

## **Growth and reduction of cost of production of *Pangasius hypophthalmus* (Sauvage, 1878) with alternate feeding schedules**

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### **ABSTRACT**

A feeding trial was conducted in pond condition to investigate the effect of alternate feeding schedules on the growth and production cost of Thai pangas, *Pangasius hypophthalmus*. Ten experimental ponds each of 400 m<sup>2</sup> size were divided into 5 treatment groups each with two replicates. Fish ( $5.3 \pm 0.6$  g average weight) were stocked at the rate of 1,000 per pond (25,000/ha). High protein (30%, H) and low protein (15%, L) diets were prepared using locally available ingredients. Five different feeding schedules employed were: high protein diet (30% protein, H, low protein (15% protein, L) diet, 1 day low protein diet followed by 1 day high protein diet (1L/1H), 2 days low protein diet followed by 2 days high protein diet (2L/2H) and 7 days low protein diet followed by 7 days high protein diet (7L/7H). The fish were fed twice daily at the rate of 15, 10, 8 and 5% of their body weight for the 1st, 2nd, 3rd and 5th months respectively. Significantly ( $P < 0.05$ ) higher growth rate of Thai pangas were achieved in feeding schedules of H, 1L/1H and 2L/2H, and the lowest with 7L/7H. The FCR values ranged between 2.08 to 2.79 with H and 1L/1H showing significantly the best FCR. The production of Thai pangas ranged between 308 to 472 kg/400 m<sup>2</sup> pond (7,708 to 11,805 kg/ha/5 months) with 1L/1H feeding schedule giving the highest production. A simple economic analysis showed that fish in 1L/1H fed alternately with low and high protein diets resulted in the highest net profit. The results of the study demonstrated the feeding of fish continuously with high protein diet is not economical.

### **Introduction**

Thai pangas, *Pangasius hypophthalmus* is a promising species for aquaculture with its omnivorous feeding habits, rapid growth and good market. The freshwater catfish requires relatively high protein level (more than 40%) in its diets for optimal growth (Ali, 2001). A major problem associated with culturing this catfish is the high operating cost contributed mainly by feed which accounts for more than 50%

of the total cost of production (Sehagal and Toor, 1991; De Silva, 1992).

An approach to reduce feed cost is to develop appropriate feeding management strategies and other improvements in husbandry techniques (Lovell, 1998). The costs of feed per unit fish production may be reduced by improving the utilization of feed, especially protein adopting appropriate feeding management strategies (De Silva 1985; 1989). De Silva (1985)

hypothesized that it might be economical to feed the fish with diets of different protein content instead of providing constant level of recommended protein in the diet. He also suggested that adoption of mixed feeding schedules where a high protein diet is alternated with a low protein diet is cost effective in semi-intensive culture. The concept of a mixed feeding schedule was based on the observation that the digestibility of feed varies from day to day, following an apparent cyclic pattern. The usefulness of mixed feeding schedules for reducing feed cost has been pointed out for species such as *Channa striata* (Hashim, 1994) and *Labeo rohita* (Saha and Ray, 1998) under laboratory conditions and Indian major carps (Nandeeshha *et al.*, 1994), common carp (Nandeeshha *et al.*, 1995) and tilapia under pond culture system (Patel and Yakupitiyage, 2003).

In Bangladesh culture of Thai pangas expanded dramatically in recent years but the profit of has decreased because of high operating feed cost. The objective of the present study was to investigate the suitability of utilizing alternate feeding schedules for increased production of this fish in ponds with a view to minimise feed costs.

## Materials and methods

### *Study area and pond facilities*

Ten experimental ponds (400 m<sup>2</sup> area) situated in the pond complex of Freshwater Station, Bangladesh Fisheries Research Institute (BFRI), Mymensingh were selected for the study. The water depth in each pond was maintained at 1.3 m. All the ponds were of similar shape, size, depth, basin configuration and bottom type including water supply facilities. The ponds were prepared by draining out and limed with quick lime (CaO) at the rate of 10 kg per

pond 14 days before stocking.

### *Experimental diets*

Two experimental diets having of low protein (15% protein, L) and high protein (30% protein, H) well prepared using locally available fish feed ingredients. Ingredients and proximate composition of the experimental diets are shown in Table 1. Fish meal, bone meal and mustard oil cake were used as protein source. Maize and rice bran were used as carbohydrate source and wheat flour as binder. The diets were prepared manually by mixing the requisite amount of dry ingredients thoroughly, followed by the addition of water to form thick dough. The diets were prepared every day and presented to the fishes as moist dough balls.

Fingerlings having average weight of 5.3±0.6 g were collected from a local fish vendor. Fishes were stocked at the rate of 1,000 fish/400 m<sup>2</sup> pond (25,000/ha). There were 5 treatments and the following feeding schedules were used: (1) continuously feeding with high protein (H) diet (T<sub>1</sub>); continuously feeding with low protein (L) diet (T<sub>2</sub>); (3) 1-day low protein diet followed by 1-day high protein diet (1L/1H) (T<sub>3</sub>); (4) 2-day low protein diet followed by 2-day high protein diet (2L/2H) (T<sub>4</sub>) and (5) 7-day low protein diet followed by 7-day high protein diet (7L/7H) (T<sub>5</sub>). Each feeding schedule had two replicate ponds and the experiment was conducted for a period of 5 months from July to November.

The fish were fed twice daily at the rate of 15,10,8 and 5% of their body weight for 1st, 2nd, 3rd and 5th month respectively. Feed quantity was adjusted based on the total biomass estimated by fortnightly sampling. At the beginning of the experiment, 15 fish were randomly sacrificed and kept for analysis of whole

TABLE 1: *Ingredients used and proximate composition of the experimental diets (% dry matter basis).*

% Crude protein (diet)	Diets	
	High protein diet (H, 30%)	Low protein diet (L, 15%)
<b>Ingredients:</b>		
Fish meal <sup>1</sup>	20.00	10.00
Meat & bone meal <sup>2</sup>	20.00	5.00
Mustard oil cake <sup>3</sup>	15.00	5.00
Maize meal <sup>4</sup>	20.00	50.00
Rice bran <sup>5</sup>	20.00	25.00
Wheat flour	5.00	5.00
<b>Proximate composition:</b>		
Dry matter	90.48	89.80
Crude protein	30.44	16.40
Lipid	10.62	9.88
Ash	16.10	14.52
Crude fibre	7.08	7.58
NFE <sup>6</sup>	35.76	51.62
Gross energy (kJ/g)	17.52	16.66
Price of diet (Tk. / Kg)	16.10	11.90

<sup>1</sup> Dry matter: 90.1; Crude protein: 60.1; Lipid: 15.6; Crude fibre: 0.5; Ash: 22.3; NFE<sup>6</sup>: 1.5

<sup>2</sup> Dry matter : 90.3; Crude protein: 46.2; Lipid: 11.8; Crude fibre: 3.7; Ash: 34.4; NFE<sup>6</sup>: 3.9

<sup>3</sup> Dry matter : 89.3; Crude protein: 34.0; Lipid: 10.2; Crude fibre: 10.2; Ash: 10.2; NFE<sup>6</sup>: 35.3

<sup>4</sup> Dry matter : 88.70; Crude protein: 10.1; Lipid: 4.9; Crude fibre: 2.9; Ash: 2.2; NFE<sup>6</sup>: 79.9

<sup>5</sup> Dry matter : 89.9; Crude protein: 12.1; Lipid: 15.3; Crude fibre: 15.3; Ash: 14.6; NFE<sup>6</sup>: 42.7

<sup>6</sup> NFE = Nitrogen free extractives, calculated as 100- (% Protein + % Lipid + % Ash + % Fibre)

<sup>7</sup> Calculated according to Jauncey (1998)

1.0 US\$ = Taka 58.0

body composition. At the end of the experiment the proximate composition of muscle was analyzed by collecting the muscle samples from the mid region just below the dorsal fin.

#### *Water quality parameters*

Water quality parameters such as temperature, pH, dissolved oxygen and transparency were monitored weekly. Plankton samples were collected at fortnightly intervals by filtering 40-L water collected from different corners of the ponds through 25 micron plankton net. Dry weight of plankton was determined by drying at 60°C for 24 hours.

Proximate composition of feed ingredients, experimental diets, initial fish carcasses and muscle composition of fish were analyzed following AOAC (1990) methods. Two fish in each pond were analyzed individually in duplicate for determining muscle composition. Specific growth rate (SGR), % weight gain, feed conversion ratio (FCR), and protein efficiency ratio (PER) were calculated as follows:

$$\text{SGR} = \left[ \frac{\ln(\text{Final body weight}) - \ln(\text{Initial body weight})}{\text{days}} \right] \times 100$$

$$\% \text{ Weight gain} = \left[ \frac{\text{Final body weight} - \text{Initial body weight}}{\text{Initial body weight}} \right] \times 100$$

FCR = Feed fed (g dry weight) / Live weight gain (g)

PER = Live weight gain (g) / Crude protein fed (g dry weight)

The growth performance, feed utilization, survival, production and muscle composition data were analyzed using one way ANOVA. Paired mean comparisons among the treatments were made using Duncan's Multiple Range Tests (Duncan, 1955). A significance level of  $P < 0.05$  was used.

## Results

The growth performance of Thai pangas in terms of final weight, mean weight gain, specific growth rate (SGR), FCR, PER, survival (%) and production are shown in Table 2. The growth increment shown in Fig.1. Economic analysis of fish production using the alternate feeding schedule was done and the results are presented in Table 3. Water quality parameters in different experimental ponds are presented in

TABLE 2: Growth, feed utilisation and production of Thai pangas maintained on mixed feeding schedules

Parameters:	Treatment (Feeding schedules) <sup>1</sup>				
	H	L	1L/1H	2L/2H	7L/7H
Initial wt. (g)	5.30 (± 0.60)	5.30 (± 0.60)	5.30 (± 0.60)	5.30 (± 0.60)	5.30 (± 0.60)
Final wt. (g)	497.00 <sup>a</sup> (± 9.07)	350.00 <sup>c</sup> (± 16.18)	510.50 <sup>a</sup> (± 8.56)	485.00 <sup>a</sup> (± 9.89)	425.50 <sup>b</sup> (± 10.49)
Wt gain	491.70 <sup>a</sup> (± 9.0)	344.70 <sup>c</sup> (± 15.64)	505.20 <sup>a</sup> (± 8.36)	497.70 <sup>a</sup> (± 8.49)	420.20 <sup>b</sup> (± 11.39)
Wt gain (%)	9277 <sup>a</sup> (± 152)	6503 <sup>c</sup> (± 279)	9332 <sup>a</sup> (± 138)	9390 <sup>a</sup> (± 183)	7928 <sup>b</sup> (± 187)
SGR	2.64 <sup>a</sup> (± 0.01)	2.29 <sup>c</sup> (± 0.02)	2.68 <sup>a</sup> (± 0.01)	2.62 <sup>a</sup> (± 0.01)	2.38 <sup>b</sup> (± 0.01)
FCR	2.10 <sup>a</sup> (± 0.08)	2.79 <sup>c</sup> (± 0.13)	2.08 <sup>a</sup> (± 0.08)	2.27 <sup>bc</sup> (± 0.03)	2.45 <sup>b</sup> (± 0.04)
PER	1.96 <sup>c</sup> (± 0.05)	2.21 <sup>a</sup> (± 0.06)	2.10 <sup>a</sup> (± 0.08)	1.81 <sup>b</sup> (± 0.01)	1.74 <sup>bc</sup> (± 0.01)
Quantity of fish harvested	923.00 <sup>a</sup> (± 15.00)	881.00 <sup>b</sup> (± 9.50)	925.00 <sup>a</sup> (± 7.90)	900.00 <sup>a</sup> (± 18.80)	890.00 <sup>b</sup> (± 15.80)
Survival (%)	92.30 <sup>a</sup> (± 1.50)	88.10 <sup>b</sup> (± 0.95)	92.50 <sup>a</sup> (± 0.79)	90.04 <sup>a</sup> (± 1.88)	89.00 <sup>b</sup> (± 1.58)
Production (Kg/400m <sup>2</sup> pond)	458.72 <sup>a</sup> (± 14.92)	308.32 <sup>c</sup> (± 10.15)	472.21 <sup>a</sup> (± 8.75)	437.14 <sup>a</sup> (± 20.40)	378.69 <sup>b</sup> (± 16.36)
Production (Kg/ha)	11,468.00 <sup>a</sup> (± 188.76)	7,708.00 <sup>c</sup> (± 225.40)	11,805.30 <sup>a</sup> (± 190.96)	10,928.60 <sup>a</sup> (± 74.45)	9,467.37 <sup>b</sup> (± 185.59)

<sup>1</sup> L, low protein diet; H, high protein diet; SGR, specific growth rate; FCR, food conversion ratio; PER, protein efficiency ratio. Values are mean ± SD of two replicates. Figures in the same row having different superscript are significantly different ( $P < 0.05$ ).

Table 4. Proximate composition of muscles of Thai pangas are presented in Table 5.

### Discussion

The results demonstrated that there was no significant ( $P>0.050$ ) difference between the weight gains of fish fed with high protein diet continuously (H) and fish fed alternately with one or two days of low protein diet followed by one or two days of high protein diet. The weight gain values in H, 1L/1H and 2L/2H feeding schedules were significantly higher than those obtained with other feeding schedules. Similar results were reported by Nandeeshha *et al.* (1993) with rohu (*Labeo rohita*) and catla (*Catla catla*) and Srikanth *et al.* (1989) with common carp.

Feed conversion ratio (FCR) and

protein efficiency ratio (PER) were lower in regular feeding with high protein diet (H) and other mixed feeding schedules compared to continuous feeding with a low protein diet (L). These findings are similar to those reported in earlier studies with Indian major carps and common carp (Nandeeshha *et al.* 1993; 1994; 1995; 2002). PER did not reflect the growth trend, instead it varied inversely with the amount of crude protein in the diet. The higher PER recorded in the low-protein diet suggests the efficient utilization of the small quantity of protein provided for growth. Similar trends were also noticed with common carp by Nandeeshha *et al.* (1995,2002). PER is also known to be high at low levels of protein input (Jauncey, 1982).

TABLE 3: Economics of fish production

Component:	Treatment (Feeding schedules) <sup>1</sup>				
	H	L	1L/1H	2L/2H	7L/7H
Expenditure (Tk. / 400m <sup>2</sup> pond)					
Pond preparation	255.00	255.00	255.00	255.00	255.00
Fingerlings	800.00	800.00	800.00	800.00	800.00
Feed	11,601.84	7,301.04	10,609.96	10,420.96	9,224.00
Operational cost <sup>2</sup>	800.00	800.00	800.00	800.00	800.00
Expenditure (Tk. / 400m <sup>2</sup> pond)	13,536.84	9,236.04	12,544.96	12,355.96	11,159.00
Total expenditure (Tk./ha)	338,421	230,901	313,624	308,899	2,78,975
Income (Tk./400 m <sup>2</sup> pond)	18,348.80	12,332.80	18,888.40	17,485.60	15,147.60
Sale proceeds of Thai pangus @ Tk. 40.00/kg					
Income (Tk./ha)	458,720	308,320	472,212	437,144	378,694
Net profit (Tk./ 400 m <sup>2</sup> pond) <sup>3</sup>	4,811.96	3,096.76	6,343.44	5,129.64	3,988.60
Net profit (Tk./ha) <sup>3</sup>	120,299	77,419	158,588	128,245	99,719
Protein saving (%)	-	41.83	23.55	21.30	19.16

<sup>1</sup>L, low protein diet; H, high protein diet.

<sup>2</sup>Operation cost is considered as 7.5% of total cost (ADCP, 1983)

<sup>3</sup>Leasing cost for pond is not included

US \$ 1.00 = Taka 58.00

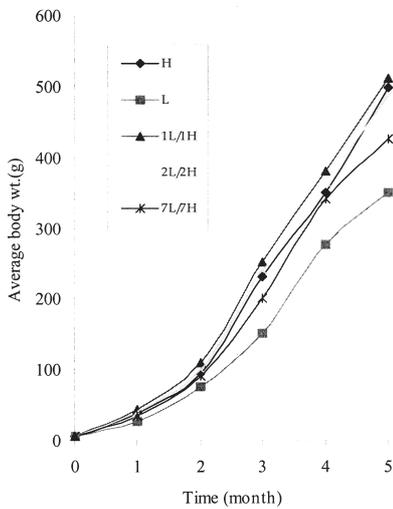


Fig 1. The mean monthly growth response of Thai pangas.

L and H refer respectively to the low and high protein diets and numerical refers to the number of days on which the particular diet was used before being substituted by the other.

Compared with continuous feeding of the high protein diet (H), the alternate feeding schedules of 1L/1H resulted in improved fish production and protein saving. Feeding on alternate days with low protein and high protein diet (1L/1H)

saved Tk. 4.20 for every 2kg of feed consumed and resulted in higher production and net profit. Higher survival of fish with 1L/1H schedule also contributed to net profit. The results demonstrated that it is possible to save 23.55% protein by adopting 1L/1H feeding schedule. Alternate feeding schedules also helped to reduce the nitrogen input substantially compared to continuous feeding of the high protein diet (Nandeesh *et al.* 1995; 2002).

Muscle composition did not vary considerably among the treatments, except muscle lipid level, which was higher in fish fed with high protein diet continuously. Feeding high protein diet led to increase in fat deposition in the fish muscle. Fat was low in fish receiving low protein diet throughout. Similar finding was reported with common carp (Srikanth *et al.*; Nandeesh *et al.*, 2002).

The ranges of water quality parameters such as temperature, pH, dissolved oxygen and transparency values observed in different treatments

TABLE 4: Water quality parameters in different treatment ponds during the experimental period.

Parameters:	Treatment (Feeding schedules) <sup>1</sup>				
	H	L	1L/1H	2L/2H	7L/7H
Temperature (°C)	25.0-34.5 (30.3 ± 0.6)	25.2-34.0 (30.2 ± 0.5)	25.4-34.6 (30.4 ± 0.4)	25.3-33.8 (30.3 ± 0.4)	25.3-34.9 (30.2 ± 0.6)
pH	6.8-7.7 (7.1 ± 0.5)	6.8-8.5 (7.2 ± 0.6)	6.8-8.0 (7.1 ± 0.6)	7.1-7.9 (7.2 ± 0.4)	6.8-8.0 (7.2 ± 0.5)
Dissolved oxygen (mgL <sup>-1</sup> )	4.0-7.4 (5.5 ± 0.5)	4.5-7.2 (5.6 ± 0.6)	4.3-7.1 (5.6 ± 0.7)	4.2-6.6 (5.4 ± 0.4)	4.3-6.6 (5.5 ± 0.7)
Transparency (cm)	17.5-31.0 (22.9 ± 3.2)	18.3-32.1 (23.3 ± 3.4)	19.7-30.3 (23.8 ± 2.5)	17.0-32.2 (23.3 ± 3.6)	16.5-32.7 (22.6 ± 3.4)
Dry weight of plankton (mg/40 L)	8.5-52.5 (29.7 ± 11.5)	8.9-48.6 (27.3 ± 10.4)	8.5-52.8 (28.2 ± 10.8)	9.0-54.5 (29.1 ± 11.2)	9.2-51.4 (28.5 ± 10.5)

<sup>1</sup>L, low protein diet; H, high protein diet

Figures in parentheses indicate mean values ± SD

TABLE 5: Whole body composition and muscle composition (% wet matter basis) of Thai pangas, at the start and at the end of the experiment

Parameters:	Treatment (Feeding schedules) <sup>1</sup>					
	Initial	H	L	1L/1H	2L/2H	7L/7H
Moisture	80.76	77.32 (± 0.28)	76.29 (± 1.67)	77.21 (± 2.25)	77.42 (± 0.49)	75.79 (± 0.97)
Crude Protein	12.05	19.26 (± 0.03)	18.23 (± 0.90)	20.12 (± 1.73)	19.98 (± 0.68)	20.02 (± 0.92)
Crude Lipid	2.92	3.79 <sup>a</sup> (± 0.59)	2.10 <sup>b</sup> (± 0.28)	3.64 <sup>a</sup> (± 0.09)	2.76 <sup>b</sup> (± 0.23)	2.65 <sup>b</sup> (± 0.52)
Ash	3.31	1.39 (± 0.04)	1.39 (± 0.18)	1.43 (± 0.03)	1.57 (± 0.04)	1.63 (± 0.05)

<sup>1</sup> L, low protein diet; H, high protein diet. Values are mean ± SD of two replicates. Figures in the same row having different superscript are significantly different (P<0.05).

were within the productive range for fish culture (Jhingran, 1991). The dry weight of plankton ranged from 8.5 to 58.5mg/40L. These values progressively increased as the experiment proceeded and were fairly uniform in all the treatments and lower than the values encountered in fertilized ponds (Wolfarth and Schroeder, 1979).

The results demonstrated that it is economically beneficial and biologically more productive to provide the fish alternately with low and high protein diets instead of feeding only with the high protein diet. Such a feeding schedule will significantly reduce the total feed costs and cost of production of fish. Therefore, for profitable Thai pangas farming in Bangladesh, farmers can use alternate feeding schedule of one or two days of low protein diet followed by one or two days of high protein diet.

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