

Effects of different types of feeds on growth and production of tiger shrimp, *Penaeus monodon* at Bagerhat region, Bangladesh

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Abstract

An experiment was carried out in farmers' *gher* (shrimp farm) at Bagerhat sadar upazilla, Bagerhat to ascertain the effects of three different types of feeds on the production and economics of brackishwater shrimp, *Penaeus monodon* for a period of 120 days. There were three treatments such as T₁ (BFRI dough feed containing of 30% fish meal, 10% protein conc., 10% soya meal, 15% mustard oil cake, 18% rice bran, 5% maize, 10% wheat flour, 1% oyster shell powder and 1% vitamin premix), T₂ (Commercial diet Saudi-Bangla grower) and T₃ (Saudi-Bangla special feed). Each treatment had two replicates and the stocking of shrimp in each *gher* was 3 nos/m². Water quality parameters did not differ significantly among the treatments except water depth. Average production and net return of shrimp in different treatments varied from 404.0 to 509.0 kg/ha and Tk. 56,493.99-Tk. 84,209.60, respectively. T₂ showed significantly ($p < 0.05$) the highest production and economic return. The result of the study implied that T₂ is more suitable and economically viable than that of other treatments for shrimp farming.

Key words: Feed, *Penaeus monodon*, *Gher*

Introduction

Most of the shrimp farmers of Bangladesh do not use any type of feed for shrimp. Natural foodstuffs present in the shrimp pond are not sufficient to fulfill the demand of the growing biomass. Growth and production of farmed shrimp is largely dependent upon the supply and intake of dietary nutrient inputs and feed. Few farmers use single or mixed feed ingredients as farm-made feed. But single or two feed ingredients cannot fulfill the nutritional demand of the animal and not suitable for shrimp production and benefit. Formulated feed nutritionally sound and boost up shrimp production.

Shrimp farming requires more investment than other aquaculture activities. Maximum shrimp farmers of the country are not well to do and need to reduce investment in shrimp farming. Feed is the key component of modern shrimp farming but its cost is one of the most important items in shrimp production cost. Though

different types of commercial feed are available in the market but there is lack of suitable feed for shrimp farmers. Application of these costly feeds increases the production cost of the farmer. As a result, the farmers are deprived from getting more net income. To increase the shrimp production per unit area, low-cost balanced shrimp feed is prerequisite. Use of formulated low-cost feed with locally available feed ingredients instead of expensive commercial feed may be a means to reduce feed cost as well as production cost. In many times, all ingredients of balanced feed are not available at local level round the year. Easily available low-cost commercial feed may be used instead of locally made low quality feed for increasing shrimp production as well as for higher net return. Keeping these views in mind, the present research work had been undertaken to enhance the shrimp production applying different types of formulated feed.

Materials and methods

The study was conducted in six shrimp farms in Sadar upzilla of Bagerhat district, where shrimp are generally cultured in extensive traditional system. The area of the selected shrimp farms was 800 m² to 1,200 m².

Shrimp farm preparation: The dikes of the shrimp farms were constructed in such a way so that water can't overflow or pass through it. The entire farm was encircled up to 1.0 m height with fine meshed nylon net so that no animal from outside can enter and destroy the reared shrimp. The farms were dried and the surface soil was treated with agricultural lime (CaCO₃) at a rate of 250 kg/ha. After 7 days, farms were fertilized with mustard oil cake at a rate of 500 kg/ha. After that, the farms were filled up with tidal water up to a depth of 50-60 cm and treated with phostoxin tablet at a rate of 1 tablet/210 sqft of water to kill the unwanted animals of the farms. After remove all dead animals, water of the farms treated with lime at a rate of 250 kg/ha. The farms were then fertilized with triple super phosphate (TSP) and urea (2:1) at a rate of 35 kg/ha.

Stocking of shrimp post larvae (PL): After 7 days of fertilization, the post larvae of *P. monodon* having an average body weight of 0.006 g were stocked at a rate of 3 nos/m² in each farm. Before the stocking, the PL were acclimatized with the temperature and salinity of water of the farm.

Post stocking management: Shrimp PL were reared in nursery enclosure and fed with commercial nursery feed (Saudi Bangla nursery feed: starter 1, 2 and 3) @ 100% of the total biomass in 1st week, 60% in 2nd week and 30% in 3rd week. After 3rd week of nursery rearing, they were allowed to spread over the whole farm by opening the nursery enclosure. At this stage, different feeds (BFRI dough feed, Saudi-Bangla grower and Saudi-Bangla special feed) were applied @ 30%, 20% and 10% of the estimated shrimp biomass at 8 hrs intervals daily for the 1st, 2nd and 3rd week, respectively by spreading. Thereafter, feeding rate was gradually decreased from 5-3% for the rest of the culture

period. For maintaining productivity, farm's water was periodically treated with lime @ 50 kg/ha and inorganic fertilizer using TSP and urea (2:1) @ 30 kg/ha as needed. Additional lime was also applied @ 125-250 kg/ha after every heavy shower. Probiotics (@1 ppm) mixed with sands and made into balls was applied to the bottom of the farms to resist possible blackening of soil due to bacterial activity. The feeding behaviour and shrimp health were checked 1-2 days intervals through cast netting. To maintain undisturbed ecology of the farms and to control shrimp disease, water was not exchanged.

Water quality parameters *viz.*, water depth, temperature, salinity, pH, nitrate, ammonia and dissolved oxygen were determined at weekly intervals. Water temperature was recorded using a Celsius thermometer. Dissolved oxygen and pH were measured directly using a digital portable oxygen meter (Oakton) and portable pH meter (Hanna 8424), respectively. Salinity was recorded using portable refractometer. Nitrate and ammonia were determined following standard methods as mentioned by Strickland and Parsons (1968) and APHA (1992).

After grow out period of four months, shrimp farms were drained by pump and all the shrimp were harvested. Total weight and number of shrimp and economics in each farm were recorded. Farmers rally was arranged in the farm site to give hands-on experience to the interested farmers. Specific growth rate of shrimp was calculated as follows:

$$\text{SGR (\% bw/d)} = [\ln(\text{final weight}) - \ln(\text{initial weight})] / \text{culture period (days)} \times 100$$

For statistical analysis of data, one way analysis of variance (ANOVA) was carried out to find the level of significance of difference among the different treatments. Significance was assigned at the 0.05% level.

Results and discussion

The physicochemical factors of the farm water under three treatments are presented in Table 1. Depth of water of the farms was 50.0—110.0, 66.0—130.0 and 59.0—135.0 cm in T₁, T₂ and T₃, respectively. The fluctuation in depth was due to evaporation and precipitation of water. Generally, depth of water of the traditional farms remains with 40-60 cm. This low depth of water provides poor space for the movement of the stocked shrimp. Besides, the stocked shrimp suffer from temperature shock during draught period. Inadequate water depth is one of the most important factors of shrimp mortality and low yield (Karim 2002). The water temperature in T₁, T₂ and T₃ ranged from 29.0—35.2°C, 29.0—35.0°C and 29.0—35.3°C, respectively with the mean values of 32.02±2.06, 31.87±2.07 and 32.04±2.06°C. The variation in temperature among the treatments were found similar (p<0.05) and was slightly higher than the suitable range for growth of shrimp (Boyd and Fast 1992, Apud 1989 and Latif and Islam 1995).

The salinity did not show any significant (p<0.05) difference among the treatments. The values of salinity ranged from 0.0—9.5, 0.0—9.0 and 0.0—9.0 ppt under T₁, T₂ and

T₃, respectively. The values varied with sampling dates, which might be associated with the differences in presence of salinity. Salinity ranging from 5.0—32.0 ppt is favourable for shrimp culture (Predalumpaburt and Chaiyakam 1994). The level of pH varied from 6.50 to 8.60, 6.50 to 8.40 and 6.5 to 9.15 in T₁, T₂ and T₃, respectively. The pH in all the farm water was more or less alkaline throughout the experimental period, which might be due to regular application of lime at fortnightly/monthly intervals. Several authors have reported a wide variation in pH 6.0—9.0 (Boyd and Green 2002), 7.5—9.2 (Hoq 2002), 7.68—8.35 (Shofiquzzoha *et al.* 2001) and 7.30—7.97 (Saha *et al.* 2001) in shrimp farms and found the ranges favourable for shrimp culture.

Table 1. Mean values (\pm SD with range) of water quality parameters as recorded from the shrimp farm under different treatments during the study period

Parameters	Treatments		
	T ₁	T ₂	T ₃
Water depth (cm)	83.75 \pm 21.17 ^b (50.0—110.0)	94.88 \pm 21.67 ^a (66.0—130.0)	95.25 \pm 25.05 ^a (59.0—135.0)
Temperature (°C)	32.02 \pm 2.06 (29.0—35.2)	31.87 \pm 2.07 (29.0—35.5)	32.04 \pm 2.06 (29.0—35.3)
Salinity (ppt)	3.05 \pm 2.96 (0.0—9.5)	3.0 \pm 2.83 (0.0—9.0)	3.0 \pm 2.28 (0.0—9.0)
Dissolved oxygen (mg/l)	4.0 \pm 0.58 (3.21—4.80)	4.0 \pm 0.51 (3.25—4.56)	3.94 \pm 0.53 (3.30—4.80)
pH	8.05 (6.5—8.60)	8.02 (6.5—8.40)	8.33 (6.5—9.15)
NO ₃ -N (mg/l)	0.013 \pm 0.002 (0.008—0.016)	0.012 \pm 0.002 (0.009—0.015)	0.012 \pm 0.002 (0.010—0.016)
NH ₄ -N (mg/l)	0.028 \pm 0.024 (0.002—0.063)	0.029 \pm 0.027 (0.002—0.070)	0.029 \pm 0.030 (0.002—0.080)

Mean \pm SD, figures with different superscript differs significantly.

The dissolved oxygen content in the experimental farms ranged from 3.21—4.80, 3.25—4.56 and 3.30—4.80 mg/l in T₁, T₂ and T₃, respectively with the mean values of 4.0 \pm 0.58, 4.0 \pm 0.51 and 3.94 \pm 0.53 mg/l. Comparatively lower level of dissolved oxygen as observed in the farms appeared to be related to sampling time when the dissolved oxygen was monitored at about 10.00-11.00 am. At this time, dissolved oxygen remains lower in concentration. Apud (1989) and Boyd *et al.* (1994) reported that dissolved oxygen content of a shrimp farm should be >4.0 mg/l and >3.8-5 mg/l, respectively. In morning, dissolved oxygen of the farm water never decreased below 3.21 mg/l, which could be considered as congenial for shrimp culture.

Nitrate nitrogen ranged from 0.008—0.016, 0.009—0.015 and 0.010—0.016 mg/l with mean values of 0.013 \pm 0.002, 0.012 \pm 0.002 and 0.012 \pm 0.002 mg/l in T₁, T₂ and T₃, respectively. These values did not show any significant difference among the treatments.

Comparatively lower values of NO₃-N recorded at the farms might be attributed to wide uptake of this nutrient by the primary producers in the farms. The values found in the present study were within the suitable range for brackishwater aquaculture (Islam *et al.* 2004). The mean concentration of total ammonium-nitrogen as recorded in T₁, T₂ and T₃ ranged from 0.028±0.024, 0.029±0.027 and 0.029±0.030 mg/l, respectively with no significant difference among them. The values obtained in the experimental farms were far below the critical level of ammonia and the variations in ammonia-nitrogen in all the treatments were within the productive range for shrimp farming (Boyd 1998 and Chien 1992).

Growth and production

The stocking density, growth, survival and production of shrimp in the shrimp farms are shown in Table 2. The shrimps of all the farms were harvested after 120 days of culture. No disease symptom was observed in the experimental farms. Shrimps in T₁, T₂ and T₃ grew up to 20.89, 23.90 and 22.80 g after 120 days with a daily growth increment of 0.174, 0.199 and 0.190 g, respectively. The daily growth of shrimp applying highly valued CP feed (Tk. 85.00/kg) was 0.278 g after 120 days reported by Saha *et al.* (2006). The growth obtained from the present study applying low valued different feeds (Tk. 40.00-48.00/kg) was slightly lower than Saha *et al.* (2006). The survival of shrimp was 64.5, 71.0 and 69.5% in T₁, T₂ and T₃, respectively with no significant difference among them. These survival rates were higher than that of Alam *et al.* (2007), Alam and Islam (2007), Saha *et al.* (2006) and Hoq *et al.* (2001). There was no significant variation among the specific growth rate (SGR) of shrimp in different treatments. The SGR of shrimp was highest of 27.47-27.82 % in the 1st 15 days in all the treatments. In the 2nd 15 days, it dropped sharply to 7.5-8.80 % and then it was continued up to 1.46-1.70 % in the last 15 days of culture. The highest average production of shrimp of 509 kg/ha was obtained in T₂ and the lowest of 404 kg/ha found in T₁, which was significantly lower than that of T₂ and T₃. But there was no significant difference in production between T₂ and T₃. The food conversion ratio (FCR) was lower in T₂ compared to T₁ and T₃.

Table 2. Growth and production performance (mean±SD with range) of *Penaeus monodon* in different treatments during the study period of 120 days

Treatments	Shrimp farm size (ha)	PL stocked (/ha)	Final wt. (g)	SGR* (% per day)	Survival (%)	Production (kg/ha)	FCR**
T ₁ (Dough feed)	0.089±0.01 (0.08-0.098)	2670±382 (2400-2940)	20.89±2.44 (18.3-22.8)	6.79	64.5±2.12 (63-66)	404.0±4.8 ^b (400.6-407.4)	3.6
T ₂ (Saudi-Bangla)	0.100±0.03 (0.08-0.12)	3000±849 (2400-3600)	23.90±2.60 (21.8-26.7)	6.91	71.0±4.24 (68-74)	509.0±33.5 ^a (485.5-532.8)	2.3
T ₃ (Saudi-Bangla special)	0.113±0.08 (0.106-0.113)	3390±297 (3180-3600)	22.8±2.13 (20.4-24.5)	6.86	69.5±4.95 (66-73)	476.0±57.4 ^a (435.64-516.83)	3.1

* SGR=Specific growth rate, ** FCR=Food conversion ratio.

This production of shrimp is comparable to that of Alam and Islam (2007), who reported a production range of 425—660 kg/ha with the average body weight of 21.88—23.88 g after 110 days of rearing at Brackishwater pond complex, Brackishwater Station, BFRI, Paikgacha, Khulna and the stocking density of their research experiment was 5 PL/m². The higher production in some of the shrimp farms compared to the present study was due to high stocking density and high survival of about 90%. Low survival in the present study might be due to stress during long transportation. Stocked shrimp PL were packed about 30-32 hrs before stocking and carried from Cox's Bazar to Jessore by air and then by road from Jessore to Foila Shrimp Fry Marketing Centre, Foila, Rampal, Bagerhat. By this time, some of the stocked PL might become weak and died after stocking to the farm. However, Mazid *et al.* (2001) and Mazid (1994) reported a yield of shrimp (*P. monodon*) of 350.0-500.0 kg/ha at 1.0-2.5 PL/m² density. These findings of improved traditional culture system are closed to that of the present study. Rahman *et al.* (2002) stated that production of shrimp in Khulna was 158.47 kg/ha/yr. Production of shrimp in extensive traditional system in the Paikgacha area was 83.47-204.46 kg/ha as reported by Islam *et al.* (2005). Alam *et al.* (2007) reported that shrimp yield in improved traditional method at BFRI pond complex, Brackishwater Station, BFRI, Paikgacha, Khulna was 212.0 kg/ha at 2 PL/m². The national production of shrimp from culture sector in Bangladesh is 370 kg/ha (Anon, 2005). These productions are several times lower than the findings of the present study.

Cost of production and economic returns

The total gross return under T₁, T₂ and T₃ was Tk. 177,760.00, 225,557.88 and 209,541.20/ha with the benefit cost ratio of 1:1.47, 1:1.60 and 1:1.54, respectively. Higher net return (Tk. 84,209.60) was achieved in T₂ and lower (Tk. 56,493.99) in T₁. But there was slight variation in net return between T₂ and T₃. Benefit cost analysis implies that higher BCR (1.60) was also found in T₂ and lower (1.47) in T₁. The net return (Tk. 56,493.99—84,209.60/ha) obtained from the shrimp culture in the present study is much higher than that of Tk. 37,070.00/ha reported by Islam *et al.* (2005). Uddin (1998) and Ling *et al.* (2001), respectively also reported lower net reruns of Tk 35,600.00 /ha and Tk 35,500.00/ha from the traditional shrimp culture practice. Miah (2001) reported the net return of Tk. 57,056.00 of alternate shrimp-rice farming which is more or less similar with the present findings. Therefore, Saudi-Bangla grower is best feed than that of BFRI dough feed and Saudi-Bangla special feed. It implies that Saudi-Bangla grower is much more profitable, economically viable and socially acceptable than others feeds.

Most of the shrimp farmers of Bagerhat region are not familiar with the improved shrimp culture systems. Current shrimp production of Bangladesh is only 175-200 kg/ha, which is 2-3 times lower than that of the present findings. The on-farm research activities on modern shrimp culture techniques will grow awareness among the farmers. Farmers' training programs were organized at field level during culture and harvesting period. The whole culture practice was presented to them. The shrimp farmers showed keen interest to observe the production and economic returns from the culture practice.

It can be expected that national shrimp production would be boost up through the implementation of this practice in this region.

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(Manuscript received 27 November 2008)