Results and discussion

The physico-chemical parameters of the pond water are shown in Fig. 1. It shows that, water temperature varied from 26^o to 32^oC (Fig.1a). Salinity was ranged from 8.0 to 17‰ (Fig.1b) and water pH was within 7.0-9.0 during the experimental period (Fig.1c). Water transparency was varying from 17.0 to 70.0 cm (Fig.1d). There was no significant difference in physico-chemical parameters of water among the treatments and congenial for shrimp culture is agreement with Grey (1990) and Jung and Co (1988). The body lesion of tilapia was observed when salinity of water increased more than 15 ppt agrees with scientists. Ridha (2008) reported similar observation when of tilapia strains were weighted over 200g and cultured in salinity above 20ppt for 34 days.

Variations in growth rate of shrimp and tilapia strains under different treatments are shown in Fig. 2. No significant growth variations of shrimp and tilapia strains among the treatment were observed. Shrimp attained its higher average weight in T₄ (27.41g) in monoculture, followed by T₃ (24.67g) shrimp with Strain-3 mixed population, T₁ (23.90g) with Strain-1 all male and T₂ (23.41g) with Strain-2 all male (Table 2).

The specific growth rate (SGR%) of shrimp was 7.06, 7.04, 7.09 and 7.17% in treatments T₁, T₂, T₃ and T₄, respectively. However, the SGR for the tilapia strains was 4.27, 6.03 and 4.59% was observed for Strain-1 all male, Strain-2 all male and Strain-3, respectively (Table 1). The final weight of tilapia strains was 225.29, 291.31 and 193.10g for Strain-1 all male, Strain-2 all male and Strain-3, respectively. The survival of shrimp was higher (63.33%) in treatment T₁, followed by T₄ (61.98%), T₃ (59.45%) and in T₂ (58.38%). Production of shrimp was higher of 339.77 kg/ha in monoculture (T₄), followed by 293.33, 290.02, 273.34 kg/ha in concurrent culture with Strain-1 all male (T₁), Strain-2 all male (T₂) and Strain-3 mixed sex popⁿ (T₃), respectively. The survival, final weight and production of shrimp among treatments were insignificant. The estimated FCR value was 1.75, 1.73, 1.92 and 2.30 in treatments T₁, T₂, T₃, and T₄, respectively found comparative lower than Ridha (2008) but higher than Kamal and Mair (2005).

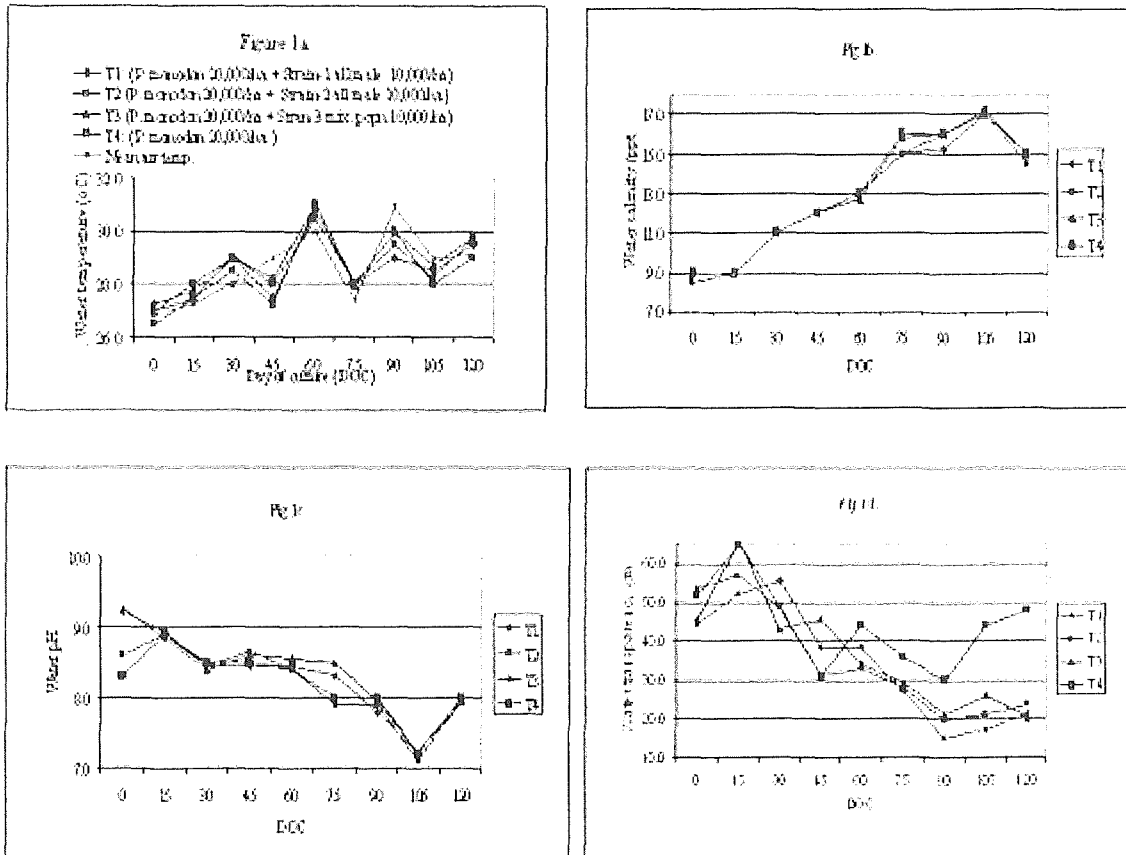


Fig. 1: The variations in physico-chemical parameters of water of the experimental ponds under different treatments

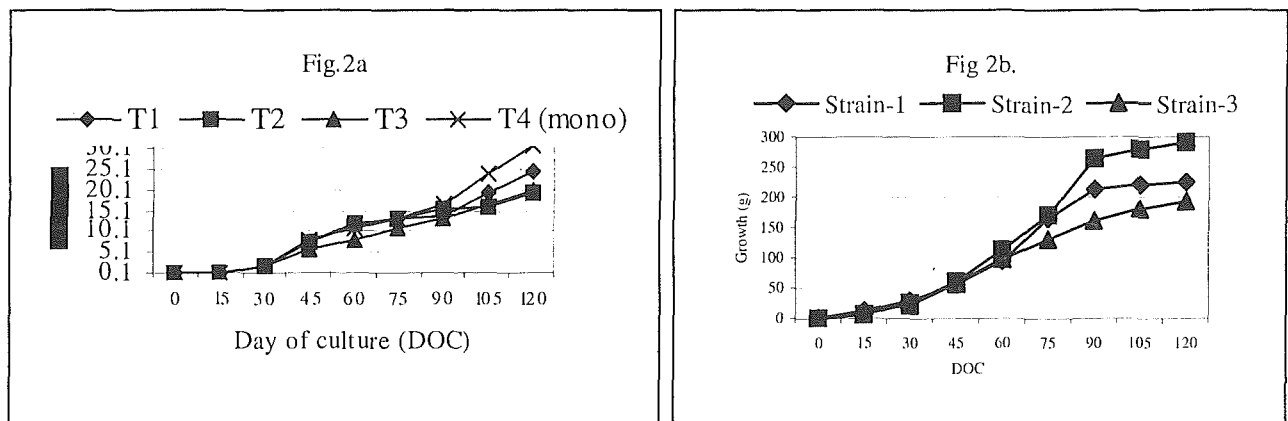


Fig. 2. Growth attainment of a. *P. monodon* and b. three different tilapia strains in concurrent culture.

Table 1. The growth, production characteristics and economics of shrimp and different tilapia strains under concurrent culture system

Treat-ments	Species	Growth attained (g)	SGR%	Survival (%)	Production (kg/ha)	FCR	Total cost (Tk./ha)	Gross return (Tk/ha)	Net return (Tk/ha)	BCR
T ₁	<i>P. monodon</i>	23.90	7.06	63.33	290.02	1.75	1,43,230.00	S- 84,775.00 (38.84%)	74989.00	1.52
	Tilapia Strain-1 all male	225.29	4.27	72.22	1668.95			F- 1,33,516.00 (61.16%)		
								T- 2,18,291.00		
T ₂	<i>P. monodon</i>	23.41	7.04	58.38	273.34	1.73	1,36,216.00	S- 73,259.00 (24.00%)	79203.00	1.58
	Tilapia Strain-2 all male	291.31	6.03	62.77	1676.69			F- 1,42,160.00 (66.00%)		
								T- 2,15,419.00		
T ₃	<i>P. monodon</i>	24.67	7.09	59.45	293.33	1.92	1,34,914.00	S- 85,559.40 (39.72%)	80479.00	1.60
	Tilapia Strain-3 mixed pop ⁿ	193.10	4.59	83.20	1622.92			F- 1,29,833.60 (60.28%)		
								T- 2,15,393.00		
T ₄	<i>P. monodon</i>	27.41	7.17	61.98	339.77	2.30	85,615.00	T-1,35,720.00	50,105.00	1.59

Taka 70.0= 1.0US\$

A simple economical analysis was done for four different cultural treatments (Table 1). The cost of production was estimated on the basis of fixed cost including land rent per hectare per 6 months, labour cost, lime and fertilizer, while the variable cost were seed and feed cost. The cost of production (Tk/ha) was Tk.143,230, Tk.136,216, Tk. 134,914 and Tk. 85,615 with the gross return of Tk.218,291, Tk. 215,419, Tk. 215,393 and Tk. 135,720 in treatments T₁, T₂, T₃, and T₄, respectively. A simple benefit-cost (B:C) analysis was done for all treatments. The B:C ratio was 1:1.52, 1:1.58, 1:1.60 and 1:1.59 in treatments T₁, T₂, T₃, and T₄, respectively. The growth and production performance and BCR indicates that both of mono or mixed sex of tilapia strains in concurrent culture with *P. monodon* will be profitable as monoculture of shrimp.

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(Manuscript received 5 November 2009)