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EFFECTS OF FEEDS ON GROWTH PERFORMANCE AND NUTRITIONAL COMPOSITION OF *CIRRHINUS MRIGALA* FINGERLINGS

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Key words: Cirrhinus mrigala, Growth performance, FCR, Nutritional composition

Abstract

Effects of four different feeds on growth and nutrient composition of mrigal fingerlings (*Cirrhinus mrigala*) were evaluated. After 30 days of rearing growth parameters and quality of fish flesh were examined. During the rearing period, the change in growth and feed utilization by the mrigal fed with feeds have been assessed as condition factor (K), average daily gain (ADG), specific growth rate (SGR) and feed conversion ratio (FCR). The highest FCR (6.23 ± 0.59) was found in the treatment 4 while the lowest (3.08 ± 0.10) in the treatment 1. The condition factor was highest (0.89 ± 0.01) in treatment 1 while the lowest (0.81 ± 0.05) in the treatment 4. After 30 days of rearing, moisture content of mrigal in different treatments was 77.2, 78.41, 76.99 and 77.86% in treatments 1, 2, 3 and 4, respectively. Protein was 17.15, 15.89, 16.90 and 14.76% in treatments 1, 2, 3 and 4, respectively. Lipid was 2.07, 2.22, 2.25 and 2.85% and ash content was 3.58, 3.48, 3.88 and 4.53% in four (1, 2, 3 and 4) treatments, respectively.

Introduction

Poor people of Bangladesh have been suffering from malnutrition due to lack of proper protein. Fish and fisheries sector can solve this problem partially by increasing fish production through modern and scientific fish culture and management practice. The growth and biomass of fish in intensive and semi-intensive culture system depends on various factors notably feeding regimes. Fish growth at different stages is largely governed by the kind of feed, feeding frequency, feed intake and its ability to absorb the nutrients. Among these, kind of feed is an important factor for the survival and growth of fish at the early stage^(1,2).

Protein is the main constituent of the fish body needed for optimum growth. Protein is the most expensive macronutrient in fish diet⁽³⁾. So, the amount of protein in the diet should be just enough for fish growth where the excess protein in fish diets may be wasteful and cause diets to be unnecessarily expensive. The level of dietary protein is of fundamental importance, because it significantly influences growth, survival and yield of

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fish. Therefore, considerable research effort is needed to determine the quantity and quality of dietary protein necessary to achieve optimum growth performance of fish. The present study was aimed at assessing the analysis of growth performance and nutritional composition of *Cirrhinus mrigala* by feeding different supplementary feeds.

Materials and Methods

Fingerlings of *Cirrhinus mrigala* were collected from BFRI (Bangladesh Fisheries Research Institute) at Mymensingh and carried in polythene bags with proper oxygen and water. The experiment was carried out in the laboratory at Zoology Section, Biological Research Division, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka.

Four artificial fish feeds were used for mrigal fingerlings rearing under laboratory condition. Physio-chemical and growth parameters were recorded. Four treatments were conducted in triplicates. Feed-1 was supplied in treatment T₁, feed-2 in treatment T₂, feed-3 in treatment T₃ and feed-4 was supplied in treatment T₄. In total 30 fingerlings were stocked in each of the aquariums. Fingerlings brought from BFRI were acclimatized for sometimes in clean water. Then fingerlings were released slowly in aquarium water and at the same time oxygen was supplied with the help of aerator. No feed was given on first day. Feed was supplied regularly on the basis of their body weight (10% of their body weight). Four types of feed were used in the experiment as described in Table 1.

Table 1. Types and composition of feeds.

Feed number	Composition
Feed-1	BCSIR feed (Mustard oil cake, soyabean meal, rice bran, vitamin and mineral mixture)
Feed-2	BCSIR feed (Fish meal, soyabean meal, rice bran, vitamin and mineral mixture)
Feed-3	Hand made feed (Mustard oil cake, soyabean meal, rice bran, duckweed, vitamin and mineral mixture)
Feed-4	Commercial fish feed (mega feed)

Temperature, dissolved oxygen, light intensity, pH and ammonia were determined in the experiment.

Fish sampling was done weekly and continued for four weeks. Prior to weighing fish were caught with a fine mesh scoop net and their individual length and weight were recorded with a measuring scale and a weighting balance. After 30 days of rearing, the final measurements of length (cm) and weight (g) of the fishes were carefully recorded.

Condition factor was calculated by the formula of $K = (W/L^3) \times 100$, where, K = condition factor, W = body weight (gm) and L = body length (cm).

Average daily gain was determined by the formula of $ADG = (\text{Mean final fish weight} - \text{mean initial weight})/\text{time } (T_2-T_1)$; where T_1 = initial time, T_2 = final time. Specific growth rate was calculated as the percentage increase in weight per animal per day as $SGR = 100 \times (\text{Ln}W_t - \text{Ln}W_i) / T - t$; where, $\text{Ln}W_t$ = natural log of weight at time T, $\text{Ln}W_i$ = natural log of initial weight, T = time T, t = initial time. FCR was calculated formula of $FCR = (\text{Feed consumed by the fish (g)}/\text{live weight of the fish (g)})$. All the parameters were determined according to Marimuthu *et al.*⁽⁴⁾.

The proximate composition (moisture, protein, fat and ash content) of the sample was determined. Moisture content was determined by oven drying method⁽⁵⁾. Crude protein content was determined by using Kjeldahl machine. Protein conversion factor (6.25) was used in converting nitrogen to crude protein. Protein was determined by using 3 steps.

Crude lipid was determined by using the Soxhlet system, (Model Tecator Sox-tact system HT 1043-001 Manual 1983) for extracting lipids of samples. Ash content was determined by gravimetric method by ignition of samples in a muffle-furnace at 550°C for 16 hours.

Data were analyzed using one-way ANOVA using SPSS version 11.5. Multivariate analysis was also performed. Tukey's post hoc test was performed with the level of significance at $p < 0.05$.

Results and Discussion

During this study the growth performance of mrigal fingerlings varied in different artificial fish feed. The growth performance parameters were Condition Factor (K), average daily gain (ADG), specific growth rate (SGR) and feed conversion ratio (FCR). No significant difference in condition factor was found within and between treatments ($p < 0.05$) (Table 2).

Table 2. Condition factor (K) at 30 days rearing period (Mean \pm SEM).

Treatment	Condition factor (K) at different intervals (days)			
	7	15	22	30
T ₁	0.89 \pm 0.01	0.85 \pm 0.01	0.82 \pm 0.00	0.80 \pm 0.02
T ₂	0.89 \pm 0.02	0.85 \pm 0.02	0.85 \pm 0.02	0.79 \pm 0.02
T ₃	0.84 \pm 0.02	0.85 \pm 0.01	0.83 \pm 0.01	0.82 \pm 0.02
T ₄	0.82 \pm 0.05	0.82 \pm 0.05	0.81 \pm 0.05	0.81 \pm 0.05

Values are Mean \pm SEM of duplicate groups of 30 fish. Means in the same column with different superscripts are significantly different at $p < 0.05$.

Highest condition factor was observed in treatment T₁ (0.89 ± 0.01) and lowest value was observed in T₄ (0.81 ± 0.05). Rahman *et al.*⁽⁶⁾ in a study on the survival and growth of cat fish after giving selected supplemental feeds got the values of condition factor between 0.81 - 0.87, which was similar with these findings.

The average daily gain was observed for mrigal fingerlings in the 30 days rearing period (Table 3). At the end of 30 days rearing period the highest ADG value was achieved by fish at T₁ ($0.03 \pm 0.00\%$) and the lowest value was observed at T₄ ($0.02 \pm 0.00\%$). This result indicates that feed affect the average daily gain. Sangrattanakhul⁽⁷⁾ found the value of ADG in *Anabas testudineus* ranging from 0.10 to 0.12 g per day, which was similar with the present findings.

Table 3. Average daily gain (ADG) at 30 days rearing period (Mean \pm SEM).

Treatment	Average daily gain at different intervals (days)			
	7	15	22	30
T ₁	0.03 ± 0.00^a	0.05 ± 0.01^a	0.03 ± 0.01^a	0.03 ± 0.00^a
T ₂	0.04 ± 0.00^a	0.03 ± 0.00^{ab}	0.02 ± 0.00^b	0.02 ± 0.00^a
T ₃	0.05 ± 0.01^a	0.04 ± 0.00^{ab}	0.03 ± 0.00^{ab}	0.02 ± 0.00^a
T ₄	0.03 ± 0.00^a	0.03 ± 0.00^b	0.03 ± 0.00^{ab}	0.02 ± 0.00^a

Values are mean \pm SEM of duplicate groups of 30 fish. Means in the same column with different superscripts are significantly different at $p < 0.05$.

The average value of specific growth rate of mrigal fingerlings was highest in treatment T₁ ($1.65 \pm 0.29\%$). On the other hand, the lowest value was found at treatment T₄ ($0.56 \pm 0.11\%$) (Table 4). The significantly highest specific growth rate in treatment T₁ might be due to the fact that the fish have utilized effectively the supplied feed. Hossain and Parveen⁽²⁾ recorded the highest SGR (1.80%) of *H. fossilis* by supplying diet which has more or less similarities with this findings.

Table 4. Specific growth rate (SGR) at 30 days of rearing period (Mean \pm SEM).

Treatment	Specific growth rate % at different intervals (days)			
	7	15	22	30
T ₁	1.57 ± 0.10^a	1.65 ± 0.29^a	1.00 ± 0.40^a	0.79 ± 0.16^a
T ₂	1.21 ± 0.12^a	0.97 ± 0.08^b	0.60 ± 0.09^b	0.64 ± 0.06^a
T ₃	1.51 ± 0.25^a	1.05 ± 0.09^{ab}	0.81 ± 0.06^{ab}	0.63 ± 0.08^a
T ₄	1.05 ± 0.13^a	0.88 ± 0.05^{ab}	0.76 ± 0.07^{ab}	0.56 ± 0.11^a

Values are mean \pm SEM of duplicate groups of 30 fish. Means in the same column with different superscripts are significantly different at $p < 0.05$.

The feeding utilization was calculated in terms of feed conversion ratio (Table 5). The value of feed conversion ratio varied between 3.08 and 6.23. A low FCR value is an indicator of better food utilization efficiency of supplemental feed. The lowest i.e., the best FCR was observed in treatment T₁ with feed -1 and the highest i.e., the worst FCR value was recorded in treatment T₄ with the feeding of feed-4. The observed FCR value showed significant difference between treatments. Doolgindachabaporn⁽¹⁾ found FCR value of *Anabas testudineus* ranges between 1.8 and 3.0 g, which has less similarities with these findings.

Table 5. Feed conversion ratio (FCR) at 30 days rearing period (Mean ± SEM).

Treatment	Feed conversion ratio at different intervals (days)			
	7	15	22	30
T ₁	3.28 ± 0.12 ^b	3.48 ± 0.16 ^b	3.53 ± 0.15 ^b	3.08 ± 0.10 ^a
T ₂	4.12 ± 0.11 ^{ab}	4.59 ± 0.18 ^a	4.70 ± 0.16 ^a	4.23 ± 0.13 ^a
T ₃	3.33 ± 0.14 ^b	3.60 ± 0.16 ^{ab}	3.72 ± 0.18 ^{ab}	3.17 ± 0.11 ^a
T ₄	4.83 ± 0.25 ^a	5.28 ± 0.49 ^a	5.73 ± 0.57 ^{ab}	6.23 ± 0.59 ^a

Values are mean ± SEM of duplicate groups of 30 fish. Means in the same column with different superscripts are significantly different at $p < 0.05$.

The water quality parameters should be maintained carefully, otherwise it may be detrimental for the fish health. Poor water quality may reduce the growth rate of fish and may also make fish diseased which ultimately reduce the expected production. The value of the water quality parameters such as temperature, dissolved oxygen, light intensity, pH and ammonia were monitored during the experimental period.

Water temperature was found between 25.5 and 30.5°C. The maximum temperature was recorded in T₂ whereas the minimum was in T₄.

Dissolved oxygen content in four treatments was 4.1 to 7.75 mg/l, 4.5 to 7.25 mg/l, 3.8 to 6.75 mg/l and 4.0 to 6.8 mg/l, respectively. The maximum dissolved oxygen was recorded in T₁ whereas the minimum was recorded in T₃. The above findings have got similarities within the findings of Ali *et al.*⁽⁸⁾ observed the values of DO between 4.0 and 7.4 mg/l.

Light intensity in four treatments was 126 to 562 lx/m², 134 to 660 lx/m², 138 to 615 lx/m² and 132 to 570 lx/m², respectively. The maximum light intensity was recorded in T₂ whereas minimum temperature was recorded in T₁. The variation in light intensity in different treatments might be due to different types of fish feeds used in rearing tank.

During the experimental period pH in four treatments were 7.99 to 8.40, 7.46 to 8.25, 7.82 to 8.30 and 7.92 to 8.43, respectively. The maximum pH was recorded in T₄ whereas the minimum in T₂. The above findings have similarities with that of Ali *et al.*⁽⁸⁾ who

observed the values of pH between 6.8 and 8.0. The pH in the system in nearly neutral zone and found no bad effect on the fish growth. Ammonia content was maximum in T₄ (0.6 mg/l) while the minimum in T₁ (0.3 mg/l).

The proximate composition of the experimental fish rearing in different treatments have been presented in Table 6. Average moisture content of mrigal in treatments 1, 2, 3 and 4 were 77.2, 78.41, 76.99 and 77.86%, respectively. Asadullah *et al.*⁽⁹⁾ observed that moisture content in India mackerel (*Rastrelliger kanagurta*) varied from 70.11 to 74.41% over the period of one year. All these findings coincide well with the present results of moisture content.

Average protein content of mrigal fish in treatments 1, 2, 3 and 4 were 17.15, 15.89, 16.90 and 14.76%, respectively. Nurullah *et al.*⁽³⁾ studied the protein content of some small indigenous fish species of Bangladesh and showed that protein content was in the range of 14.08 to 21.70% with highest value in kankila and lowest in chapila. Azam *et al.*⁽¹⁰⁾ studied protein content of different fish species and reported protein content in the range of 8.58 to 19.06%.

Table 6. Proximate analysis of mrigal fingerlings after 30 days of rearing period.

Treatment	Moisture (%)	Protein (%)	Lipid (%)	Ash (%)
T ₁	77.2	17.15	2.07	3.58
T ₂	78.41	15.89	2.22	3.48
T ₃	76.99	16.90	2.25	3.88
T ₄	77.86	14.76	2.85	4.53

Average lipid content of mrigal fish in treatments 1, 2, 3 and 4 were 2.07, 2.22, 2.25 and 2.85%, respectively. Wimalasena *et al.*⁽¹¹⁾ studied on the lipid content of some commonly eaten fresh water fish and found 2.3, 4.4, 2.3 and 1.7% lipid in stinging cat fish (*H. fossilis*), climbing perch (*A. testudineus*), tilapia (*O. mossambicus*) and snakehead (*O. striatus*), respectively.

Ash content of mrigal in four treatments were 3.58, 3.48, 3.88 and 4.53%, respectively in treatments 1, 2, 3 and 4. Islam *et al.*⁽¹²⁾ reported ash content of freshwater gobi (*Glossogobius giuris*) ranged from 0.95 to 1.52% in male and 1.06 to 1.82% in female. Mazumder *et al.*⁽¹³⁾ investigated the ash content of some small indigenous fish species and recorded that mean ash content for these species ranged from 1.19 to 3.92%.

From the findings of the present study it can be concluded that feed-1 prepared with the composition of mustard oil cake, soyabean meal, rice bran, vitamin and mineral mixture can be used for better growth of mrigal fingerlings.

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