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Feeding in every alternate day is a sustainable technique for Thai pangas (*Pangasius hypophthalmus*) culture

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Abstract

An experiment was conducted for reducing feed cost and to identify the sustainable culture technique for Thai pangas *Pangasius hypophthalmus*. Fish maintained in four treatments were either: feed to satiation twice a day (Control-A), feed alternative day (1:1- B), starved two days followed by a spell of two days feeding (2:2-C) and starved for 5 days followed by 5 day feeding (5:5-D) at a stocking density of 100 fingerling per decimal at 28±1.54º C. Fish in all four treatments were fed to satiation. Thai Pangas responded to a change from a restricted to satiation feeding showing a higher daily feed demand compared to their counterparts raised on a liberal-feeding regime. The total feed demand of fish in control treatment was, however, much higher than the fish in other three treatments. Nonetheless, fish that were feed to satiation on alternate day (1:1) had similar body weights to the controls, and were larger than those exposed to 2 or 5 days of feed deprivation (2:2 or 5:5). There was no significant differences in specific growth rate of fish in the treatments A and B over the experimental period. The highest FCR was found in A (Control) where fish were fed to satiation twice a day. There were also no significant differences in tissue protein level in fish from different treatments. The study provided evidence that Thai Pangas could be cultured in feeding regime with feeding in alternate days without any significant difference in fish size and final production. In this way, Thai pangas culturists can save feed cost up to 30% and make the culture sustainable following alternate days feeding. As the farmers are giving less feed in the system they can control the water quality in a better way. In addition, this type of feeding regime also helps fish farmers to improve their personal time management since they may not need to attend the fish everyday.

Keywords: Feeding, Sustainable, Thai pangas, Alternate day

Introduction

Thai pangas belonging to the Family Pangasiidae is an exotic fish for Bangladesh. Its origin is the Mekong river of Vietnam to the Chao Phraya River of Thailand. It was introduced into Bangladesh in 1990 under the Ministry of Fisheries and livestock (MOFL) from Thailand. It is a quick growing species and can be grown in the fish pond. Because of its year round production, quick growth and high productivity Thai pangas culture has proved itself as a profitable enterprise. Basically, Thai pangas culture in the pond is a new technology and for its culture, right method should be followed to obtain higher yield. The climate, water and soil condition of Bangladesh have proved totally suitable for Thai pangas culture. It is possible to produce Thai pangas fish in the pond where water remains for 4 to 5 months. Within this period the fish gain weight above 500 g and becomes ready for marketing. So, owing to its taste, popularity and large production capacity as compared to Carp species only Thai pangas can help greatly to be fulfill the demand of animal protein of the country. Increased Thai pangas production can help meet the increased domestic demand for fish. Although initially commercial farming of Thai pangas was highly profitable for both small scale and commercial pangas farmers, but nowadays it is not very profitable due to ever-growing feed cost. Feed cost is the largest operational cost in covering of aquaculture 50% of the total production costs. Moreover, in Bangladesh, use of complete artificial diet to get better yield is not possible for most farmers due to a lack of necessary credit. It is, therefore, important to examine the benefits that may occur from the employment of different rearing methods & feeding regimes involving compensatory growth. Compensatory growth is defined as a phase of usually rapid growth, following a period of under nutrition (Dobson and Holme, 1984; Hayward *et. al.* 1997). Through this growth spunt, animals subjected to previous nutritional restriction may partially or completely catch up in body size with those that have not undergone food restriction (Dobson and Holme, 1984; Russel and Wootton, 1992; Kim and Lovell, 1995). Compensatory growth in fish is not only of theoretical interest, but may also have application in aquaculture (Quinton and Blake, 1990; Jobling *et. al.* 1994; Hayward *et. al.* 1997) as appropriate exploitation of this phenomenon may result in increased growth rate and feed efficiency.

A number of workers have speculated that compensatory growth could be exploited in the commercial production of both farm animals and fish, to control rates of weight gain or to manipulate the final composition of body tissue or to improve growth efficiency (Wilson and Osbourn,1960; Plavnik and Hurwitz, 1985; Kindschi, 1988; Quinton and Blake, 1990; Jones and Farrell, 1992). The time dependent compensatory growth has been described for three of the cyprinid species by Russell and Wootton (1992).

Commercial pond culture of Thai pangas has become less profitable in present time due to high feed cost. It is found that Thai pangas take very little natural food and depends mainly on artificial feed. Therefore, it is a burning need to develop scientific technique of reducing feed cost to make Thai pangas culture sustainable and profitable. As a result, study of compensatory growth response of Thai pangas is very essential. A good number of studies on pond fish culture are available but very few economic studies were conducted on Thai pangas culture in the pond and no compensatory growth study was carried out. The present study, has, therefore, been designed to reduce feed cost and provide information about productivity and economic returns from Thai pangas fish culture using compensatory growth. It will generate useful information, which will be useful for existing and prospective producers in taking decisions. The findings from this study may also help the policy maker in making decisions on pangas fish culture. The information will also be useful to the extension workers. This study will help determine selection of more profitable practice of pangas, fish production and thereby increase farmers income as well as make the culture sustainable.

The general goal of the study was to increase the profitability for rural farmers by reducing the feed cost and make the culture sustainable for Thai pangas. The objectives of the experiment were:

a) To reduce the feed cost
b) To obtain the same or better result using less feed
c) To maintain water quality in a better way

Materials and Methods

Eight earthen ponds situated at the field laboratory of the Faculty of Fisheries, Bangladesh Agriculture University, Mymensingh, were used for this experiment. The area of each pond was 1.5 decimal with an average depth of about 1.5m. All ponds were similar with shape, size, depth, contour and bottom type.

The experiment was carried out for a period of 18 weeks each with two replications. Ponds were randomly selected for four sets of trials. All the ponds were prepared well and then fish fry were stocked. The fry were taken from Santahar hatchery, Bogra and transported in oxygenated polythene bag to the ponds. The fry were properly conditioned before stocking and stocking density was maintained at @ 100 per decimal. The fish were attended twice daily, and these inspections included feeding with pellet feed (Quality Feed Ltd, Dhaka, Bangladesh). Proximate composition of the feed was moisture-10.5%, protein-27.89%, lipid-6.28% and ash-14%.On each feeding day, the fish were hand-fed at 0900 and 1700 h until they no longer accepted feed, with each feeding lasting for about half an hour. The experiment commenced with the establishment of groups of fish held according to the following feeding regime- Treatment A: No deprivation and fed to satiation twice per day ; Treatment B: 1 day deprivation, 1 days feeding; Treatment C: 2 days deprivation, 2 days feeding; Treatment D: 5 days deprivation, followed by 5 days feeding.

A sample of 15 fish was taken from each of the treatment at the start of the experiment. The initial TL and weight of the fish were measured on the day of first stocking. The growth rate in terms of change in length (cm) and weight (g) of fish were recorded in every 15 days by randomly sampling 10 fish from each pond. Weight was taken with a balance (DONGIL- 1 k g x 5 g) and length with a wooden scale. Then one fish from each treatment was killed by a sharp blow to the head and dissected in the Fisheries Biology and Genetics laboratory-2 and collected muscle tissue and preserved for proximal composition analysis. Water quality parameters such as, temperature, dissolved oxygen, and p^H were monitored fortnightly. The temperature and dissolved oxygen of water were determined by DO meter (YSI Model 58, USA) and p^H was recorded by p^H meter (HI 98106 Hanna instrument, portable and made in Portugal) according to the instrumental manual.

Proximate analysis of body tissue was carried out from the fish sample taken every 15 day throughout the experiment. Proximate composition of fish sample was determined following the standard methods given by association of Official Analytical Chemists (AOAC, 1990) in the Nutrition Laboratory of Faculty of Fisheries, BAU, Mymensingh.

Ninety-five percent confidence limits (CL) were calculated as, $CL = X \pm t_{0.05(n-1)} (S/\sqrt{n})$, where X = mean, $t_{0.05(n-1)}$ = value from a two-tailed t table where 0.05 is the proportion expressing confidence, n-1 = degree of freedom and S = standard deviation. Proportions were arcsine transformed prior to analysis. One way ANOVAs were used to test the effect of feeding schedule on growth, survival, gut and liver index and proximate body composition. Wherever a significant F resulted from the analysis of variance the Turkey's test was applied to locate difference among treatments and the means were ranked using a computer program (SPSS 10.0 for Windows). Differences were regarded significant when $P < 0.05$.

Results and Discussion

Growth of fish

The initial mean weights were not significantly different ($P > 0.05$) among the treatment groups. The mean weight started to differ significantly from second week. The weekly weight increases among treatments A and B were not significantly different over the experimental period except in week 4 and 6. From the 8th week, there were visible and highly significant difference in weight gain between treatments A and B and treatments C and D. At the end of the experiment, mean body weight of the fish that were feed at alternative days (Treatment B) was still numerically lower than that of the controls (Treatment A), but the difference was not significant (Table 1). Total lengths in the treatments were not significantly different over the experimental period although there was a tendency of numerically lower growth in fish in treatments C and D than fish in treatments A and B from week 8 until the end of the experiment (Fig. 1).The observed growth increase of Treatment B (feeding every alternate day) is probably due to the fact that, one day feed deprivation appears to be readily overcome by juvenile Thai pangas upon realimentation.Weight lost during the 1-day period of feed deprivation was recovered such that weight gain of restricted and regular-fed fish was the same after the end of the experiment. Complete compensation was recorded within 3 weeks of refeeding in minnows *Phoxinus phoxinus* (bw 1–2 g) after a 16-day deprivation (Russell and Wootton, 1992), and in adult rainbow trout (very wide size range 6–120 g) after a 3-week deprivation (Quinton and Blake, 1990). The inability of Thai pangus deprived for 2 and 4 days to catch up in body weight probably resulted from the relatively weak capacity for compensatory growth coupled with greater weight losses during deprivation. One more explanation could be the period of deprivation was too long for the small size of juveniles used in this experiment. Kim and Lovell (1995) observed that adult channel catfish held in ponds could recoup mass loss and attain final weights equivalent to control, satiate-fed fish when deprived of feed for 3 weeks then full fed for 3 weeks, but more extended feed deprivation prohibited the channel catfish from attaining a final weight equal to control fish. A similar finding has been reported for the same species by Gaylord and Gatlin (2000). Length of Thai pangas increased regularly irrespective of the effects of the treatments. With the trials progressed, fish from treatments C and D became thin to thinner. This confirmed that, when in an adverse situation like feed deprivation, body muscle stops to grow, skeleton, however grows in a normal manner. The result of this experiment shows, towards the end of the experiment, the individual length of fish from treatments C and D became gradually lower than that of the fish in treatments A and B.

Table 1. Mean individual weight (g) of Thai pangas, *P. hypophthalmus* in four treatments over the experimental period (Values in the same column followed by different letters indicate differ significantly, P=0.05)

Treatments	Weeks									
	0	2	4	6	8	10	12	14	16	18
A	38.76	62.82	92.05[c]	124.07[c]	180.08[c]	225.93[b]	323.78[d]	410.13[b]	523.45[c]	575.13[c]
B	40.48	62.30	78.71[b]	111.23[c]	165.28[c]	212.34[b]	275.23[c]	390.34[b]	489.09[c]	555.36[c]
C	37.34	51.82	75.60[b]	98.88[b]	115.14[b]	146.06[a]	241.88[b]	237.44[a]	313.19[b]	346.43[b]
D	37.48	54.44	62.75[a]	80.81[a]	84.66[a]	139.76[a]	180.72[a]	235.34[a]	251.15[a]	288.23[a]

Specific growth rate (SGR) was never negative during the experimental period. In addition, in some cases the SGRs in fish from treatments C and D were higher than those of Treatments A and B which indicate that Thai pangas responds positively to compensatory growth.

Specific Growth Rate

Specific growth rates (for every 15 days) calculated from wet weight are presented in Table 2. In general, specific growth rates were higher in fish from treatments A and B than the fish from treatments C and D. In treatment A, the SGR decreased gradually with some fluctuations. In other treatments, SGRs fluctuated over the experimental period. During Week 10 and 18, growth rate were significantly higher in treatment D than other treatments.

Table 2. Specific growth rates of Thai pangas (*P. hypophthalmus*) in fish from four treatments over the experimental period

Treatments/Week	A	B	C	D
2	3.63^b	3.13^b	2.37a	2.70^a
4	2.65c	1.68^b	2.73^c	1.02^a
6	2.15^a	2.50^b	1.94^a	1.82^a
8	2.70^c	2.87^c	1.09^b	0.33^a
10	1.63^a	1.81^a	1.71^a	3.65^b
12	2.60^b	1.87^a	3.67^c	1.85^a
14	1.70^b	2.53^c	0.88^a	1.90^b
16	1.76^b	1.62^b	0.97^a	0.47^a
18	0.67^a	0.91^b	0.72^a	0.99^b

Table 3. Monthly mean values of water quality parameters recorded in different treatments during the experimental period

Parameters	Months	Treatment-A	Treatment-B	Treatment-C	Treatment-D
Temperature (^{0}C)	May	28.5	28.5	28.5	28.5
	June	29.5	29.5	29.5	29.5
	July	30.0	29.0	29.0	29.0
	August	30.0	29.5	29.5	30.0
	September	31.5	30.5	30.5	31.5
Dissolved oxygen (ml/L)	May	3.5	4.6	4.0	5.0
	June	3.6	4.2	4.1	4.1
	July	3.8	4.1	4.2	4.7
	August	3.6	4.1	4.9	4.1
	September	3.5	4.1	4.1	4.1
p^H	May	7.2	7.5	7.7	7.8
	June	7.1	7.6	7.4	7.7
	July	7.3	7.6	7.4	8.0
	August	7.1	7.4	7.5	7.6
	September	7.3	7.5	7.6	8.5

Food conversion ratio (FCR) and feed used

Feed conversion ratios were presented in Fig. 2. FCRs varied significantly among the treatments (ANOVA n= 4, $F(3,12) = 11.63$ and $P = 0.73 \times 10^{-3}$). The highest FCR (1.65 ± 0.07) was found in the fish in treatment A followed by treatment C and there were no difference in FCR of the fish from treatments B and D. Individual mean fish weight (g) and feed used per fish (g) for various treatments are presented in Fig. 3. Although the FCRs obtained from treatments B and D were not significantly different, final production from treatment B was much higher that treatment D. Production from treatment C was in the third position, however FCR in this treatment was much higher than That found in treatment D. Therefore, comparative production cost was highest in this treatment. The highest FCR found in control treatment where fish were fed twice a day regularly proved that lot of feed wastage in this treatment. Unfortunately this is the common practice in fish culture all over the country. It needed approximately 50% more feed in case control treatment than the feed needed in alternate day feeding (treatment B) to produce almost same amount of fish. As feed is the most expensive item in rural aquaculture, all concerned people should think twice about following the commonly practiced two or three times feeding a day.

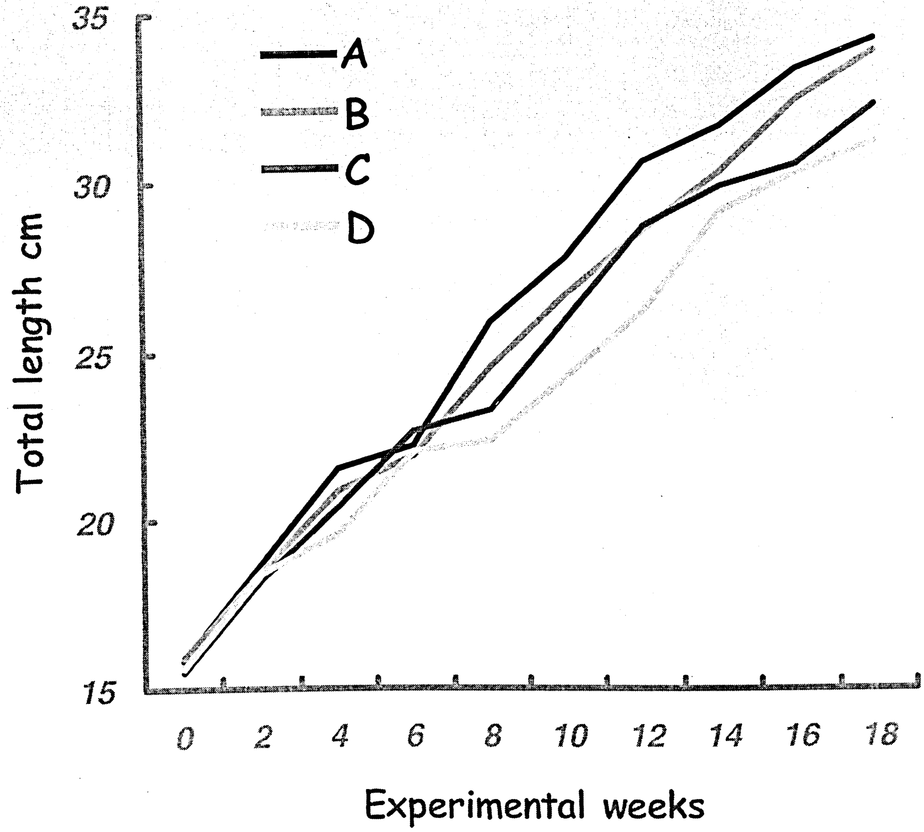

Fig. 1. Mean total length cm of Thai pangas P. hypophthalmus in four treatments over the experimental period

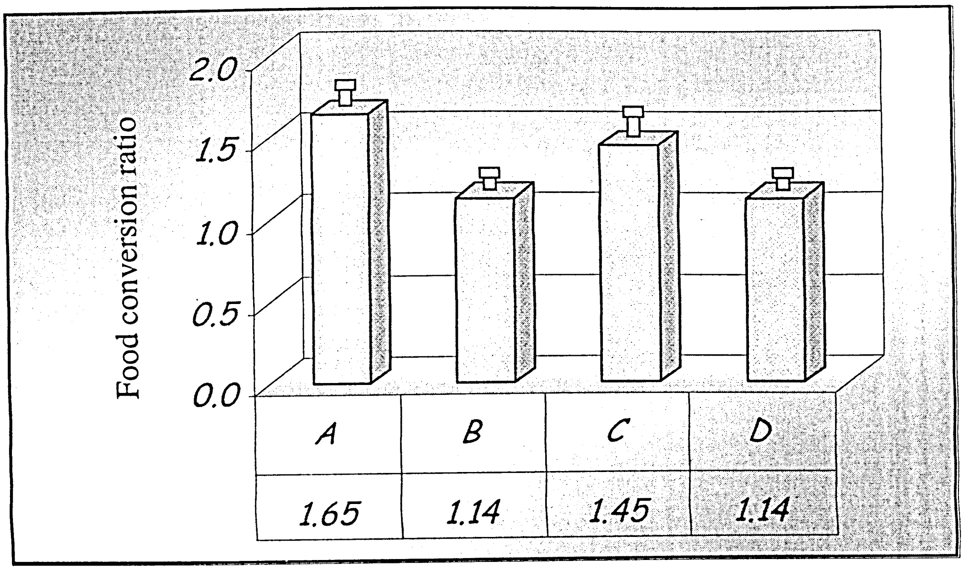

Fig. 2. Feed conversion ratios in four treatments over the experimental period

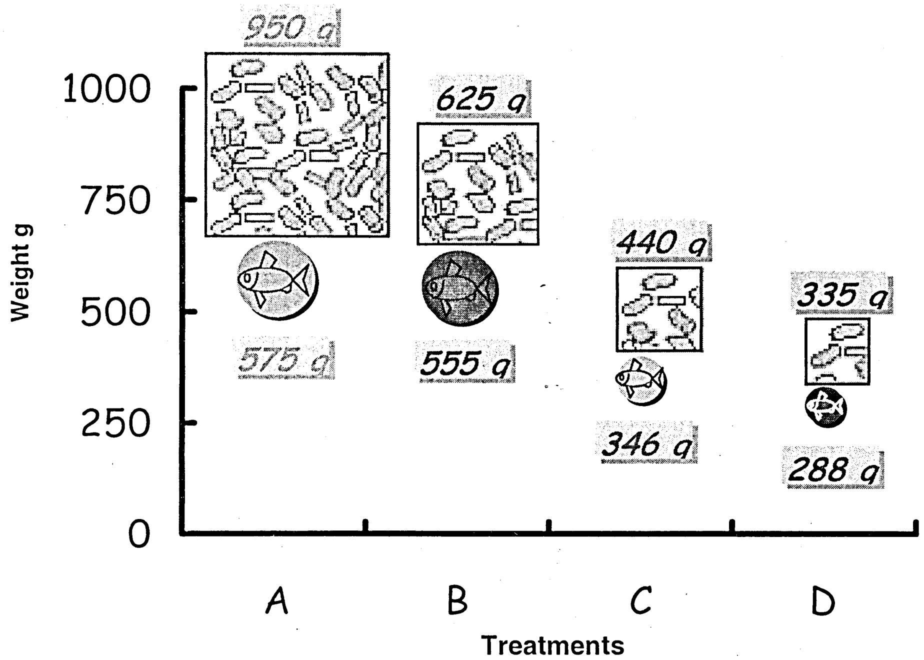

Fig. 3. Individual mean fish weight (g) and feed used per fish (g) under four treatments

Proximate composition

Mean protein content (% dry weight) in fish from different treatments were not significantly different over the experimental period (Fig. 4). It, however, decreased with time in all the treatments. Mean lipid contents (% dry weight) for whole body mass are presented in Fig. 5. During the stocking of fish, lipid contents were not significantly different. However, from week 2 fish in treatment D had the lowest lipid level until the end of the experiment. Lipid content in fish from treatment A and B were similar all over the experimental period. While the differences in body composition in Thai pangas in this experiment may be slight as a result of short exposure in controlled conditions, they may become more obvious and possibly more deadly for populations that are exposed repeatedly to extended periods of food deprivation coupled with uncontrollable and complex natural condition. Fish have developed an impressive ability to withstand long periods of starvation during which they mobilise their body reserves to stay alive (Paul *et. al.*, 1995). Visceral fat is obviously a readily utilized tissue during either low rationed period or short/long term starvation. Under a starved condition, in general, fish use reserved lipid and glycogen. For example Weatherley and Gill (1981) found that starved rainbow trout *Salmo gairdneri* lose visceral fat in a reversible way. Jobling (1980) also reported that body fat was the major storage utilized during the starvation in plaice *P. platessa*. Wall and Crivello (1999) reported that starved winter flounder has significantly lower level of glycogen compared to the fed conspecifics. Therefore under starvation Thai pangas juveniles have to utilize their reserved lipid. Unlike lipid, protein level did not show drastic decrease during the metamorphosis. This indicates that structural body musculature is conserved during the energetically challenging starvation period in favour of using lipid reserves.

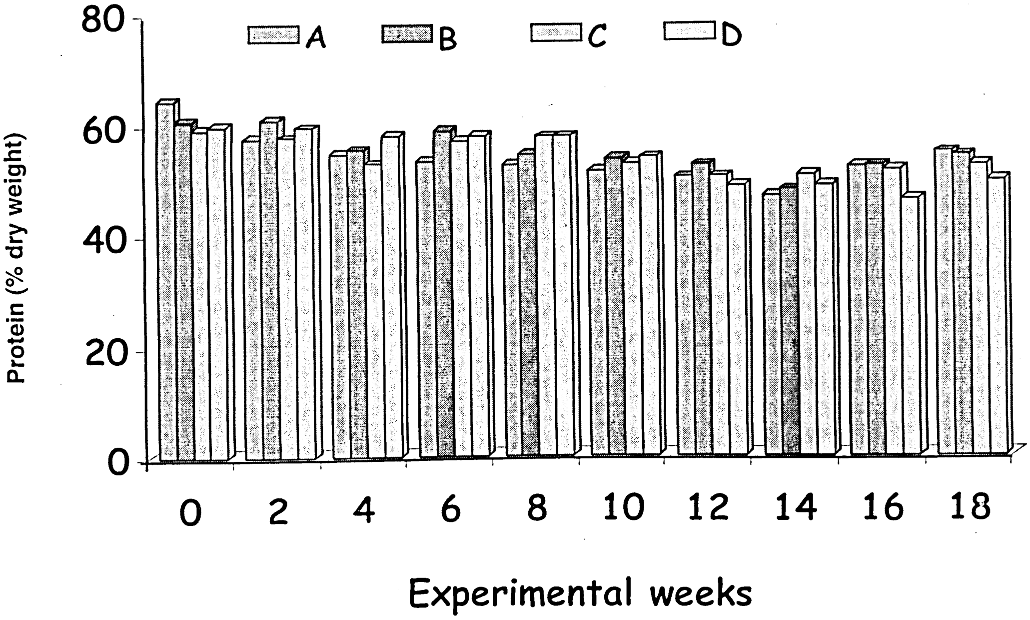

Fig. 4. Mean protein content (% dry body weight) in of *P. hypophthalmus* in four treatments over the experimental period

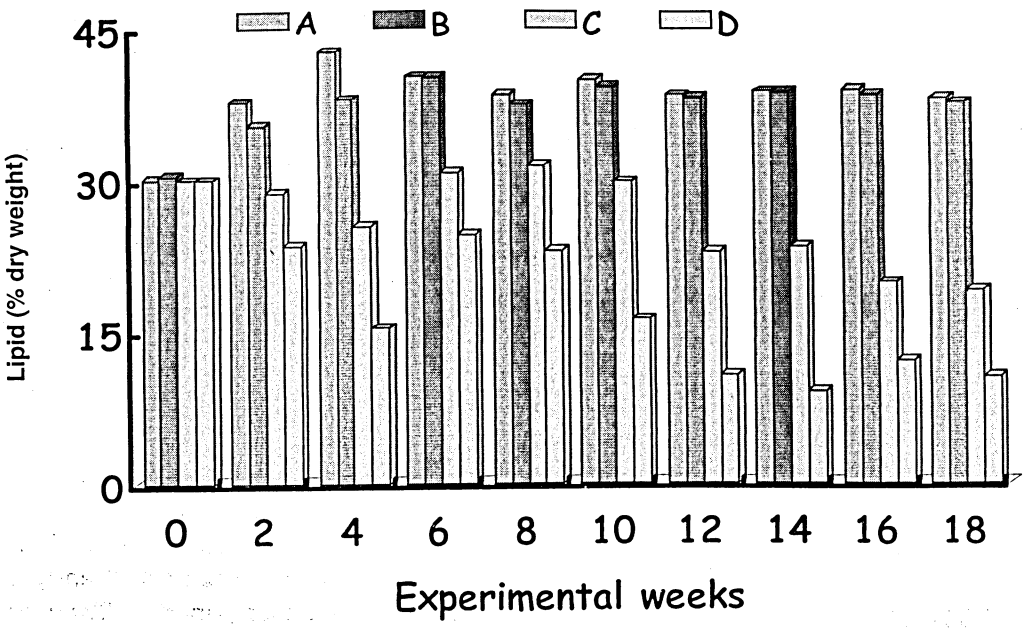

Fig. 5. Mean lipid content (% dry body weight) in of *P. hypophthalmus* in four treatments over the experimental period

Water parameters

Water temperature of pond water under four treatments was found to be more or less similar. The values of dissolved oxygen was found to be range from 3.5 to 3.8 mg/L., 4.1 to 4.6 mg/L, 4 to 4.9 mg/L and 4.5 to 5.0 mg/l for the Treatment A, B, C, and D respectively. P^H values were found to be fluctuated from 7.1 to 7.3, 7.4 to 7.6, 7.4 to 7.7 and 7.6 to 8.5 for Treatment A, B, C and D respectively. Monthly mean values of water temperature, dissolved oxygen level and P^H level of the experimental ponds are shown in the Table 3. Culture of fish and other aquatic animals of commercially importance depend almost completely on the water quality. The ranges of water temperature in this study were 28.5 to 31.5^{0}C. The present findings agree with the findings of Mollah and Haque (1987), Wahab *et. al.*(1995), Kohinoor *et. al.* (1998). Dissolved oxygen level in this study, in the Treatment A was completely lower than the others. It may be due to more decomposition of supplied feed. This study has shown comparatively lower P^H level in the Treatment A (Saturated feeding twice in a day) than the others which may be due to more carbon oxide gas production through higher decomposition of organic feed.

The result of the study showed that the total feed demand of fish in control treatment was, however, more than the fish in other three treatments. Nonetheless, at the end of the experiment, fish that were fed to satiation on alternative day (1:1) had similar body weights to the controls, and were larger than those exposed to 2 or 4 days of feed deprivation (2:2 or 4:4). There was no significant difference in specific growth rate of fish in A and B over the experimental period. The lowest FCR was found in Treatment B at which fish were fed to satiation level in alternative day, whereas the highest FCR was found in Treatment A (control) where fish were fed to satiation twice a day. Over the experimental period relative gains in lipid in different tissues were highest in fish from Treatment A and Treatment B and lowest lipid was found in fish from Treatment D.

The study provided evidence that Thai pangas could be cultured in feeding regime with feeding in alternate day without any significant difference in fish size and final production. This way *P. hypophtahlmus* farmers can save feed cost up to 30%. As the farmers give less feed in this system they can control water quality in a better way. In addition, this type of feeding (feeding in every alternate day) regime also helps culturist to improve their personal time management since they do not need to attend the fish everyday. In a field situation farmers also can have another advantage in alternate day feeding-they have to attend the fish *i.e.*, go to ponds not everyday but every alternative day. Therefore, they can manage their time in a more efficient way. By considering all these aspects, it can be concluded that feeding in every alternate day is a sustainable technique for Thai pangas culture.

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