Middle-East Journal of Scientific Research 27 (1): 39-54, 2019
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2019.39.54

Effects on the Growth Performance and Survival Rate of *Pangasius hypophthalamus* in Different Feeding Rate of Complete Diet

[1]Md. Shemul mian, [2]Md. Mohibul Hasan, [3]Abul Khayer and [1]Md.Ahasan Habib

[1]Department of Fisheries and Marine Science,
Noakhali Science and Technology University, Noakhali-3814, Bangladesh
[2]Department of Fisheries Management,
Bangladesh Agriculture University, Mymensingh-2202, Bangladesh
[3]Department of Agriculture, Noakhali Science and Technology University,
Noakhali-3814, Bangladesh

Abstract: Background: *Pangasius hypophthalamus* has a high acceptance among the people of Bangladesh for its fastest growth, low price and good taste. In order to have good profit farmers need to know better feeding requirements for the higher growth in a limited time. For that reason farmer should have proper knowledge about feed techniques to increase growth performance and survival rate of this profitable fish. Methods: A field experiment was conducted to know the effect of feeding ration on the growth and survival rate of *Pangasius hypophthalamus*. The experiment was designed with three experimental net cages (hapas) namely T1, T2 and T3 for a period of 8 weeks commencing from 04th October to 1st December, 2017 the hapas were equal in size(0.0725 decimal) and rectangular in shape. Results: In the present study, the mean final weight was higher in T3. Although the individual weight gain in T3 was highest this might be due to difference in feeding rate. Conclusions: Based on the present experimental condition, it can be recommended that the optimum feeding rate for Pangas in hapa condition is 12% of their body weight compared to 8% and only natural food is not sufficient for the profitable growth.

Key word: Natural Food · Feeding Ration · Experiment · Hapas · Pangas · Growth

INTRODUCTION

Fish plays a crucial role in the Bangladeshi diet, providing more than 60% of animal source food. Fisheries of Bangladesh have immense prospects and scope of development [1]. Bangladesh is now the fourth major fish producing country in the world as it has raised production from 7.5 Lakh tones to more than 35 Lakh tones in the last twenty years [1].

In Bangladesh the aquaculture production from inland closed water-bodies is 55.15% of the total production. Bangladesh is in 5th position as aquaculture producing country in the world [2].

Many exotic fishes are now under intensive culture practices in Bangladesh that has become a good and profitable fishery here. One of them is Thai-pangas,*Pangasius hypothalmus*. It is an important catfish for its fast growth, high resistance to disease very good taste, recently increase popularity, fame for its aristocracy and good marker demand. Pangas species is dominant in fish farming which is considered to be the main source of fish intake of the country's low and middle income people because of to their lower price in local markets. Amongst exotic fish species Thai-pangus (*Pangasius hypothalmus*) is the best due to its easy culture system, favorable weather condition for culture and high market demand [3]. In recent year, Thai pangas has become one of the most popular commercial cultureable species due to its high yield and low production cost and many hatcheries all over the country are now producing Thai-pangas fry to meet up the farmers demand.

Corresponding Author: Shemul Mian, Department of Fisheries and Marine Science, Noakhali Science and Technology University, Noakhali-3814, Bangladesh. Tel: +8801760907491.

Taxonomic position of (*Pangasius hypophthalmus*)
Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii
Order: Siluriformes
Family: Pangasiidae
Genus:Pangasianodon
Species: P. hypophthalmus

The Thai pangas (*Pangasius hypophthalmus*) is a species of shark catfish (family Pangasiidae) native to the rivers of Southeast Asia. It is not a shark. It is found in the Mekong basin as well as the Chao Phraya River and is heavily cultivated for food there. The meat is often marketed under the common name swai. It has also been introduced into other river basins as a food source and its striking appearance and iridescence have made it popular with fish keeping hobbyists, among whom it is also known as the Siamese shark or sutchi catfish. The swai's omnivorous diet consists of crustaceans, other fish and plant matter.

Thai pangus originate from the large rivers Chao Phraya and Mekong in Asia, though they have been introduced into other rivers for aquaculture. They are a freshwater fish that natively live in a tropical climate and prefer water with a 6.5–7.5 pH, a water hardness of 2.0–29.0dGH and a temperature range of 22–26 °C (72–79 °F).They prefer large bodies of water similar to the deep waters of their native Mekong river basin. *Pangasius hypophthalmus* is commonly known as Thai Pangus, which belongs to family Pangasidae of the order siluriformes. The origin of *Pangasius hypophthalmus* was from the Mekong River of Vietnam to Chao Phraya River of Thailand and distributed to other countries such as Malaysia, Indonesia and China [4]. This specie is widely cultured in Asian countries such as Bangladesh, Vietnam, Malaysia, Indonesia, Laos, Cambodia and China [4]. The culture significance of Thai Pangas, (Pangasius hypophthalmus) in the South East Asian region has gained much attention very recently. In some cases they are preferred over the indigenous carps and other catfishes for aquaculture. In Bangladesh some attempts on induced breeding and aquaculture of Thai pangas have been found successful. They become sexually mature at the age of 2.5 to 3 years in captive condition. Aquaculture of Thai pangas is common and widely practiced in Bangladesh. Profit varies around Tk. 0.4-0.5 millions/ha and Tk. 0.4-0.5 millions/ha in semi-intensive monoculture and semi-intensive polyculture, respectively. Pangasius species have a low to moderate fat content with high levels of protein. The amount and composition of the fat content will be influenced by the feed used in aquaculture operations. A nutrition label for a four ounce raw portion of Pangasius is provided. The actual nutrient content of products that are consumed will be affected by added ingredients and the cooking method that is used.

With increase in human population and diminished natural fisheries resources, aquaculture is rapidly gaining importance. Pond aquaculture is growing fast in many resource-constrained Asian countries. In order to maintain the present per capita supply of aquatic products in the future, further growth of aquaculture production is needed as the supply through capture fisheries cannot grow any more. But, fish culture on a small scale basis has often failed due to inadequate knowledge regarding ideal feeding rate, stocking density and feeding frequency of fish. However, feeding frequency is generally used to refer how many times the organisms should be fed in a day. It is considered to be one of the important factors that affect fish growth, feed utilization and gross fish yield. The full utilization of space for maximum fish production through intensive culture can improve the profitability of the fish farm. Fish and fisheries play a significant role in our national economy, nutrition, employment generation, income and also help a lot of foreign exchange earnings. Most of the poor people have been suffering from malnutrition due to lack of proper animal protein. Fish and fisheries sector can solve this problem partially by increasing the fish production through modern and scientific fish culture and management practice. Modern fish culture means improvement of culture practices through adopting modern fishing technology, regular feeding, maintenance of the physico-chemical parameters, proper investigation of disease occurring, optimum stoking density and other control measures. Pangus has established a secure position in a number of water impoundments of Bangladesh, where one sex displays remarkable growth superiority. It has been widely introduced in the shallow and seasonal ponds. The fish can form a readily available source of animal protein in the diets of rural and urban dwellers belonging to the lower socio-economic strata. Hence, new techniques for maintenance of high growth rate of pangus are the need of the day. Considering these aspects, the present study aims to evaluate the growth performance of the allin aquaculture, like other farm of husbandry, feeding is a vital point for its viability and success. Feed should be used conservatively to prevent the input of more nutrients than necessary, to avoid the

waste of feed ingredients, to increase the efficiency of feed use and to reduce production costs. Feed cost is one of the largest operational costs in aquaculture [5]. Therefore, the act of feeding may be pointed as one of the most important element in the culture practice. The practice of feeding in an aquaculture system involves selection of appropriate ration sizes (the amount of feed supply), determining frequency (how many times the organism should be fed in a day) and timing of meal and efficient broadcasting of the predetermined ration to the culture system. Many more studies have also shown the multiple feeding results in a more efficient utilization of the feed than a single feeding. The number of feeding per day and the time of feeding vary with species, size of fish and environmental condition. Pangus is popular as a culture species of their ability to efficiently use both natural organisms and manufactured feed efficiently allowing high levels of production.

Generally the feeding rate, feeding frequency and growth of fish are intrinsically correlated. Thus the feeding strategy may provide clue for maximum growth because the feeding frequency contribute to feed efficiency and growth response. The feeding frequency is important to ensure best weight gain and best FCR gain of cultured organism. However, an important step in the feeding strategy is to determine the optimal feeding frequency. It is evident from the earlier studies that, rate of feeding play a vital effect on the digestibility of fish, as excess feeding may lead to leaching of nutrients and limited feeding may reduce the growth rate of fish due to starvation. Therefore, it is important to standardize the feeding frequency for the target species in aquaculture for desired growth.

METHODS AND MATERIALS

To collect valid and reliable information for the research an investigator must follow appropriate methodology. In order to attain the objective of the study and to analyze the data one must select the right method and without it researcher or investigator will fail to reach a good conclusion.

Study Area, Study Period and Description of the Water Body: The experiment was conducted in the Bismillah agro farm and hatchery (Fig. A.14). The study period was 04th October to 1 st December, 2017. An 8 week experiment was conducted in pond where main source of water were pump and rain water. The water depth of the water body was more than 3 feet on average, where net of the cage (hapa) was set in a manner that it maintains minimum of water level always higher than 1.5 feet inside the cage.

Experimental Design: This experiment was conducted by establishing 3 different cages in the water body using net and local bamboo. The size of each cage was 8L×4W×4H feet (Fig. A15). Distance of each cage from its neighboring one was maintained 100 cm. and same distance was maintained between the embankment and a cage. Three cages were marked as treatment-1 (T1), treatment-2 (T2) and treatment-3 (T3). In the treatment of T1, no supplementary feed was given and fish was completely dependent on natural food. In T2, feed was given by 8% of the body weight of the *Pangasius hypophthalamus* and in T3 feed was given 12% of the body weight (Table. A5). Stocking density was 420fish/decimal in all treatments.

Pre Stocking Management/preparation of the Water Body: Before stocking all water body need to prepare for the fishes which ensures the best environment for the fishes. The following measure was taken before starting the experiment.

Preparation of Hapa (Cage): Hapa (cage) was made by the nylon net which are available in local market. The bamboo was set into the bottom of the water body and net was tight up with rope in both top and bottom of the bamboo. Inner side of the net was fixed with bamboo by rope (Fig. A15).

Source of Fry: The *Pangasius hypophthalmus* fry was collected from Bismillah Agro farm, Noakhali. The fry was 40 days old. The average length of the fry was 8 cm and weight was 5 gm on average. Same length and weight of fry were selected for this study. All fry were healthy and disease free.

Conditioning of Fry: The fry were conditioned in the Bismillah Agro farm for 3 hours before stoking in the experimental hapa (cage). Good water quality was maintained during the conditioning. Conditioning was done in a big bucket which was like a circular tank. Fish were kept without any feed during the conditioning time. No fish were marked as deformed or weak after conditioning. Fin, eye and scales everything was in good condition.

Stocking of Fish: After preparation of hapa (cage) fry (*Pangasius hypothalamus*) was stocked into the hapa (cage) (Fig. A16). All fishes were similar in size and age. For every treatment 30 species were stocked. This species were healthy and disease free.

Post Stocking Management: Analysis of water quality parameters

In the study period, water temperature, Dissolve oxygen, pH, abundance of natural food (plankton) was recorded one times per week respectively.

1water Temperature (°C): Water temperature of the experimental water body was measured using mercury Celsius thermometer one time in a week during the study period (Fig. A17). During the study period we measured temperature of the experimental water body at the same time one day in a week.

pH: pH of the water body was measured one times in a week during the study period. For this operation a digital portable pH meter (Model: HANNA- HI 96107) were used (Fig. A18).

Dissolve Oxygen (mg/l): To determine the dissolve oxygen of the experimental water body a portable DO meter (Model: Lutron-DO-5509) was used and DO was measured in the spot without collecting any water sample in the laboratory (Fig. A19).

Feeding and Feed Management: In this experiment floating starter feed (diameter: 2.6±0.3mm) is used throughout the experimental period. Feed was given two times daily at 10:00 am in the morning and 5:00 pm in the afternoon. The composition of the feed is in (Table A6).

For T1, no supplementary feed were supplied, T2 feed were supplied according to 8% of the body weight of the fish and for T3 feed were supplied according to 12% of the body weight of the fish (Fig. A20). Feeding rate was calculated from the average weight of pangas after each sampling. Feed were kept in air tight polythene bag. Feed was supplied directly without any feeding tray. Feed was distributed evenly over the surface of the water inside the hapa (cage). Half of the ration was supplied at 10:00 am and remaining half was supplied at 5:00 pm everyday respectively.

Sampling and Measurement of Length & Weight: Fishes were caught by using a scoop net from the hapa and measured the length and weight of each species and data were recorded. For weighting an analogue balance machine was used and for length a tap was used (Fig. A21). Data on length and weight were taken every 7 days interval. During sampling day all fishes were caught to confirm that if any fish have escaped or died. Health conditions were monitored during the sampling of fishes. The total sampling process were handled very carefully as the small fry are very susceptible to handling stress. During sampling we tried to minimize the sampling error carefully.

Biological Data Collection: To evaluate the fish growth weight gain, increase in length and specific growth rate were measured during the study period.

Weight gain was calculated by the following formula

- Mean weight gain = Mean final fish weight (g) – Mean initial fish weight (g)
- Specific growth rate (SGR) was estimated by the following formula

In final mean weight- initial mean weight × 100

SGR (%) = Culture period (days)

- Mean length gain= mean final length – mean initial length

Survival Rate: The survival rate of fishes of each treatment was calculated from the number of fish species harvested from each treatment at the end of experiment and the number of fish at the starting time of experiment. It was calculated by the following formula

Survival rate (%) = Number of harvested fish × 100 /Initial number of fish

Calculation of FCR: FCR is very important for any fish culturist. FCR is stands for feed conversion ratio or feed conversion rate. FCR is a measure of fish's efficiency in converting feed mass into increases of the desired growth. In this experiment FCR was calculated using following formula.

FCR= Amount of feed given by dry weight during the experimental period/Final live weight gain by fish

Statistical Analysis: Data that are obtained from the experiment on growth performance, weight gain, increase in length, survival rate and production were statistically analyzed to see whether the influence of different treatments (feed) on these parameters were significant or not. This was done by using different statistical method by the help of statistical software named Microsoft excel

RESULTS

Observation of Water Quality Parameter of Experimental Site: Temperature, pH, dissolve oxygen and transparency were observed during the whole study period. Temperature, pH and dissolve oxygen were found variable and transparency was found almost similar. All water quality parameter of the experimental water body is represented in the (TableA1).

Observation of Water pH: pH is a very important parameter for aquaculture. In this study we measured pH of the water where fishes were live. The pH of the experimental water body was measured in every 7 days interval during the study period. The highest pH value was found 8.6 2nd week in T1 and the lowest value of pH was found 7.5 in 2nd week. Average pH was highest in T_1 during the study period and it was 8.13. (Fig A1)

Observation of Water Temperature (°C): During the whole study period water temperature of the experimental water body was calculated in every seven days interval. Temperature of the water was found highest 32°C in 2nd week in T1 and T3 and in 6th and 8th week in T2 and T3 respectively. The lowest temperature is recorded 28 °C in T1 2nd week and T2 in 4th week and T3 1st week. The average highest temperature was recorded 30.37 °C in T3. (Fig A2)

Observation of Dissolve Oxygen (DO): Dissolve Oxygen was measured during the study period in every seven days interval. Highest DO was found 7.8 mg/l in T2. Lowest value of dissolve oxygen was recorded 5.6 mg/l in T1 in 8th week. From the figure we observe that the average DO level was higher at the beginning of the study period but the level of DO was decrease with the increase of the study period in all three treatments (Fig. A3).

Growth Performance of *Pangasius hypophthalamus*: Growth performance of Pangus (*Pangasius hypophthalamus)* in different treatment was calculated by weight gain and increase in length. The evaluation of growth performance of *Pangasius hypophthalamus in* all treatment has been done in term of final weight gain (g), mean weight gain (g), average daily weight gain (g), percent weight gain (g) and survival rate of the species.

Observation of Weight Performance: Average total weight was calculated by using weight machine. The average initial weights of fish as in all treatments were 5g. Sampling was done randomly and found the weight of *Pangasius hypophthalamus* variable in different treatment. Weight of all fish increased with the time interval (from 1st week to 8th week). At the end of the experiment, average weight of *Pangasius hypothalamus*in T_3 was found (23.18±11.7)gm, in T_2 weight was found (18.68±9.76)gm, in T_1 average weight was found (15±7.76)gm. The average weight gain of T_3 was found higher and lower in T_1 (Fig. A4).

Observation of Length Performance: Average total length was calculated by using a scale. Average Initial lengths of all fishes were 8 cm. For measurement of length of *Pangasius hypophthalamus*, random sampling was done and found the length variable in three treatment. Length of all fishes increased with the time interval. At the end of the experiment, average length of *Pangasius hypophthalamus* was found (9.65±1.15) cm, (10.83±1.86) cm and (11.83±2.05) cm in T_1, T_2 and T_3, respectively. Increase in length was notable in T_3. Average increase in length was highest in T_3 than other three treatments. On the other hand increase in length was found lowest in T_1 (Fig. A5).

Weight Gain of *Pangasius Hypophthalamus*: Weight gain of *Pangasius hypophthalamus* fish fry was observer during the study period in each treatment. In each week weight gain was different. Final average weight gain was found 15g, 18.68g and 23.18g in T1, T2 and T3, respectively. In T1 weight gain was almost similar in every week. The average weight gain in T1 was (3.11±2.1) gm. In T2 highest weight gain was recorded in 8th week (5 gm) and lowest was found in 6th week (3gm). In this treatment average weight gain was (4±2.97) gm. In T3 the highest weight gain was found in 2nd week (7.8gm) and the lowest was recorded in 6th week (3.2gm). Average weight gain in T3 was (4.93±3) gm (Fig. A6).

Length Gain of *Pangasius Hypophthalamus*: Length gain of *Pangasius hypophthalamus* was observed during the whole study period in different treatment. Final average length gain was 9.65 cm, 10.83 cm and 11.38 in T1, T2 and

T3 respectively. In T1 highest length gain was found in 8th week (0.6cm) and the lowest was in 4th week (0.4 cm). Average length gain in T1 was (0.48±0.25) cm. In T2 highest length gain was found in 2nd week (1 cm) and lowest was in 7th week (0.6 cm). The average length gain of T2 was found (0.78±0.49) cm. In T3 highest growth was found in 2nd week (1.5 cm) and lowest was in 6th week (0.60 cm). The average length gain was (0.88±0.59) cm (Fig A7)

Survival Rate: Survival rate was lowest and found 87% in T_1. In T_2 survival rate was found 93%. Highest survival rate was 97% T3.The variation in survival rate was due to environmental condition and different feeding percentage and feed utilization. (Fig A8)

Observation of FCR: FCR of the two experimental treatments (T_2& T_3) was calculated after the study. In T_3 FCR is found 3.60 and in T_2 FCR was found 2.41. In T_1 no feed were supplied this is why FCR was not applicable for that treatment. (Fig A9)

Observation of SGR: In T_1 highest SGR value was found (0.97±0.61) in 7th week and lowest was found (0.38±0.61) in 3th week. Average SGR in T_1 was 0.67 during the study period. In T_2 highest SGR was recorded (0.62±0.51) in 1stand 8Thweek while lowest value was recorded (0.37±0.51) in 7th week. Average SGR of this treatment was recorded 0.51. In T_3 highest SGR was found (0.97±0.41) in first week and lowest SGR was found (0.26±0.41) in 3thweek. Average SGR of T_3 was 0.413. In term of average, the highest SGR was found in T_1 (Fig A10).

Correlation Between Growth and Length of Pangasius hypophthalamus

Growth vs. length in T_1: A significant positive correlation was found between growth and length in T_1 (Table A2). The value of R^2 was 0.963 for T_1 (Fig A11).

Growth vs. length in T_2: In T_2 correlation between growth and length was found significantly positive where R^2=0.942 (Fig A12) (Table A3).

Growth vs. length in T_3: Correlation between growth and length was found significantly positive in T_3 where R^2= 0.919 (Fig A13), (Table A4).

DISCUSSIONS

This study was conducted to have some idea about growth rate and survival rate of *Pangasius hypophthalamus* in different treatment and also water quality parameter was monitored during the whole study period.

Weight Performance: The mean initial weight of fish fry in all three treatments was 5 g. At the end of the study, the mean weight of *Pangasius hypophthalamus* was (15±7.76) g, (18.68±9.76) g and (23.18±11.7) g in T_1, T_2 and T_3, respectively. The mean weight gains of fry at the end of the experiment were highest in T3. The mean weight of *Pangasius* fry at harvest was higher in T_3 (23.18±11.7g), followed by T_2 (18.68±9.76 g) and T_1 (15±7.76g). The highest weight gain of *Pangasius hypophthalamus* was observed in T_3 in which feed was given according to 12% body weight of the fish [6]. Scientist carried out an experiment in metal cage and found similar results in case of *Pangasius hypophthalamus* by feeding formulated diet prepared by locally available material and used feed daily ata rate that decreased with fish growth from 15% to 3% of body weight reported a weight gain of about 128 g for Pangas in on-farm ponds for a culture period of 6 months fed rice bran at 5-6% of their body weight [7,8]. Considering the 8 weeks culture period in this study, compared to 6 months period [8]. Pangas in the present study performed better in respect of weight gain.

Length Performance: The mean initial length of fish fry in all three treatments was 8 cm. At the end of the study, the mean length of pangus was (9.65±1.15) cm, (10.83±1.86) cm and (11.38±2.05) cm in T_1, T_2 and T_3, respectively. The mean length gains of fry at the end of the experiment were highest in T3. The mean length of pangas fry at the end of the study was higher in treatment T_3 (11.38cm), followed by T_2 (10.83cm) and T_1 (9.65cm). One hundred juvenile of *Pangasius hypophthalamus* after the end of the experiment and found the length of fish ranged from 5.5 to 11.4 cm [9]. In the present study the highest average length was in T_3 (11.38) which were almost similar to the findings of previous research [8].

Survival Rate (%) : The mean survival rates of *Pangasius hypothalamus*were recorded 93% in average three treatments, during the study period. In the present study, higher survival was achieved as the fish can survive under adverse conditions like low oxygen, high temperature and high pH value. The results of present study were close to the research findings of researchers who observed that the survival rates of koi (*Anabas testudineus*) were varied from 60-80% [10]. The result of this study also agree with f T_1 and T_3 who reported that the survival rates of *Pangasius hypophthalamus* varied from 79%-92% [11].

Food Conversion Ratio (FCR): In the present study Food Conversion Ratio (FCR) values for pangus fry with the commercial feed was 3.60 and 2.40 in T_1 and T_2, respectively. Lower FCR value (2.40) was obtained in T_2 with supplemental feed at the rate of 8% body weight. Ahmed *et al*. (2013) found that Food Conversion Ratio (FCR) was 1.51 and 1.40 respectively in homemade and commercial feed treatments in pangus. Researcher found FCR value formulated diet was 1.71-1.77 which was little different from the present study [12]. This difference could be due to the fact temperature and geographical location difference as well management. In the present study moisture content was 11% which could also a cause of higher FCR value. One of the scientist indicated that the *Pangasius hypophthalamus* fingerlings need 2030% crude protein in ration to give optimum results in ponds [13]. The feed in T_2 and T_3 of the present study also contained crude protein within similar range. So the change in FCR is not due to protein in feed.

Specific Growth Rate (SGR %/day): In this study Specific Growth Rate (SGR) of fish in the around 8 weeks were 0.41, 0.62 and 0.97 in T_1, T_2 and T_3, respectively. Fish feed on supplemental feeds could show SGR value between 3-4%/day which is similar to the result of T_2 and T_3 in the present study [14]. SGR value of 3.10 with of *Pangasius hypophthalamus* in Thailand used feed and fertilizer [15]. A slightly lower SGR value of 2.03 with pangas in Honduras was found using feed and fertilizer [16]. SGR value of pangus ranged from 2.04-2.30 fed on formulated diet which is lower than the present value [12]. The differences of SGR values of *Pangasius hypophthalamus* in the present study are due to the difference in temperature, pH, dissolve Oxygen and geographical location in two studies. Specific growth rate (SGR) of of *Pangasius hypophthalamus* was recorded 3.09 and 2.97 by using homemade and commercial feed which is also close to the present study [17].

Water Quality Parameters: Water parameters have great influence on the maintenance of a healthy aquatic environment and production of food organism. The water quality parameters studied were water temperature, pH, dissolved oxygen and transparency which are discussed below.

Water Temperature (°C): Reproduction, growth, survivability and other activities of fish are largely depends on temperature. Metabolic rates of organisms increases with the increase of temperature [18]. Perciform fish have not developed a mechanism that allows them to adapt to the cold environment [19]. Therefore temperature has a remarkable effect on overall production of fish. During the present study, the water temperatures were between 28°C and 32°C. The growth and feed utilization of *Pangasius hypophthalamus* juveniles may be higher at 26 and 30 °C [20]. In the present study the temperature rang was higher than Azaza. That the optimum temperature for feeding is between 28.8 and 31.4°C and the fastest growth rate was at 31.4°C, at which the fish averaged an increase of 3.42% of their body weight in 24 h [21]. This temperature range is similar to the present study. The (29.0±1.0) °C temperature of water can give a remarkable growth ($p<0.5$) for (*Pangasius hypophthalamus).*

Dissolved Oxygen (Mg/1): Dissolved oxygen of a water body is very important factor for fish culture. During the present study, dissolved oxygen content was between 5.6 to 7.80 mg/l [22]. Suitable DO for fish culture is from 5.0 – 8.0 ppm [23]. The DO level of present study is not similar to DoF report. This is due to environmental condition, type of water body and geographic location [24]. DO level is 1.19 – 7.74 mg/l on average in two pond in BAU Campus [25]. The findings of present study are similar to his study.

Water pH: The range water of pH level in this study was 7.5 to 8.6. According to DoF the optimum level for pH is 6.5 to 8.5. The level of pH in the present study is in optimum level according to DoF. pH level from 6.5 to 8.0 is acceptable for culture[26]. But another study said that pH level from 5.66-7.66 is suitable for fish culture [26, 27]. Compared to previous studies pH level in the present study is little high [28, 29]. This is due to several environmental conditions, geographical location and other operational factors [30, 31].

CONCLUSIONS

The proximate composition of the experimental diet (% dry matter basis) was moisture 11%, protein 30%, fat 6%, ash 10% and fiber 7%. A stocking density of 280 fish per decimal was used for the experiment in all three treatments. The fish were dependent on natural food in T1, fed at the rate of 8% of their body weight in T2 and the feeding rate was 12% in T3. Feeding frequency was two times in a day in T2 and T3. The water quality

parameter was monitored at 7 days intervals and they were more or less similar in three treatments and remained within the suitable ranges for aquaculture. The range of water quality parameters were, water temperature 28 to 32°C, Dissolved oxygen 5.6 to 7.8 mg/l and water pH 7.5 to 8.6 during the experimental period. The growth parameters were monitored at 7 days interval. The average survival rate of all three treatments was 93%. The mean initial weight of Pangas fry in three treatments were 5 g and after completion of the experiment the mean final weight of pangas was (15±1.06)g for T1, (18.68±1.87)g for T2 and (23.18±2.11)g for T3. Mean initial length was 8 cm in three treatment and final length was found (9.65±1.15) cm, (10.83±1.16) cm and (11.38±2.05) cm in T1, T2 and T3 respectively. The highest weight gain, length gain were found in T3 having the feeding rate of 12% of the body weight and lowest was found in T1 in which no supplementary feed were used. The result of the present study demonstrated that 12% body weight feeding rate played better effect on the growth and survival performance of *Pangasius hypophthalamus* in this geographical location.

Appendix

Table A1: Water quality parameter

	Parameter Time	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	8.4	8.1	7.9	8.0	8.3	7.8
T_1	pH	8.0	8.6	8.4	8.1	7.9	8.0	8.3	7.8						
	DO (mg/l)	7.0	6.5	6.8	7.2	6.8	6.4	6	5.6						
	Temperature(°C)	30	28	32	30	31	29	30	31						
T_2	pH	8.0	8.4	8.3	7.8	8.5	8.0	7.8	8.2						
	DO (mg/l)	7.0	7.5	7.4	7.0	6.9	6.5	7.8	6.0						
	Temperature(°C)	30	29	31	28	30	32	30	30						
T_3	pH	7.8	7.5	8.1	8.3	7.9	8.5	8.4	7.8						
	DO (mg/l)	5.8	7.0	6.5	6.4	5.9	7.6	7.3	6.0						
	Temperature(°C)	28	30	32	29	30	31	32	32						

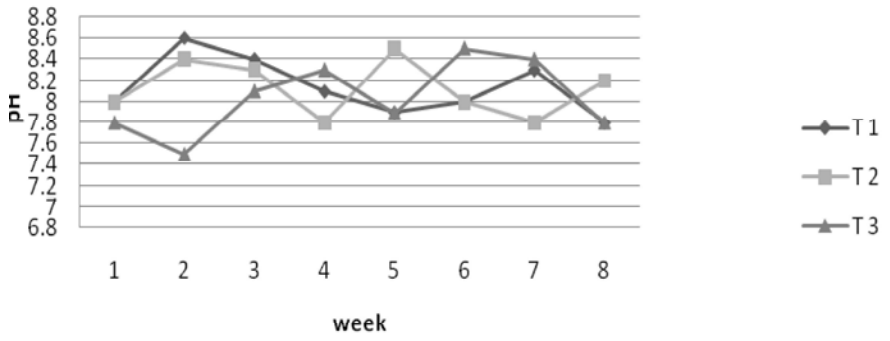

Fig. A1:Variation of water pH during the study period

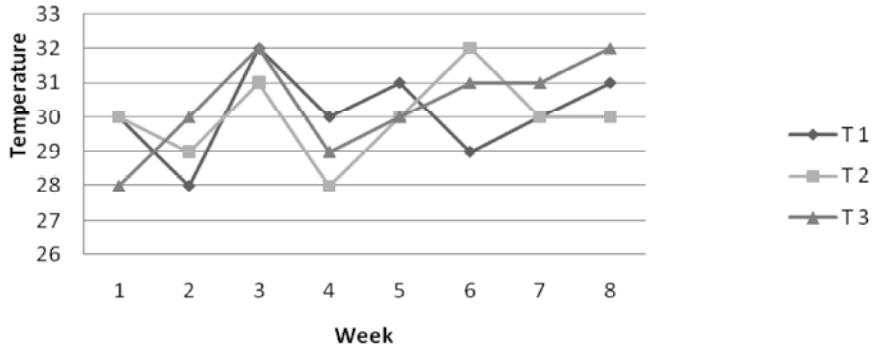

Fig. A2: Variation of water temperature during study period

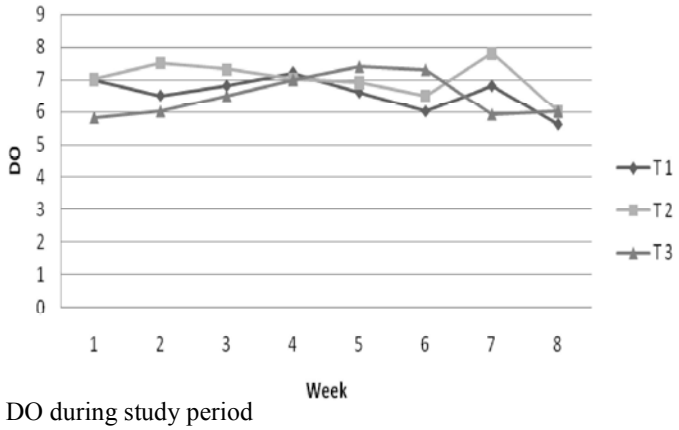

Fig. A3: Variation of water DO during study period

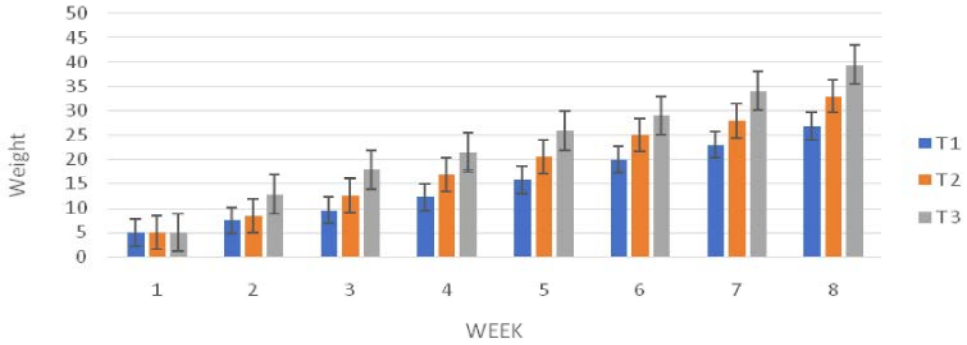

Fig. A4: Weight performance of Pangus fry in different treatments

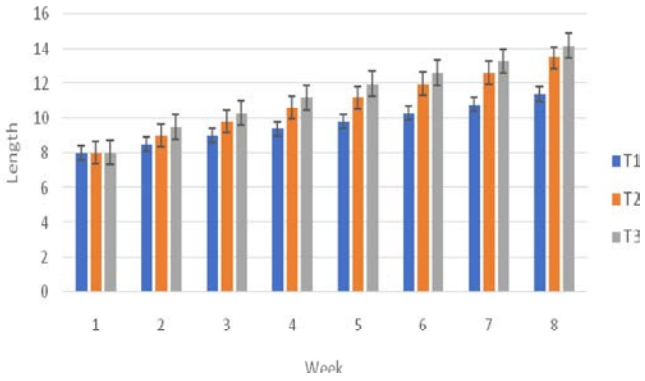

Fig. A5: Length performance of *Pangasius hypophthalamus* fry in different treatment

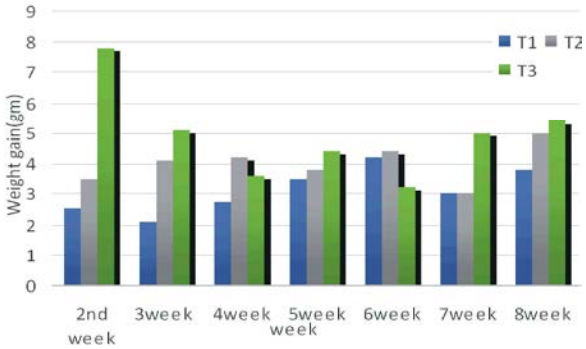

Fig. A6: Variation in weight gain of*Pangasius hypothalamus*in different treatment.

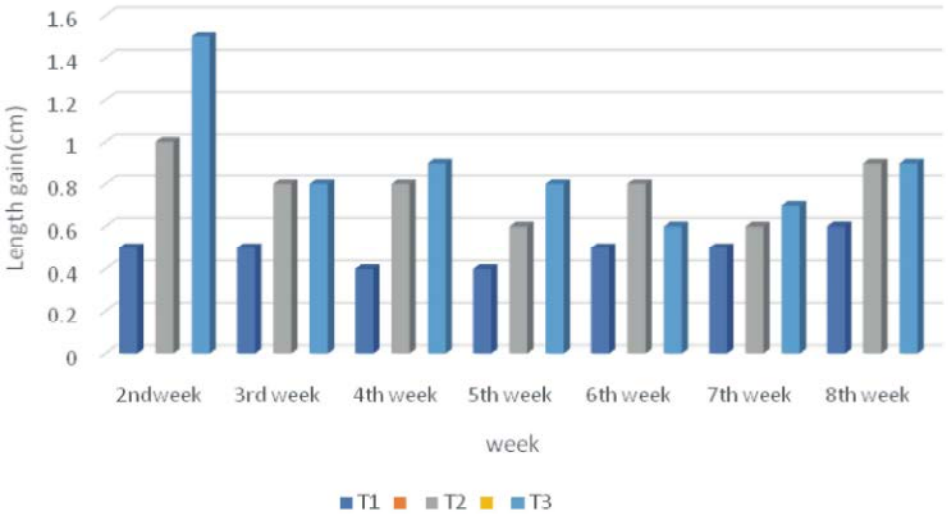

Fig. A7: Variation in length gain in different treatment.

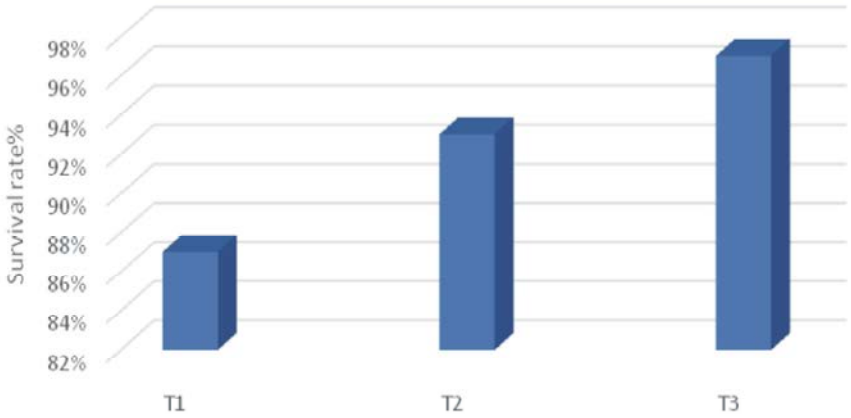

Fig. A8: Survival rate of fry in different treatment

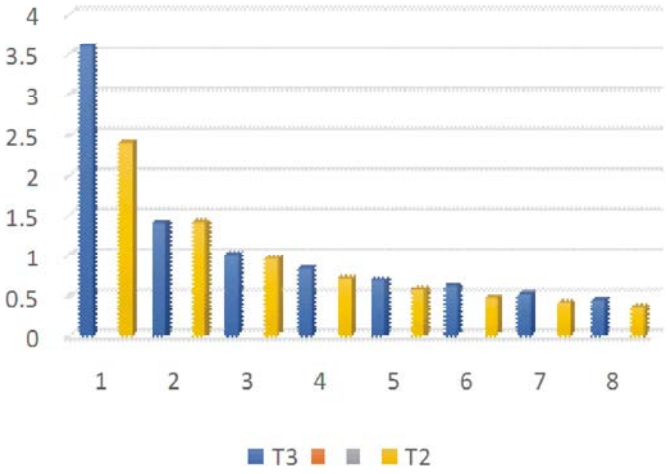

Fig. A9: Variation of FCR in different treatment

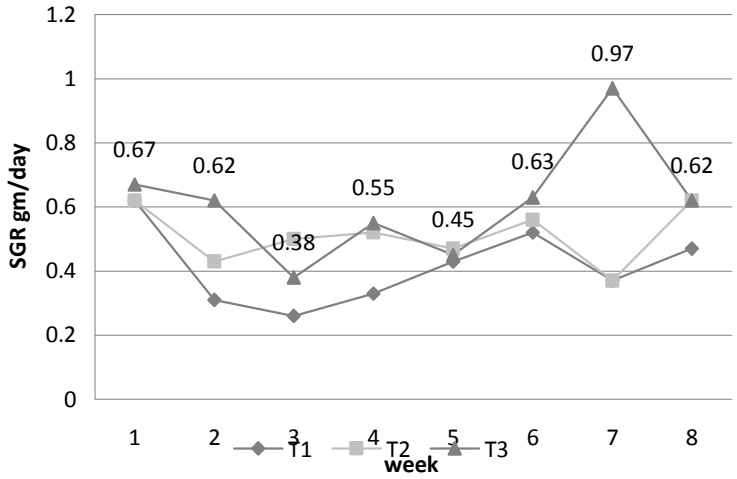

Fig. A10: Specific growth rate (SGR) of different treatments

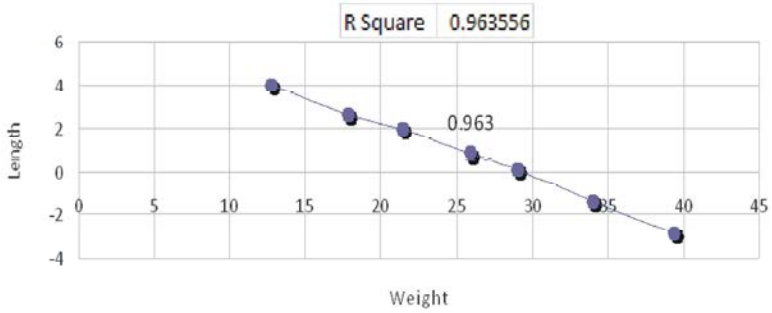

Fig A11: Correlation between growth and length of *Pangasius hypothalamus* in T_1

Table A2: Regression Statistics for T1

R square	Coefficient	Standard error	T stat	P value
0.942	0.496	0.050051	9.92747	6.04E-05

Table A3: Regression Statistics for T2

R square	Coefficient	Standard error	T stat	P value
0.91906	0.53744	0.065112	8.25403	0.000171

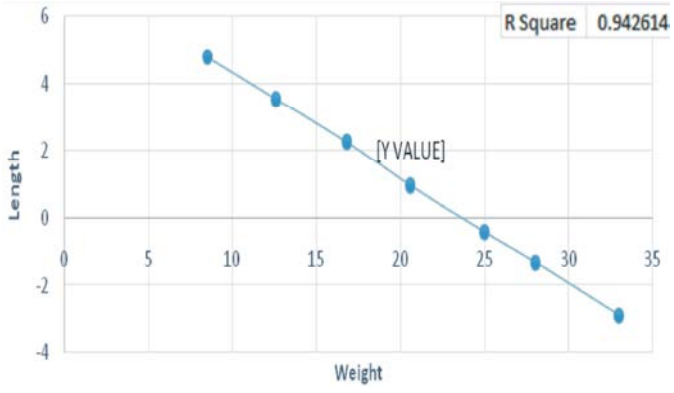

Fig. A12: Correlation between growth and length of *Pangasius hypophthalamus* in T_2.

Table A4: Regression Statistics for T3

R square	Coefficient	Standard error	T stat	P value
0.919	0.53744	0.065112	8.254043	0.000171

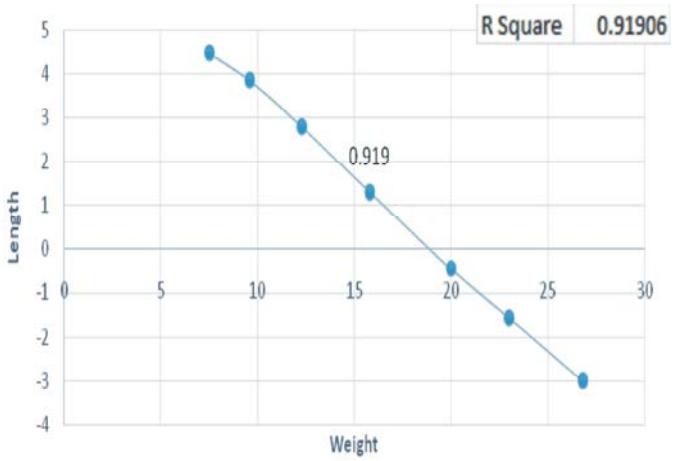

Fig. A13: Correlation between growth and length of *Pangasius hypophthalamus*in T_3.Correlation between growth and length was found significantly positive in T_3 where $R^2 = 0.919$

Fig. A14: Image of the study area collected from Google map

Table A5: Experimental layout of *Pangasius hypothalamus*.

Treatment	Size of the cage(Dec.)	Stocking density/Dec	Number of fish	Fish feed
T-1	0.0725	420	30	No
T-2	0.0725	420	30	8%
T-3	0.0725	420	30	12%

Fig. A15: Establishment of experimental hapa (cage)

Fig. A16: Stocking of fry in experimental hapa (cage)

Fig. A17: Temperature Measurement of experimental water body

Fig. A18: pH Measurement of experimental water body

Fig. A19: Measurement of DO in experimental water body

Table A6: Composition of feed used in the experiment

Type of feed	Protein (minimum)	Moisture (maximum)	Fat (minimum)	Fiber (maximum)	Ash (maximum)
Floating starter	30%	11%	6%	7%	10%

Fig. A20: measurement and feeding management.

Fig. A21: Measurement of length and weight

REFERENCES

1. DoF, 2015. MatshaPakkahShankalan. Directorate
2. FAO, 2015. WFP. 2015. The state of food insecurity in the world 2015. In Meeting the
3. Sarker, M.T., 2000. Pangus, Chash Babosthapana Management of Pangus culture, Department of Fisheries, Bangladesh, pp: 25.
4. Roberts, T.R. and Vidthayanon, 1991. Systematic revision of the Asian catfish family Pangasiidae with biological observations and descriptions of three new species. Proceedings of Academy of Natural Sciences of Philadelphia, (143): 97-144.
5. De Silva, S.S. and F.B. Davy, 1992. Fish nutrition research for semi-intensive culture systems in Asia. Asian Fisheries Science, 5(2): 129-144.
6. Binh, C.T., C.K, Lin and H. Demaine, 1997. Evaluation of low cost supplemental diets for culture of Pangasius hypophthalamus in North Vietnam (part 1) Formulation of supplementaldiets. PondDynamics/ AquacultureCollaborative Research Support Program Fifteenth Annual Technical eport.
7. Hasan, M.R., A.K.M. Aminul, M. Aminul and E.U.M.K. Khan, 1982. Studies on the effects of stocking density on the growth of Pangasius hypophthalamus in floating ponds. Bangladesh Journal of Fisheries, 2-5(1-2): 37-41.
8. Hussain, M.G., A.H.M. Kohinoor, M.S. Islam, S.C. Mahata, M.Z. Ali, M.B. Tanu and M.A. Mazid, 2000. Genetic evaluation of Pangasius hypophthalamus under on-station and on-farm conditions in Bangladesh. Asian Fisheries Science, 13(2): 117-126.
9. Olurin, K.B. and O.A. Aderibigbe, 2006. Length-weight relationship and condition factor of pond reared juvenilePangasius hypothalamus. World Journal of Zoology, 1(2): 82-85.
10. Felt, R.A., F. Rajts and D. Akhteruzzaman, 1998. Small Indigenous Fish Species Culture in Bangladesh. Integrated Food Assisted Development Project (IFADEP), Dhaka, Bangladesh.
11. Kohinoor, A.H.M., P.C. Modak and M.G. Hussain, 1998. Growth and production performance of Pangasius hypophthalamus under low input culture system. Bangladesh Journal Fisheries Research, 3(l) 11-17.
12. Hossain, M.A. and M.A. Alim, 1991. Evoluation of silkworm pupae meal as dietary protein source for catfish Heteropneustesfossilis (Bloch) fish Nutrition in practice, Biarritz (france), Ed.INRa. Paris, pp: 785-791.
13. Leboute, E.M., S.M.G. Souza, L.O.S. Afonso and S.O. Zimmermann, 1994. Preliminary study on the cage culture ofPangasius hypothalamus. Aquaculture, 8(4): 151-155.
14. Das, M. and G.U. Mughal, 1992. Induced breeding and fry rearing of Clariasbatrachus (Linn). Bangladesh J. Zool., 20: 87-95.
15. Chheng, P., 2004. Synthesis of all Published Information on Sutchi Catfish Pangasiushy pophthalmus (trey pra) Based on FishBase 2004. Worldfish Center and Inland Fisheries Research and Development Institute, Cambodia, Phnom Penh, pp: 17.
16. Gupta M.V., M. Ahmed, M.A. Bimbo and C. Lightfoot, 1992. Socio-economic impact and farmers Assessment ofPangasius hypophthalamus culture in Bangladesh. ICLARM technical Report No. 35, International center for living aquatic Resources Management, Manila, Philippines, pp: 50.
17. Ahmed, G.U. and M.G. Kibria, 1996. Culture feasibility of pangus (pangasiuspangasius, Ham) in earthen ponds with different supplemental diets. Bangladesh. J. Fish. 19(1-9): 23-27.

18. Chakraborty, S.B., D. Mazumdar and U. Chatterji, 2011. Growth of Pangasius hypophthalamus in Different Culture Systems.
19. Clarke, A. and N.M. Johnston, 1999. Scaling of metabolic rate with body mass and temperature in teleost fish. Journal of Animal Ecology, 68(5): 893-905.
20. Azaza, M.S., M.N. Dhraief and M.M. Kraiem, 2008. Effects of water temperature on growth Pangasius hypothalamusreared in geothermal waters in southern Tunisia. Journal of thermal Biology, 33(2): 98-105.
21. Hussain, M.G., 2004. Farming of Pangus: Breeding Plans, Mass Seed Production and Aquaculture Techniques. Bangladesh Fisheries Research Institute, Mymensingh 2202, Bangladesh. pp: 130.
22. Ridha, M.T., 2006. Comparative study of growth performance of three strains ofPangasius hypophthalamus at two stocking densities. Aquaculture Research, 37(2): 172-179.
23. Do, F., 1998. MatshyaShaptah 98" a publication on the occasion of fish week,1998, Department of fisheries, MatshyaBhaban, Park Avenue, Ramna, Dhaka, pp: 110.
24. Mollah, M.F.A. and A.K. Haque, 1978. Studies on monthly variations of plankton in relation to the physico-chemical conditions of water and bottom soil of two ponds. Phytoplankton. Bangladesh J. Fish, 1(1): 29-39.
25. Do, F., 2001. Report of fish Week-2001, a publication on the occasion of fish week, Department of Fisheries, MatshyaBhaban, Park Avenue, Ramna, Dhaka.
26. Boyd, C.E., 1984. Water quality in warm water fishponds. Auburn University, Agricultural Experimental Station, Auburn, Alabama, USA, pp: 359.
27. Mohsin, A.B.M., F. Yeasmin, S.M. Galib, B. Alam and S.M.M. Haque, 2014. Fish fauna of the Andharmanik River in Patuakhali, Bangladesh. Middle-East Journal of Scientific Research, 21(5): 802-807.
28. Hossain, S., S. Bhowmik, M.T. Hasan, M.S. Islam and M.A. Hossain, 2015. Socio economic condition of Jatka fishers in same selected spots of Meghna estuary. Middle East Journal of Scientific Research, 23(3): 378-386.
29. Mondal, S., M. Rahman, D. Saha, R. Adhikary and M.B. Hossain, 2013. Present status of good aquaculture practices (GAP) in shrimp farms of South-Western coastal area, Bangladesh. Middle-East Journal of Scientific Research, 14(6): 873-878.
30. Ali, M.M., M.B. Hossain, M.H. Minar, S. Rahman and M.S. Islam, 2014. Socio-Economic Aspects of the Fishermen of Lohalia River, Bangladesh. Middle-East Journal of Scientific Research, 19(2): 191-195.
31. Azim, M.A., M.R. Islam, M.B. Hossain and M.H. Minar, 2012. Seasonal variations in the proximate composition of Gangetic sillago, Sillaginopsis panijus (Perciformes: Sillaginidae). Middle-East Journal of Scientific Research, 11(5): 559-562.