OPTIMIZATION OF FEEDING FREQUENCY ON THE GROWTH PERFORMANCE OF THAI PANGAS, *PANGASIUS HYPOPHTHALMUS* (SAUVAGE, 1878)

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Abstract

Thai pangas, *Pangasius hypophthalmus* fingerlings were reared for 60 days in laboratory condition to investigate the effects of feeding frequency on the growth performance. The fish fingerlings in three treatments were fed with two, three and four times a day, respectively. During the feeding trial, growth and feed utilization were assessed by condition factor (K), average daily gain (ADG), specific growth rate (SGR) and feed conversion ratio (FCR). Significantly lower FCR 1.81 ± 0.02 and higher ADG 0.38 ± 0.02 and SGR 2.20 ± 0.02% were found in fish fed thrice a day than that of other treatments ($p < 0.05$). Highest condition factor 1.69 ± 0.13 was found in fish fed four times a day while the lowest condition factor 0.77 ± 0.03 was detected in fish fed twice a day. Moisture content of Thai pangas in treatment T_1, T_2 and T_3 were 79.23 ± 0.77, 78.08 ± 0.85 and 77.84 ± 0.17%, respectively. The crude protein, crude lipid and ash contents were 16.11 ± 0.00 to 16.38 ± 0.08%, 3.22 ± 0.27 to 3.41 ± 0.06% and 1.47 ± 0.02 to 1.82 ± 0.04%, respectively. The findings of the present study demonstrated that three times feeding frequency showed better growth performance and nutritional composition of Thai pangas fingerlings.

Introduction

Thai pangas, *Pangasius hypophthalmus* is a fast-growing catfish which has recently become a very popular food fish and valuable aquaculture species in South-East Asia. The fish is extensively cultured by commercial fish farms in Thailand, India and Myanmar. It has been introduced to Bangladesh in 1990s and has since developed into a very popular species amongst fish farmers and consumers. The fish proved to be a great success in Bangladesh aquaculture and is the only catfish species used for commercial aquaculture in the country [1].

Feed is the most important item for the viability and success of aquaculture particularly in terms of feed cost. Feed should be used optimally to prevent the input of

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more nutrients than necessary. To avoid the waste of feed ingredients should increase the efficiency of food use and to reduce production costs. Feed cost is one of the largest operational costs in aquaculture [2]. Therefore, the effort 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, feeding frequency and time of meal supply to the culture system. The growth of fish depends on the types of feed, feeding frequency, feed intake and its ability to absorb the nutrients. Feeding frequency is an important factor for the survival and growth of fish at the early stage [3, 4]. Therefore, the present study was designed to investigate the feeding frequency by determining the growth performances for optimum aquaculture production of *Pangasius hypophthalmus*.

Materials and Methods

Thai pangas (*Pangasius hypophthalmus*) (7.0 ± 0.15 cm and 3.1 ± 0.25 g) fingerlings were obtained from the Brahmaputra fish hatchery at Mymensingh and transported to the rearing laboratory of the Department of Fisheries, University of Dhaka. The fingerlings were acclimated for two weeks prior to experiment. Nine circular tanks (each with 500 l pond water) were used in the present study in three treatments with three replicates each with ten fingerlings with continuous aeration. Fifty per cent water was exchanged every week with pond water. The fish fingerlings in three treatments were fed with 2, 3 and 4 times a day, respectively. The fingerlings were fed at the rate of 5% of their body weight. The sampling was done all the fishes in each tank at every 20 days interval and water quality parameters were observed weekly. During the feeding trial, the change in growth and feed utilization have been assessed by determining the condition factor (K), average daily gain (ADG), specific growth rate (SGR) and feed conversion ratio (FCR). MEGA feed, Bangladesh, was used as experimental feed with 12% (maxi.) moisture, 32% (mini.) protein, 7% (mini.) lipid, 17% (maxi.) ash, 6% (maxi.) crude fiber, 2.1% (maxi.) calcium and 0.8% (mini.) phosphorus on the basis of per cent dry matter.

Sampling was accomplished at an interval of 20, 40 and 60th days of the experimental period. Prior to weighing fish were caught with a fine mesh scoop net and individual length and weight were recorded to the nearest centimeter and gram, respectively. After 60 days of rearing, the final length (cm) and weight (g) of the individual fishes were recorded by using measuring tap and electronic balance.

Specific growth rate (SGR) (%/day) = [(final weight) ÷ (initial weight)/rearing period in days] × 100; Average daily gain (ADG) = (mean final fish weight ÷ mean initial fish weight)/time (T_2-T_1) and feed conversion ratio (FCR) = [dry feed fed (g)/wet weight gain (g)] were estimated by Marimuthu *et al.*[5]. The condition factor (K) was determined by K = $\{(W/ L^3) \times 100\}$[6], where, W = body weight (g) and L = body length (cm).

The biochemical analysis was performed in the laboratory of Department of Fisheries, University of Dhaka. The moisture, crude protein, lipid, and ash contents of experimental fishes were determined by the standard methods [7].

Water temperature (°C) and dissolve oxygen (DO, mg/l) were measured by HACH DO meter (Model: HACH sension6, USA) and pH was measured by HANNA pH meter (HI 991001, USA) once in every week at 10 a.m. Data were analyzed by ANOVA followed by Tukey's HSD post hoc for multiple comparisons with the level of significance at $p < 0.05$ (using SPSS version 20).

Results and Discussion

Different growth performance parameters, namely condition factor (K), average daily gain (ADG), specific growth rate (SGR) and food conversion ratio (FCR) were observed in Thai pangas at different feeding frequencies. The observed condition factor showed significant difference within the treatments (Table 1). At 60th day sampling, the highest value of condition factor was observed in treatment T_3 and the lowest value was found in treatment T_1 ($F = 32.427$, $p = 0.001$, Table 2). Condition factor found in treatment T_3 was significantly higher than that of T_1 and T_2 at 40th day sampling. Condition factor was increasing with increasing feeding frequency as a result maximum K value was found at treatment T_3 as 1.71 ± 0.16 and lowest value was observed at treatment T_1 as 0.77 ± 0.03. As condition factor depends on the weight and length, so it may be due to higher feeding frequency the condition factor was increased. Rahman *et al*. showed the survival and growth of cat fish after giving selected supplemental feeds got the values of condition factor between 0.81 - 0.87 percent[8].

Table 1. Condition factor (K) during rearing period (Mean ± SEM).[1]

Treatment (feeding frequency a day)	Condition factor (K)		
	20th day	40thday	60th day
T_1 (2 times)	0.78 ± 0.06^b	0.77 ± 0.04^b	0.77 ± 0.03^c
T_2 (3 times)	1.06 ± 0.04^{ab}	1.17 ± 0.01^b	1.14 ± 0.04^b
T_3 (4 times)	1.28 ± 0.15^a	1.71 ± 0.16^a	1.69 ± 0.13^a

[1]Values are mean ± SEM of triplicate groups of 10 fish. Means in the same column with different superscripts are significantly different at $p < 0.05$.

Significant difference was found in average daily gain for pangas fingerlings while 3 times feed was used in a day during the rearing period ($p < 0.05$, Table 3). At the end of 60 days rearing, the highest ADG value (0.38 ± 0.02 g) was achieved by fish at treatment T_2 (Table 4). On the other hand, the lowest ADG 0.12 ± 0.01 g was found in T_1 at 20th day. The result indicated feed affect on the average daily gain. Similar result was noticed in African catfish *(Clarias gariepinus)*[9].

Table 2. ANOVA table for condition factor (K) during rearing period.

Date of sampling (day)	Sources of variations	Sum of squares	Degrees of freedom	Mean square	F
20th	Between treatments	0.378	2	0.189	6.951
	Within treatments	0.163	6	0.027	
	Total	0.541	8		
40th	Between treatments	1.326	2	0.663	23.193
	Within treatments	0.171	6	0.029	
	Total	1.497	8		
60th	Between treatments	1.285	2	0.643	32.427
	Within treatments	0.119	6	0.020	
	Total	1.404	8		

Table 3. Average daily gain (ADG) during rearing period (Mean ± SEM).

Treatment	ADG (g)		
	20th day	40th day	60th day
T_1	0.12 ± 0.01^b	0.13 ± 0.02^c	0.14 ± 0.00^b
T_2	0.17 ± 0.01^a	0.35 ± 0.03^a	0.38 ± 0.02^a
T_3	0.12 ± 0.01^b	0.22 ± 0.01^b	0.21 ± 0.02^b

Table 4. ANOVA table for average daily gain (ADG) during rearing period.

Date of sampling (day)	Sources of variations	Sum of squares	Degrees of freedom	Mean square	F
20th	Between treatments	0.005	2	0.003	9.966
	Within treatments	0.002	6	0.000	
	Total	0.007	8		
40th	Between treatments	0.075	2	0.038	28.670
	Within treatments	0.008	6	0.001	
	Total	0.083	8		
60th	Between treatments	0.086	2	0.043	53.316
	Within treatments	0.005	6	0.001	
	Total	0.091	8		

The highest specific growth rate ($3.66 \pm 0.01\%$) was detected in treatment T_2 and the lowest value ($1.50 \pm 0.01\%$) was obtained in T_1 (Table 5). All the treatments were significantly different among themselves at 60th day of sampling (F = 99.686, p = 0.00) (Table 6).

SGR progressively increased with the increase in feeding frequency and decreased with feed wastage. The significantly highest SGR in treatment T_2 might be due to the fact that the fish have utilized effectively the supplied feed taking small amount at a rate of three times a day. Hossain and Parween have recorded the highest SGR (1.80%) in *H. fossilis* by supplemental diet which is similar to the present findings[10]. Wing-Keong *et al.* reported SGR as 1.27%/day fed with 5% of BW/day in bagrid catfish (*Mystus nemurus*) [11].

Table 5. Specific growth rate (SGR) during rearing period (Mean ± SEM).

Treatment	SGR (%)		
	20th day	40th day	60th day
T_1	2.74 ± 0.05^c	1.83 ± 0.35^b	1.50 ± 0.01^c
T_2	3.66 ± 0.02^a	3.58 ± 0.01^a	2.20 ± 0.02^a
T_3	2.98 ± 0.02^b	2.96 ± 0.06^a	1.73 ± 0.05^b

Table 6. ANOVA table for Specific growth rate (SGR) during rearing period.

Date of sampling (day)	Sources of variations	Sum of squares	Degrees of freedom	Mean square	F
	Between treatments	1.388	2	0.694	219.710
20th	Within treatments	0.019	6	0.003	
	Total	1.407	8		
	Between treatments	4.716	2	2.358	19.086
40th	Within treatments	0.741	6	0.124	
	Total	5.457	8		
	Between treatments	0.756	2	0.378	99.686
60th	Within treatments	0.023	6	0.004	
	Total	0.778	8		

Table 7. Feed conversion ratio (FCR) during rearing period (Mean ± SEM).

Treatment	FCR		
	20th day	40th day	60th day
T_1	2.75 ± 0.07^a	2.78 ± 0.08^a	2.83 ± 0.05^a
T_2	1.85 ± 0.01^c	1.91 ± 0.01^c	1.81 ± 0.02^c
T_3	2.46 ± 0.02^b	2.49 ± 0.06^b	2.43 ± 0.09^b

The lowest food conversion ratio (FCR) (1.81 ± 0.02) was observed in treatment T_2 and the highest (2.83 ± 0.05) in treatment T_1 (Table 7). The lowest FCR value was an indication of better food utilization efficiency of supplemental feeds. All the treatments were

significantly different among themselves (F = 69.722, p = 0.00) (Table 8). The lower FCR value might be due to the feeding behavior of Thai pangas. The fish might be properly utilized most of the supplemental feed and the utilized feed helped in production of supplemental food by releasing nutrients through decomposition. Relatively better FCR value (1.624 ± 0.083) was detected by Marimuthu *et al.* in African Catfish (*C. gariepinus*) fingerlings by feeding twice a day[5].

Table 8. ANOVA table for feed conversion ratio (FCR) during rearing period.

Date of sampling (day)	Sources of variations	Sum of squares	Degrees of freedom	Mean square	F
20th	Between treatments	1.255	2	0.627	125.018
	Within treatments	0.030	6	0.005	
	Total	1.285	8		
40th	Between treatments	1.171	2	0.586	62.816
	Within treatments	0.056	6	0.009	
	Total	1.227	8		
60th	Between treatments	1.572	2	0.786	69.722
	Within treatments	0.068	6	0.011	
	Total	1.639	8		

Table 9. Proximate composition of Thai pangas (Mean ± SEM) at 60 days of rearing.

Treatment	Moisture (%)	Crude protein (%)	Crude lipid (%)	Ash (%)
T_1	79.23 ± 0.77	16.11 ± 0.00	3.24 ± 0.03	1.47 ± 0.02[b]
T_2	78.08 ± 0.85	16.38 ± 0.08	3.22 ± 0.27	1.58 ± 0.03[b]
T_3	77.84 ± 0.17	16.34 ± 0.12	3.41 ± 0.06	1.82 ± 0.04[a]

At the end of the rearing and feeding trial, investigations were carried out on the proximate composition of *P. hypophthalmus* for different feeding frequency. The biochemical composition of Thai pangas fish analyzed on dry weight basis. Average moisture content of Thai pangas in treatments T_1, T_2 and T_3 were 79.23 ± 0.77, 78.08 ± 0.85 and 77.84 ± 0.17%, respectively. Shaheen *et al*. observed that moisture content in catfish bacha and pabda were 72.2 and 73.7%, respectively[12]. Average protein content of Thai pangas fish in treatments T_1, T_2 and T_3 were 16.11 ± 0.00, 16.38 ± 0.08 and 16.34 ± 0.12%, respectively. Shaheen *et al*. studied the protein content of the same species of catfishes in Bangladesh were in between 16.1 and 17.3%, respectively [12]. Average fat/lipid content of Thai pangas fish in treatments T_1, T_2 and T_3 were 3.24 ± 0.03, 3.22 ± 0.27 and 3.41 ± 0.06%, respectively while Wimalasena *et al*. found 2.3% lipid in stinging catfish (*Heteropneustes fossilis*)[13]. In the present investigation, average ash content of Thai pangas fish in

treatments T_1, T_2 and T_3 were 1.47 ± 0.02, 1.58 ± 0.03 and 1.82 ± 0.04%, respectively. Wing-Keong *et al*. investigated the ash content of bagrid catfish and recorded that mean ash content was 3.8% (w/w)[11]. From the above discussion, it is clearly revealed that the protein content increased; moisture contents decreased and fat and ash contents fluctuated at the time of rearing and feeding trial.

During the study period water temperature was found in suitable range between 27.17 ± 0.04 and 27.20 ± 0.04 °C. The dissolved oxygen of the water was within the range of 5.50 ± 0.17 mg/l to 5.97 ± 0.03 mg/l and water pH was 7.10 ± 0.06 to 7.40 ± 0.06.

The results of the present study based on the growth parameters and proximate composition suggests that *P. hypophthalmus* fingerlings (7.0 ± 0.15 cm and 3.1 ± 0.25 g) should be fed at three times a day for maximum growth performances.

Acknowledgement

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