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Effects of formulated feed on growth and production performance of tiger shrimp (*Penaeus monodon*) in an improved culture system

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Abstract: The effects of formulated feed on growth and production of tiger shrimp (*Penaeus monodon*) were studied in six *ghers* (pond) at Shyamnagar, Satkhira, Bangladesh over 137 days during March to July, 2007. Two treatments, one without feed (T_1) and another with feed (T_2), with three replicates having one hectare area each were used in the study. Ponds were stocked with shrimp post larvae (PL) at 20,000 ha^{-1}. Management practices were same in both treatments except supplying formulated feed daily at 5-10% body weight of shrimp in T_2. Water quality parameters and shrimp growth were monitored once in a month. Water temperature, pH and salinity did not differ significantly (P>0.05) between the treatments, while dissolved oxygen and ammonia level were significantly higher (P<0.05) in T_2. All the parameters except ammonia were within the suitable range, while ammonia level was within the tolerable range for shrimp culture in both treatments. All the growth and production parameters like mean individual final weight, SGR, survival rate and production differed significantly (P<0.01) between the treatments with better performance in T_2. Treatment with supplying formulated feed (T_2) yielded in 205% increased production (708 kg ha^{-1}) over without feed (T_1) treatment (232 kg ha^{-1}).
Key words: Shrimp, growth, production, formulated feed, fertilizer

Introduction

Export of frozen shrimp and prawn comprising about ninety percent of total export earning of fisheries sector (DoF, 2008). For a long period, catch from wild stock of both marine and fresh water habitat was the main source of shrimp supply. To increase the foreign exchange earning, irrational development of sea food processing industry created a pressure on raw material supply which pinpointed the need of immediate aquaculture development. As a result, coastal aquaculture activities have been initiated with fertilizers and formulated feed without proper environmental study. Primarily some positive results in economy have been achieved. But, recently the farmers suffered a lot due to less productivity, high mortality and onset of diseases. Therefore, a sustainable development of this sector is the demand of the day to produce more shrimp including other aquaculture products. Bangladesh is considered as one of the most promising country in respect of shrimp culture. At present there are more than 2,17,877 ha of lands in the coastal region under shrimp and prawn culture (DoF, 2008). Many farmers are using formulated pellet feed in their shrimp farms. The present paper embodies with the effects of SABINCO prawn/shrimp feed on growth, survival and production of *P. monodon* in improved shrimp culture system.

Materials and Methods

Study area and period: The study was carried out in six farmers' pond on the bank of the river Munshigong at Munshigong union of Shyamnagor upazila under Satkhira district. Before commencing trial a thorough discussion was made with the *gher* (pond) owners and six of them agreed to spare one hectare area each in their farm for this research purpose. The study was conducted from 3 March to 15 July 2007 for a period of 137 days.

Pond preparation: Primarily pond water was driven out and the bottom soil was sun-dried. After proper drying, bottom soil was ploughed and leveled. After two weeks the black soils and other dirty materials were removed from the bottom and lime ($CaCO_3$) was applied at the rate of 150 kg ha^{-1}. Ponds were provided with independent inlet and outlet-sluice gates. To prevent entry of predators and escape out of juveniles the inlets and outlets were fitted with nylon screen (l.0 mm mesh size). After preparing the ponds, tidal water was allowed to enter into the ponds up to an approximate depth of 1.5 meters and 5-6 days. After water filling all ponds were fertilized with urea at the rate of 40 kg ha^{-1} and T S P at the rate of 20 kg ha^{-1}. Shrimps were reared after 5-7 days of fertilization with formulated SABINCO feed in the ponds under treatment with feed (T_2) and no feed (T_1).

Sources of shrimp fry and stocking: Shrimp fry; post larvae (PL) collection season starts from January and lasts till August every year in the study area. The ponds were stocked with wild PL of *P. monodon*. The mean weight of the PL was 0.45-0.49 g. All PL were purchased from local fry traders on prior contract basis. The stocking density Pl ha^{-1} was 20,000.

Food and Feeding Management: All ponds were fertilized with 12-15 day intervals throughout the study period. Whereas in T_2 formulated feed at the rate 5-10% body weight of shrimp per day were supplied additionally. Feeding started from the second week of stocking. Half of the daily ration was supplied at dawn and rest half before dusk with the help of feeding trays. A total of 10 feeding trays were placed in different places of each pond. The feed were adjusted based on monthly sampling. The shrimp feed were procured from Saudi-Bangla Fish Feed Co. Ltd. The proximate compositions of formulated feed are detailed in Table. 1.

Table. 1: Proximate composition (dm. basis) of feed used in the experimental ponds

Name of the Ingredient	Content (%)
Moisture	12.0
Crude protein	36.0
Crude lipid	3.5
Crude fiber	6.0
Ash	18.0
Nitrogen free extract (NFE)	24.5
Total	100

Water quality management: On an average water was exchanged 2-3 times per month during full moon and new moon. During high tide, water was allowed to enter directly into the ponds and discharged during low tide through main sluice gate. The feed treated ponds were oxygenated with three paddle wheels in each pond. The physico-chemical conditions such as pH, temperature, salinity, ammonia and dissolved oxygen (DO) of water of ponds were measured throughout the study period. Sampling was conducted in between 09:00 hrs -12:00 hrs

monthly. For physical and chemical analysis, samples were collected from the ponds in properly cleaned 1 liter plastic bottles. The opening and closing of the sterile bottles were done with meticulous care to avoid any contamination. Temperature and DO was measured by a YSI digital DO meter (Model 58), water pH value was determined by a digital pH meter (Model-HANNA-HI-9142), and salinity was measured by a digital refractometer on the spot. Ammonia nitrogen (NH_3-N) was determined on filtered neutral sample (pH≤7) by a Hach kit (DR/2010 Spectrophotometer) in the Water Quality Laboratory, Bangladesh Agricultural University, Mymensingh..

Growth and survival of shrimp: In order to study growth and survival rate, data were collected monthly. Shrimps were collected from each pond on a random basis using a cast net of 10 square meters effective area with 10 mm mesh size. The shrimp weight were taken in gram using a portable electronic balance. Survival rate was estimated by the following formula (ASEAN,1978):

$$\text{Survival (\%)} = \frac{\text{Total population}}{\text{Total no shrimp stocked}} \times 100$$

The total population during sampling was calculated by the following formula:

$$\text{Total Population} = \frac{\text{Average no of sample}}{\text{Area of the net}} \times \text{pond area}$$

(Area of net = πr^2, where, r = radius of net)

For final survival rate (%), the average number of shrimp per kg was estimated and then the total number of shrimp was determined. Finally, survival rate was calculated. Specific growth rate (SGR) was determined in terms of body weight according to the following formula:

$$\text{SGR (\% bw.d}^{-1}) = \frac{LN(W_1) - LN(W_0)}{t_1 - t_0} \times 100$$

Where, W_1 = mean wt (g) at time t_1, W_0 = mean wt (g) at time t_o, t_o = starting time (stocking day), and t_1 = final time (sampling day).

Harvesting of shrimp: In the present study, final harvesting was made on 15 July, 2007. Prior to harvesting some water was introduced into the ponds. A bag mounted on a wooden frame was fitted with the outlet for shrimp trap. After draining out water to a certain level shrimps were trapped. Immediately after harvest, shrimps were washed in pond water to remove mud and bottom debris then kept in bamboo baskets. The harvesting was initiated in the evening and continued for whole night. The total catch was carried to the landing center with ice where shrimps were washed in well water and then chilled quickly. The chilled shrimps were poly-packed in bamboo baskets with crushed ice and transported to the nearby plants.

Results and Discussion

pH: The trend of pH value observed in both the treatment is shown in Fig.1. The pH value was more or less similar throughout the study period except a little bit higher values in the last two months. The range of pH value was 6.9-8.7 in both the treatments, while overall mean of water pH was 7.8 ± 0.5 in T_1 and 7.8 ± 0.4 in T_2. Sayeed *et al.*, (2004) observed the pH ranged 7.3-8.6 which coincide the result. The observed pH is considered to be favorable for the growth and survival of *P. monodon* reported by Law (1988); Wickins (1976); Thampy *et al.* (1988); Precilla and Myma (1991); Ray *et al* (1992).

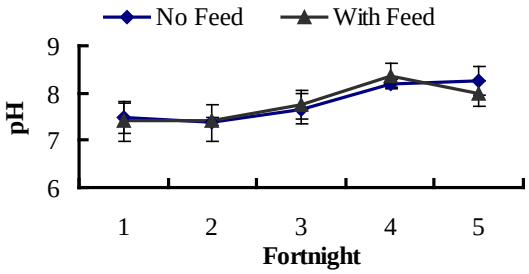

Fig.1. The trend of pH value during the experimental period in both the treatments

Water temperature: The observed water temperature ranged from 22.1^{0}C to 30.9^{0}C. The variation of water temperature during the study observed more or less similar except in the month of May when the environmental temperature was higher (Fig. 2). The temperature was higher in T_2 than T_1. This might be due to the effect of decomposition of excess feed particles (Liao and Murai, 1986).

The suitable temperature range for normal growth and survival of shrimp is 25 to 30^{0}C and not harmed within the temperature range of 15 to 35^{0}C (Chen,1985; Thampy 1988; Poernomo 1990). The water temperature ranged 28 - 32^{0}C in the present study was suitable for normal growth of shrimp.

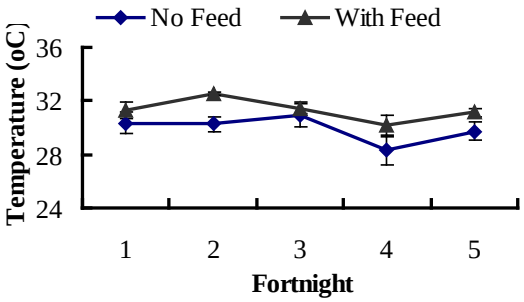

Fig. 2. The variation of water temperature in the experimental ponds

Salinity: Salinity ranged from 22 to 29 ppt. and remained almost same till May. However from June onward salinity dropped down from 10 ppt. to 7 ppt but fell to critical level. Variations of mean salinity are presented in Fig.3. Sayeed *et al.*, (2004) observed the salinity ranged 5-24 ppt. in the Satkhira region in his study. Chen (1985) reported that the salinity range that supports the normal growth of *P.monodon* is 15 to 30 ppt. Chanratchkool *et al.* (1995) recommended the optimum salinity range is within 10 to 35 ppt. The observed salinity from initial stage to the end

of third month of the study was optimum and favorable for growth and survival of shrimps. *P. monodon* can tolerate salinity level below 10 ppt, but growth and survival may be effected significantly (Cowthorne *et al.*, 1983, Chakraborti *et al.*, 1986). Growth and survival of shrimp might be affected by sudden drop in salinity at the end of study.

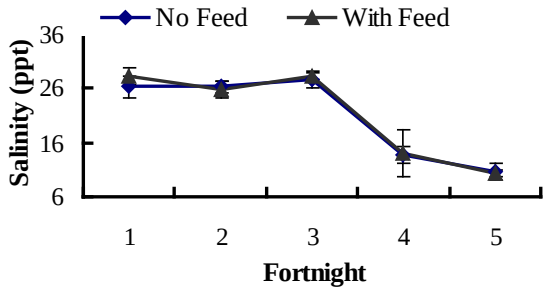

Fig. 3. The trend of salinity in the experimental ponds during study period

Ammonia: The fluctuation of ammonia (NH_3-N) level varied from 0.01 to 0.41 mg l^{-1}, with overall mean values of 0.10 ± 0.04 and 0.23 ± 0.10 in T_1 and T_2, respectively. Monthly variations of ammonia are plotted in Fig. 4. It was observed that the ammonia level was significantly (P<0.05) higher in the ponds of T_2. However, ammonia level was within the tolerable range for shrimp culture (Boyd and Zimmerman, 2000).

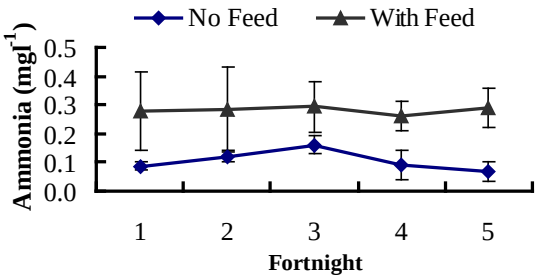

Fig. 4. The trend of ammonia in the experimental ponds during study period

Dissolved Oxygen: The range of DO was 4.0 – 10.0 mg l^{-1} in the experimental ponds. The monthly trend of DO concentration variations are plotted in Fig. 5. Mean value of DO in ponds water varied significantly (P<0.05) between the treatments with higher value in T_1 (8.5 mg l^{-1}) and lower in T_2 (7.0 mg l^{-1}). This is may be due to faster utilization of DO by decomposing organic matter like unutilized feed in T_2 (Liao and Murai, 1986). Sayeed *et al.*, (2004) observed DO level from 4 to 13 mg l^{-1} in his study in the same area.

Growth and survival rate of shrimp: The trend of monthly growth performance of shrimp in both the treatments is shown in Fig. 6. Significant (P< 0.01) difference in final individual mean weight of shrimp in two treatments was observed, and recorded as 31.31 g and 65.55 g in T_1 and T_2, respectively. There was also significant (P<0.01) difference of shrimp weight gain in T_1 and T_2. The SGR ranged from 4.14 to 4.91 in different ponds with significant (P<0.01) difference between the treatments. Sayeed *et al.* (2004) reported SGR of shrimp ranged from 4.15 to 4.45 in an improved extensive culture, which coincide the result of the present study. The growth and production parameters of shrimp in both the treatments are shown in Table. 2. The survival rate ranged from 37-55% in different ponds under T_1 and T_2, which differed significantly (P<0.01) between the treatments. The survival of *P. monodon* found ranges from 45 to 55% in the Cox's Bazar region by Rahman (1994) and Das (1998). Therefore, the survival rate of the present study was satisfactory.

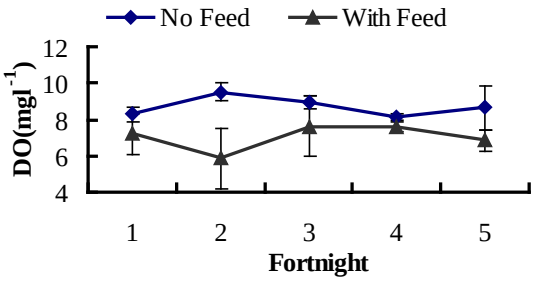

Fig. 5. The trend of DO in the experimental ponds during study period

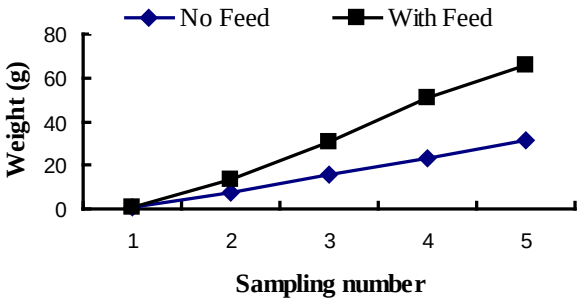

Fig. 6. Growth performance of shrimp in different treatment during study

The production performance of shrimp: The production performance of shrimp showed in Table. 2. The production obtained in the present study was 232 and 706 kg ha^{-1} $crop^{-1}$. Latif and Islam (1995) reported a production of 601 kg ha^{-1} $crop^{-1}$ in a 150 days study of *P. monodon* culture with fertilizer and some formulated feed. In another study, Sayeed *et al.*, (2004) reported a production of 280 and 570 kg $ha^{-1}crop^{-1}$ in fertilized and some formulated feed used trials, respectively in a 165 days culture. They applied formulated feed starting from third month of culture. The higher production obtained in the present study may be due to healthy management and use of feed starting from second week.

The environmental factors like pH, water temperature, salinity were more or less similar in both the treatment, however DO and ammonia level were higher in T_2. This may be due to faster utilization of DO for decomposing organic matter and accumulated metabolites. However, each of the parameters was in the optimum level.

Therefore, it may be concluded growth and production performance of shrimp culture may be satisfactory and viable, if the pond is well managed with feed and fertilizers.

Table. 2. Mean ± SD of growth and production parameters of shrimp (*P. monodon*) observed during study

Parameters	Treatments		Remarks
	T_1	T_2	
Initial weight (g)	0.45 ± 0.02	0.49 ± 0..03	
Final weight (g)	31.31 ± 0.44	65..55 ± 2.66	**
Weight gain (g)	30.86 ± 4.55	65.06 ± 2..64	**
Specific growth rate (%)	4.24 ± 0.06	4.89 ± 0.02	**
Survival rate (%)	38.69 ± 2.30	54.00 ± 1.00	**
Production ($kgha^{-1}$)	232.47 ± 3.23	708.26 ± 41.87	**

** Differed significantly at 1%

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