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EFFECT OF DIFFERENT PROTEIN LEVEL ON FINGERLINGS PRODUCTION OF BLACK CARP *MYLOPHARYNGODON PICEUS* (RICHARDSON, 1846) IN POND

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Abstract

An experiment was conducted to assess the effect of feed supplement on growth and production performance of fingerlings of black carp (*Mylopharyngodon piceus)* such as T_1 (25% protein supplement), T_2 (30% protein supplement) and T_3 (35% protein supplement), and each having three replications for a period of 60 days from 17 July to 16September 2012 in Rajshahi University hatchery complex. In this experiment, same stocking density was maintained in the study with different protein level supplemented feed. The highest final weight gain (22.48±0.34 g), survival rate (93.33±0.83%) and cost benefit ratio (CBR) were found in T_3 (1:1.13). The lowest feed conversion ratio (1.48±0.01) was observed in T_3 and the highest FCR value (1.91±0.04) was recorded in T_1. The net profit was the highest in T_3 and lowest in T_1, which was significantly ($p<0.05$) different among the treatments. Cost and benefit ratio were calculated among the treatments. CBR was also the highest in T_3 (1:1.13) and lowest in T_1 (1:0.40). Findings indicated that treatment T_3 (35% protein containing feed) was found best in terms of production and economics of *M. pecieus* fingerlings cultured in ponds.

Keywords: Feed, fingerlings, production and black carp.

Introduction

Black carp, also known as snail carp, was introduced for the first time in Bangladesh by the Department of Fisheries in 1983 (Rahman, 2005). It also reduces and control snails biomass of the water body as well as increase the carrying capacity of the pond. Farmer based fingerlings production technique of black carp is not available in Bangladesh. For grow-out production of black carp, it is essential to develop and promote for availability of fingerlings for fish farmers in Bangladesh. Successful controlled method of fry nursing depends on a proper knowledge of nutritional and environmental requirement of the larvae in the aquatic ecosystem (Mollah, 1985). Lack of proper care and understanding about the biotic and abiotic factors in the rearing system may result in mass mortality of young fry (Jhingran and Pullin, 1985).

For fish supplementary diet, the continuous dependence on traditional feed ingredients like rice bran, oil cakes and soybean meal has led to an increase in the process of these components, which in turn influence profitability of aquaculture enterprises (Kumar, 2000). Aquaculture is a feed based industry with over 60% of the operational cost coming from feed sources alone (Pandian *et al.,* 2001). The cost of feed is largely influenced by the level and sources of protein which is the most expensive component of a fish diet. It is the major dietary component which influences growth of fish. Insufficient as well as excess level of protein in feed is not desirable.

Formulated artificial feeds can be either complete or supplemental. Complete diets supply all the nutrients (protein, carbohydrates, fats, vitamins and minerals) necessary for optimal growth and health of fish. Fish farmer use complete diets, when fish are reared at high density (indoor systems) or in cages and supply of natural feed is negligible. The ultimate aim of artificial feeding in aquaculture is to achieve maximum protein deposition and growth within minimum inputs of feed at a minimum cost (Steven and Helfrich, 2002). The development of commercial aqua feeds have been and are traditionally based on fishmeal (FM) as the main protein source due to its

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high protein content and balanced essential amino acids (EAA) supply, digestible energy and supply of minerals and vitamins. In Bangladesh a wide variety of agro based feed-stuffs, rich in protein, carbohydrate and energy are available and these ingredients can be better used for the formulation of cost effective fish feed. The aquaculture industry depends worldwide on availability of low cost, high quality feeds. From the last several decades, fish nutritionists have evaluated alternative sources of plant protein in fish diets as partial or total fishmeal replacement (Ramachandran and Ray, 2004). The ultimate aim is formulation of cost effective and nutritionally balanced feed which is acceptable to fish, environment friendly and promote fish growth to greater extent that farmers could acknowledge (Tahir *et al.*, 2008).

Therefore, a suitable culture method for rearing of *M. piceus* fry are very important to ensure reliable and regular supply of fingerlings. Growth, survival and production of fingerlings in nursery ponds depend on quality of supplementary feeds and stocking density. The present experiment had been conducted to develop an optimum protein level of *M. piceus* fry in nursery pond management system.

Materials and Methods

Research period and location: The experiment was carried out for a period of 60 days from 17 July to 16 September 2012 in Rajshahi University Campus. Initial mean length, 3.0±0.02 cm and weight, 3.0±0.02 g of *M. piceus*fry were stocked in the experimental ponds. The experimental ponds were rectangular in shape with similar size, depth, basin configuration and bottom type including water supply facilities. The average area of the ponds was 0.60 decimal (0.0024 hector). The water depth was maintained around 1.0 - 1.25 m. To maintain the water level and to keep the good water quality, water was added to the ponds at regular intervals using pump machine.

Experimental design: *M. piceus* was used as experimental species. The experiment was conducted under 3 different treatments of black carp fry namely T_1, T_2 and $T_{3,}$ each with three replications for feeding with 25, 30 and 35% protein supplement, respectively. The fry stocking density was 240 deci^{-1} (60,000 no. ha^{-1}) for each treatment.

Pond preparation: At first the bottom and sides of the selected ponds were repaired and all the aquatic weeds were removed manually. Rotenone (19.76 kg ha^{-1}) was used for the removal of predator and unwanted fish. After 7 days, all ponds were treated with lime at the rate of 247 kg ha^{-1} to disinfect the water. Ponds were fertilized by using urea (242.06 kg ha^{-1}) and TSP (192.66 kg ha^{-1}). The sources of water of experimental ponds were rainfall and deep tube-well. During the introduction of water in the experimental pond, fine meshed (2 mm) nylon net hapa was used in the mouth of the pumped water to prevent predatory fish egg, spawns, fry and adult or fry of aquatic harmful insects to inhabit their entrance. Then natural food production was tested by glass and secchi disc method and the water toxicity of the ponds was checked simple hapa method with releasing some fry. Netting was done to remove small frog and water bug from the pond before 3 days of fry stocking.

Collection and stocking of fry: Black carp fries were collected from private hatchery in Jessore. Fries were kept inside the polythene bag with proper oxygen and the mouth of the polythene was bound tightly by rope. Then the fry were brought and were transferred to the experimental pond and were acclimatized for about half an hour before releasing the fry to the experimental pond. The initial length and weight of 10 fries were recorded with the help of 5 mm graph paper and a sensitive portable electric balance (KD300kc:0.01g-300g). Initial average length and weight *M. piceus* fry 3.0±0.02 cm in length and 1.5±0.01 g in weight were stocked in the experimental ponds.

Preparation of feed and application: Seven ingredients which were fish meal, rice bran, mustard oil cake, sesame oil cake, wheat bran, binder (molasses) and vitamins used in prepared feed. The proximate composition of feed has been presented in the Table 1. Pearson squares method (New, 1987) was used to calculate different protein level for fry of *M. piceus* in Table 2. The required quantities of all ingredients mixed with hand (prepared feed) and spread it to the experimental pond surface. The supplemental feed was given to fry at the rate of 10%, 8% in 1st and 2nd month, respectively. The quantities of feed were adjusted every 15 days interval on the basis of increase in the average body weight of the stocked biomass. Half of the ration was supplied at 9.00 am and remaining half was supplied at 4.00 pm.

Growth sampling and harvesting of fish: Fishes were sampled fortnightly using seine net to assess their growth and health condition. At least 10% of fish from each pond was taken to make assessment of growth trends and to readjust feeding rate. Length and weight of sampled fish were measured using a measuring scale and digital electronic balance (OHAUS, MODEL no. CT-1200-S). Fishes were handled carefully to avoid stress during sampling. After 60 days of rearing, all the fishes were harvested by netting repeatedly with a seine net from each pond.

Table 1. Proximate composition of the feed ingredients used (% dry matter basis) in feed.

Ingredients	Dry matter	Protein	Lipid	Ash	Crude fiber	NFE
Fish meal	89.21	56.0	16.56	18.50	2.20	6.74
Mustard oil cake	90.31	36.0	12.36	7.80	10.3	33.54
Sesame oil cake	90.4	38.0	9.4	14.6	17.4	20.60
Rich bran	89.5	12.0	14.2	11.4	16.2	46.4
Wheat bran	89.2	14.0	3.8	4.40	14.5	63.3

** Nitrogen free extract (NFE) calculated as 100-% (Moisture + Crude protein + Crude lipid + Crude Fiber + Ash)*

Table 2. Different protein level calculation and feed ingredients used in feed making.

Ingredients	Treatments		
	T_1 (Inclusion level %)	**T_2 (Inclusion level %)**	**T_3 (Inclusion level %)**
Fish meal	15	15	15.0
Mustard oil cake	12.91	23.2	6.24
Sesame oil cake	12.91	23.2	6.24
Rich bran	27.08	16.8	33.74
Wheat bran	27.08	16.8	33.74
Binder	3	3	3
Vitamin and Mineral	2	2	2
Total protein (%)	**25% protein**	**30% protein**	**35% protein**

Water quality parameters: Physico-chemical parameters like water temperature (°C), transparency (cm), dissolved oxygen (mg 1^{-1}), CO_2 (mg l^{-1}), NH_3-N (mg 1^{-1}), pH, alkalinity (mg 1^{-1}) of each experimental pond were measured at 15 days intervals and data were recorded on sampling dates. Temperature was recorded using a celsius thermometer, transparency by secchi disc and other chemical parameters were recorded using Hack kit box (FF2, USA). Recording of water quality data were taken between 09:00 am and 10:00 am.

Growth parameters: The growth, length and weight were measured in every 15 days intervals. To evaluate the fish growth the following formula were used.

i. Weight gain (g) = Average final weight - Average initial weight
ii. Length gain (cm) = Average final length - Average initial length
iii. Specific growth rate (SGR) = $\frac{\text{Ln}W_2 - \text{Ln}W_1}{T_2 - T_1} \times 100$
Where, W_2 = Final live body weight (mg) at time T_2
W_1 = Initial live body weight (mg) at time T_1
iv. The survival rate was calculated by the following formula =

$$\frac{\text{Initial number of fry} - \text{Final number of fry}}{\text{Initial number of fry}} \times 100 \qquad \text{(Brown, 1957)}$$

v. Feed conversion ratio, FCR= Feed fed (dry weight)/ Live weight gain

vi. Production of fishes = No. of fish harvested x final individual average weight of fish.

Economics analysis: A simple economic analysis was done to estimate the economic return in each treatment for experiment. The total cost of inputs was calculated and the economic return was determined by the differences between the total return (from the current market prices) and the total input cost. The cost in taka per unit yield (CPY) was calculated and was expressed as the cost in Tk kg^{-1} of fishes produced.

Statistical analysis: For the statistical analysis of data collected, one-way analysis of variance (ANOVA) was performed using the SPSS (Statistical Package for Social Science, evaluation version-15.0). Significance was assigned at the 0.05% level. The mean values were also compared to see the significant difference through DMRT (Duncan Multiple Range Test) after Zar (1984).

Results and Discussion

Results

Water quality parameters: Water quality parameters were monitored fortnightly. Water temperature, water transparency, dissolved oxygen, pH, total alkalinity, ammonia-nitrogen of water varied from 29.11±0.34 to 29.18±0.32°C, 32.10±1.29 to 34.46±1.77 cm, 5.09±0.09 to 5.18±0.07 mg 1^{-1}, 7.12±0.05 to 7.78±0.04, 112.6±2.63 to 119.00±4.14 mg 1^{-1} and 0.09±0.004 to 0.12±0.006 mg 1^{-1}, respectively. Among the parameters ammonia-nitrogen and alkalinity were varied significantly ($p<0.05$). Variation in the mean values of water quality parameters in three different treatments are shown in Table 3.

Table 3. Mean values of physico-chemical characteristics recorded under different treatments during the study period.

Parameters	T_1	T_2	T_3
Temperature °C	29.15±0.33^a	29.11±0.34^a	29.18±0.32^a
Transparency (cm)	32.10±1.29^a	32.60±1.81^a	34.46±1.77^a
DO (mg l^{-1})	5.09±0.09^a	5.18±0.07^a	5.10±0.09^a
pH	7.75±0.05^a	7.78±0.04^a	7.12±0.05^a
Alkalinity (mg l^{-1})	112.6±2.63^a	118.75±2.78^a	119.00±4.14^a
NH_3-N (mg l^{-1})	0.11±0.0^b	0.09±0.004^b	0.12±0.006^a

Figures in a row bearing common letter(s) do not differ significantly (p<0.05)

Growth parameters: The final weight ranged from 15.80±0.12 to 23.98±0.34 g. The weight gain was the highest (22.48±0.34 g) in T_3 and the lowest (14.30±0.12 g) in T_1. The length gain during study period was 11.25±0.23 cm to 13.57±0.33 cm. The final length was found to be ranged from 14.36±0.22 to 16.57±0.33 cm. The SGR was also the highest (4.67±0.04) in T_3 and the lowest (3.77±0.09) in T_1. The survival rate (%) during study period was 86.78±1.67 to 93.33±0.83. The yield was found to be ranged from 2048.33±53.41 to 3490.93±57.63 kg ha^{-1} 60 days^{-1}. Among all the mean values of different growth parameters, final weight and yield were found significant (Table 4).

Table 4. Growth and production of black carp fingerlings in different treatment after 60 days culture period.

Growth parameters	Treatments T_1	T_2	T_3
Initial weight (g)	1.5±0.01^a	1.5±0.01^a	1.5±0.01^a
Final weight (g)	15.80±0.12^c	19.05±0.19^b	23.98±0.34^a
Weight gain (g)	14.30±0.12^c	18.55±0.19^b	22.48±0.34^a
Initial length (cm)	3.0±0.02^a	3.0±0.02^a	3.0±0.02^a
Final length (cm)	14.36±0.22^c	15.26±0.11^b	16.57±0.33^a
Length gain (cm)	11.25±0.23^c	12.26±0.11^b	13.57±0.33^a
SGR (% bwd^{-1})	3.77±0.09^c	4.14±0.06^b	4.67±0.04^a
FCR	1.91±0.04^a	1.68±0.01^b	1.48±0.01^b
Survival rate (%)	86.78±1.67^b	89.17±0.83^b	93.33±0.83^a
Total production (kg ha^{-1} 60 days^{-1})	2085.33±53.51^c	2597.61±49.4^b	3490.93±57.63^a

Figures in a row bearing common letter(s) do not differ significantly (p<0.05)

Economic analysis: A simple economic analysis was performed to estimate the net profit from this culture operation. The cost of production was based on the local wholesale market price of the inputs used of the year 2013.

The cost of leasing ponds was not included in the total cost. The cost of different inputs and economic return from the sale of fishes in different treatments are summarized in Table 5. The total cost of inputs and profit hectare^{-1} were significantly different ($P<0.05$) among the treatments. The cost of input was the lowest in T_1 and followed by T_2 and T_3. The net profit was the highest in T_3 (Tk.719445.1±2.74) and the lowest in T_1 (Tk.217163.2±2.18), which was significantly different. Cost and benefit ratio were 1:0.40, 1: 0.68 and 1: 1.13 in T_1, T_2 and T_3, respectively.

Table 5. Inputs cost, profit and CBR of *M. piceus* fingerlings production system for 60 days in nursery ponds in three different treatments.

Components	**Treatments**		
	T_1	**T_2**	**T_3**
Pond operation (Tk ha^{-1})	3240±00^a	32110±00^a	32110±00^a
Fry cost (Tk ha^{-1})	237120±00^a	237120±00^a	237120±00^a
Feed cost (Tk ha^{-1})	264735±2.45^c	300015±3.22^b	359205±493^a
Operational cost (Tk ha^{-1})	10150±00^a	10150±00^a	10150±00^a
Total cost (Tk ha^{-1})	543769.67±2.15^c	582875.33±1.76^b	639573.67±3.13^a
Total income (Tk ha^{-1})	760932.8±4.29^c	982319.7±2.48^b	1359019±2.46^a
Net profit (Tk ha^{-1})	217163.2±2.18^c	399444.3±2.85^b	719445.1±2.74^a
CBR	0.40±0.005^c	0.68±0.02^b	1.13±0.04^a

Figures in a row bearing common letter(s) do not differ significantly (p<0.05); Leasing cost is not included*

Discussion

Water quality parameter: Quality of experimental water remained favourable for fish growth throughout the experimental period. Jhingran (1983) suggested that optimum temperature for major carp culture range from 18.3 to 37.8°C. Prinsloo *et al.* (1984) observed marked decrease in fish production when mean water temperature of pond was belong 20°C. In the present study the mean water temperature ranged between 29.11±0.34 to 29.18±0.32°C. The range of water temperature was similar to the range reported by Jhingran (1983). In the present experiment, the range of pH was between 7.12±0.05 to 7.78±0.04 which is suitable for fish growth. The pH values of the present study were also agreed with the findings of Hossain *et al.* (2013), Chakraborty and Mirza (2007) and Kohinoor *et al.* (1994).

Dissolved oxygen (DO) content in the present experiment ranged between 5.09±0.09 and 5.18±0.07 mg l^{-1}. Chakraborty and Mirza (2007) recorded DO 3.88 to 5.22 mg l^{-1} while Kohinoor (2000) measured dissolved oxygen 2 to 7.4 mg l^{-1} in nursery pond. So, the level of dissolved oxygen was within the acceptable range in all the experimental ponds.

Boyd (1998) stated that the natural fertility of pond water increases with increase in total alkalinity more than 100 mg l^{-1} should be present in high productive water bodies. Kohinoor (2000) found the average total alkalinity values above 100 mg l^{-1} in his experiments. In the present study, the range of total alkalinity was 112.6±2.63 to 119.00±4.14 mg l^{-1} and found suitable for fish growth. The mean values of transparency significantly varied from 32.10±1.29 to 34.46±1.77 cm. Boyd (1982) recommended a transparency between 15 - 40 cm as appropriate for fish culture. The present findings also agreed with Kohinoor (2000) who reported that the water transparency was 15 - 58 cm in fishponds. NH_3-N concentration of the pond water was varied from 0.09±0.004 to 0.12±0.006 mg l^{-1}. The present findings were more or less agreed with Boyd (1998) who suggesting to keep the ammonia nitrogen value in fish pond as less than 0 - 0.1 mg l^{-1}.

Growth performances: The highest weight gain and length gain in T_3 might be due to the fact that the fish had received 35% protein supplement and utilized the applied feed effectively converted into muscle. In the present study, the *M. piceus* fingerlings feeding with 35% protein supplement showed a significant weight and length increment ($P<0.05$) over feeding with 25% and 30% protein supplement. The findings of Shabir *et al.* (2003) and Ali and Salim (2004) are in the agreement with the present study. The specific growth rate (SGR% bw day^{-1}), 3.77±0.09, 4.14±0.06 and 4.67 ± 0.04 per 60 days was found in T_1, T_2 and T_3, respectively. SGR progressively increased with the increase in protein supplement. The significantly highest (4.67±0.04) specific growth rate (SGR) in T_3 might be due to the fact that the fish had utilized effectively the supplied feed. The findings of present study also agreed with the findings of Alim *et al.* (2005). The mean value of survival rate of *M. piceus* significantly varied from 86.78±1.67% (T_1) to 93.33±0.83% (T_3). The survival rate was more or less similar with the findings of Rahman and Rahman (2003) and Rahman *et al.* (2005) during rearing of exotic carp. A low FCR value is an indicator of better food utilization efficiency of formulated feed. The lowest FCR (1.48±0.01) was observed in treatment T_3 with 35% protein supplement and the highest FCR value (1.91±0.04) was recorded in T_1, with 25% protein supplement and 1.68± 0.01 in T_2, with 30% protein supplement. FCR values of the present study are lower than those reported by many workers (e.g., Islam *et al.*, 2002; Rahman *et al.*, 2005).

The production of fish in T_3 in the present study was higher than T_1 and T_2. The production of *M. pecies* was ranged between 2058.33 kg ha^{-1} to 3490.93 kg ha^{-1}. Boyd (1990) suggested that feeding of carp with mixture of oilcake and rice bran 1:1 for between productions. Saha *et al.* (1988) obtained a gross production of 1385.15 to 1995.60 kg h^{-1} for 8 weeks of *Labeorohita* fingerlings at different feed supplementation. The production of present study is higher than the other authors due to species variation and also for fertilization to natural food production. Among the treatments, the highest production (3490.93±57.63 kg ha^{-1}) was found in T_3 and consequently provided the highest net profit (Tk 719445.1±2.74 ha^{-1}) in T_3 where fishes were fed with 35% protein supplement.

The present study is based on the fingerling production technique of *M. piceus* with protein supplement and the main aim of the study is to find out real status of fingerling production of *M. piceus* in Bangladesh for rural and subsistence farmers. From the study, considering water quality, production and economics, it is clear that the higher growth and survival of *M. piceus* was found in 35% protein supplement in (T_3).

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