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EFFECTS OF DIFFERENT LEVELS OF DIETARY PROTEIN ON GROWTH PERFORMANCE OF STUNTED FINGERLINGS OF INDIAN MAJOR CARPS

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ABSTRACT
The growth performance of stunted fingerlings of three Indian major carps for a period of 90 days was studied. A total of 288 nos. of stunted fingerlings were divided into four groups of 72 nos. of fingerlings in each group. Each group was further sub divided into three replicates having 24 nos. of stunted fingerlings. Four different diets prepared with conventional feed ingredients having different levels of protein (30, 24, 36 and 42%) were fed to the four different groups (T_c, T_1, T_2 and T_3) taking 30% protein level as a reference diet. The best growth of fish was recorded in treatment group T_2 (36% CP). The initial weight of the fishes in T_2 was 47.34 ± 1.13 g which at the end of the study period it attained a weight of 353.83 ± 10.33 g. The FCR and SGR were significantly higher in T_2 (2.18 and 2.23 respectively) group fed with diet containing 36% crude protein than T_1 and T_3. However, PER was better in treatment group T_1 (1.70). These findings suggest that diet containing 36% crude protein appears to be sufficient for obtaining optimum growth of IMC in unmanured pond condition.

INTRODUCTION

In the recent years, encouraging result has been reported from grow out culture of stunted fingerlings and are produced to make stocking material available throughout the year (Ramaswamy *et al.,* 2013). The agro climatic zone like Assam, fish culture is monsoon depended and as such when winter period ceases and climate become warm, no fresh seed are available for stocking those pond where water is available. In such situation the stunted fingerlings are the only option to stock such fish ponds. Therefore, to produce stunted fingerlings advance fry or fingerlings are stocked at higher densities with suboptimal feeding and fertilization, rendering the fish to stressful conditions. In shorter cultures period, stunted fingerlings showed improved performance in terms of growth and survival than normal fingerlings when stocked in grow out ponds with optimal conditions (Nandeesha *et al.,* 1994). The concept of stunted fingerlings can be well implemented in the context of short duration fish culture practice. Short duration fish culture is widely practiced in seasonal ponds which can hold water at least 6-7 month. The agro climatic condition of Assam is highly flood prone and characterized by severe hazard of floods. In Assam, the problems of flood normally occurs in the month of July and August, although in some years flood have been reported in early June or in the end of September. Therefore, in such condition the month of February to May can be considered as the best period for culture of fish in flood prone areas because of lesser risk of flood and the optimum temperature availability and hence this study was carried out during that period. In order to grow and survive, fish required adequate nutritionally rich diet in culture operation and supplementary feed can be considered as a nutritionally balanced diet because it plays an important role in achieving higher production. Fish production can go up to ten times through supplementary feeding in culture system. As the protein is the most important factor affecting growth performance of fish, therefore it is necessary to study the effects of low as well as high protein diets on the growth of fish. In aquaculture, diet is the largest operating cost item and incurred over 50% of the total operating costs in intensive aquaculture (El-Sayed, 2004) and protein is the most expensive component in the diet.

Thus, considering the aforesaid facts, the present study aimed to find out the nutritionally balanced diet with optimum protein requirement for growing of stunted fingerlings to table size fish since the growth and survival of stunted fingerlings are dependent on the level of protein in the diet.

MATERIALS AND METHODS

The experiment was carried out for a period of 90 days in 12 cement cisterns having the size of 6 m × 4 m × 1.25 m during February to May 2015 in College of Fisheries, Assam Agricultural University. The cisterns were cleaned and dried under sunlight. The cisterns were filled with pond water through pumping. All the cisterns were initially filled with water

up to a level of 1m and the level was maintained throughout the experimental period. To disinfect the cisterns and to stabilize the pH of water, liming was done with CaO @ 400 kg/ha. The cisterns were stocked with stunted fingerlings of *Catla catla* (catla), *Labeo rohita* (rohu) and *Cirrhinus mrigala* (mrigal) at the ratio of 3:4:3 and stocking density of 10,000 nos./ha. 288 nos. of stunted fingerlings *i.e. Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* were randomly selected from the fish farm of College of Fisheries, AAU, Raha, Nagaon. All the fishes were equally distributed into four treatment groups *viz*. Tc T_1, T_2, and T_3 with three replicates in each groups having 24 numbers of fingerlings in the ratio of 3:4:3. This study was carried out using formulated diet with four different dietary protein levels *viz*. D_c (30% CP), D_1 (24% CP), D_2 (36% CP), and D_3 (42%) as shown in Table-3.1. The initial weight and length of the stunted fingerlings were recorded individually. The cisterns were covered with a net to prevent the escape of fingerlings from the cistern. Reduction of water in cisterns was periodically compensated and partial water exchange was done to control the growth of algal blooms.

Sampling of fish

Sampling of fish was done to measure the growth of the fishes in different treatment groups. At least 50% of the stocked fish in each tank was caught for measuring the length and body weight in every sampling. After sampling, the fishes were returned to the appropriate tank. Individual fingerlings of each groups of different species weighed in Avery Balance having capacity of 1 kg with 1 g in each fraction and the length of the experimental fishes was measured with an ordinary scale. The body weight of each fingerling were recorded initially than at 15 days interval till 90 days. The tanks were drained out at the end of the experiment to collect the entire fishes and to record the individual weight and length of each fish, as well as number of survivors. The length of the fish was measured in centimeter and weight was taken in grams.

Growth parameters

The growth parameters of the experimental fish *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* were assessed by taking the body weight and length. The growth parameters in respect of weight gain (g) were calculated following the formula of Rahman *et al*. (2012) and specific growth rate (SGR), feed conversion ratio (FCR) and protein efficiency ratio (PER) were calculated using the method given by Sveier *et al*. (2000). The growth parameters were estimated using the following formulae,

Weight gain (g)

$$\text{Weight gain(g)} = \text{Final weight of fish} - \text{Intial weight of fish}$$

Specific growth rate (SGR %):

$$\text{Specific growth rate(\%)} = \frac{\text{In W2} - \text{In W1}}{T} X100$$

Where,

W_1 = Initial weight of fish

W_2 = Final weight of fish

T = Number of days in the feeding period

Feed Conversion Ratio (FCR)

$$\text{Feed conversion ratio} = \frac{\text{Feed intake}}{\text{Weight gain}}$$

Protein Efficiency Ratio (PER)

$$\text{Protein Efficiency ratio} = \frac{\text{Weight gain}}{\text{Protein intake}}$$

Composition of experimental diets

Four diets were prepared with conventional feed ingredients namely, rice polish, wheat flour, mustard oil cake, ground nut oil cake, fish meal, soybean meal and vegetable oil with different proportions. The mineral mixture and vitamin were added @1% as shown in Table - 1. Different ingredients were adjusted in such a way that percentage of protein of each diets i.e D_c, D_1, D_2 and D_3 were 30, 24, 36 and 42% respectively. The level of protein percent in control diet in the present investigation has been chosen according to Renukaradhya and Varghese (1986) i.e 30%. The stipulated levels of protein in experimental diets were 20% below (T_1), 20% (T_2), and 40% (T_3) above than the control.

The data obtained from experimental groups were subjected to one way Analysis of variance to determine the level of significance. The level of significance was set at $P < 0.05$. The MSTAT C statistical package was used for statistical analysis. One way ANOVA was used to test the effect of different level of protein in each treatment on growth performance of stunted fingerlings of Indian major carps. This was followed by Duncan's New Multiple Range Test (DNMRT), Duncan (1995) at 5% level of significance to observe the difference among the treatment mean.

RESULTS AND DISCUSSION

Growth performance of stunted fingerlings of Indian major carps with different protein levels has been studied in this experiment.

Growth performance of fish

In the present study, the higher growth rates of catla, rohu and mrigal were obtained when fish were fed with diet containing 36% crude protein level than the other level, while lowest with diet containing 24% crude protein. Average values of changes in body weight at 15 days interval of different groups of fish in the present experiment are presented in Table - 2. The average initial weights in different groups were 47.99 ± 1.18 g, 47.24 ± 1.11 g, 47.34 ± 1.13 g and 47.70 ± 1.15 g in group T_c, T_1, T_2 and T_3 respectively. The growth of the fish in all the groups increases with increase in age. At the end of the experiment of 90 days, fish fed with diet D_c (30% CP), D_1 (24% CP), D_2 (36% CP) and D_3 (42% CP) attained weights of 315.92 ± 10.59 g, 277.65 ± 9.68 g, 353.83 ± 10.33 g and 282.00 ± 9.99 g in group T_c, T_1, T_2 and T_3 respectively. There is a significant difference between the days and treatments and their interactions ($p < 0.05$). Higher growth of fish was observed in treatment group T_2 where fish fed with diet containing 36% crude protein followed by T_c, T_3 and T_1. These findings showed that 36% crude protein level was suitable for stunted fingerlings of Indian major carps in polyculture system. Nandeesha *et al*. (2002) reported that 25% protein and 37%

Table 1: Proximate composition of the experimental diets

Composition (%)	Control (D_c)	Diet 1 (D_1)	Diet 2 (D_2)	Diet 3 (D_3)
Dry matter	93.33	94.47	93.19	91.47
Organic matter	89.32	91.63	86.84	85.15
Crude protein	30.69	24.35	36.25	42.76
Ether extract	5.24	6.22	4.87	3.68
Crude fibre	14.30	12.02	9.37	9.41
Nitrogen free extract	39.09	49.04	36.00	29.37
Ash	10.69	8.37	13.53	14.86
Acid insoluble ash	1.27	0.94	1.49	1.95

Table 2: Changes in body weight recorded at 15 days interval during the experiment

Experimental period in days							
0 days (g)		15 days (g)	30 days (g)	45 days (g)	60 days (g)	75 days (g)	90 days (g)
T_c	47.99 ± 1.18	69.69 ± 1.13	91.29 ± 2.02	140.41 ± 4.71	191.34 ± 6.62	244.17 ± 8.18	315.92 ± 10.59
T_1	47.24 ± 1.11	61.59 ± 1.45	82.86 ± 1.98	116.49 ± 3.11	163.46 ± 4.74	208.46 ± 6.96	277.65 ± 9.68
T_2	47.34 ± 1.13	74.58 ± 1.12	104.86 ± 2.67	166.63 ± 5.56	219.63 ± 6.64	279.25 ± 8.47	353.83 ± 10.33
T_3	47.70 ± 1.15	62.35 ± 1.47	83.99 ± 2.21	119.13 ± 3.37	167.40 ± 5.02	213.82 ± 7.14	282.00 ± 9.99

SEm for Treatment means (T) : 0.1580 ; CD5% : 0.44 ;SEm for Days means (D) : 0.2090 CD5% : 0.58;SEm for TxD means : 0.4180 CD5% : 1.16

Table 3: SGR, FCR and PER of catla, rohu and mrigal in different treatment groups

Treatment	Catla			Rohu			Mrigal		
	SGR (%)	FCR	PER	SGR (%)	FCR	PER	SGR (%)	FCR	PER
T_c	2.09 (8.32)	2.34 (8.80)	1.54 (7.12)	2.14 (8.41)	2.29 (8.70)	1.53 (7.11)	2.01 (8.15)	2.47 (9.04)	1.45 (6.91)
T_1	1.99 (8.11)	2.36 (8.83)	1.73 (7.57)	2.01 (8.15)	2.37 (8.86)	1.90 (7.91)	1.88 (7.87)	2.60 (9.29)	1.62 (7.32)
T_2	2.36 (8.83)	2.18 (8.50)	1.36 (6.71)	2.28 (8.68)	2.18 (8.50)	1.38 (6.74)	2.18 (8.49)	2.46 (9.02)	1.33 (6.64)
T_3	1.99 (8.10	2.38 (8.88)	1.07 (5.93)	2.02 (8.17)	2.35 (8.81)	1.07 (5.95)	1.88 (7.88)	2.60 (9.27)	1.30 (6.44)
SEm (±)	0.10	0.03	0.05	0.01	0.03	0.14	0.01	0.02	0.40
CD5%	0.33	0.10	0.16	0.03	0.10	0.45	0.03	0.06	1.30

Note: Value within the parenthesis indicates angular value.

carbohydrate were the optimum requirements in natural feed for stunted yearlings of Indian major carps. Swamy *et al*. (2004) reported good growth performance in stunted fingerlings of rohu and mrigal fed with diet containing 25% dietary protein level reared in manured pond. Ramaswamy *et al*. (2013) studied on protein requirement of stunted fingerlings of catla in manured ponds and the results indicated that fingerlings fed with diet containing 25% protein showed better growth performance in terms of growth parameters. The higher body weight gain in all the species at treatment group T_2 fed with diet containing 36% crude protein may be the level of protein that is optimum for this three species. However, the decreased growth rate in higher level of protein in T_3 (42%) might be due to reduction in dietary energy available for growth and due to excretion of excess absorbed amino acid (Jauncey 1981). Thus, it appears that the highest changes in body weight was observed in treatment group T_2 (36% CP) and the lowest in T_1 (24% CP).

Specific growth rate (SGR)

Specific growth rate was calculated and the average SGR of Indian major carps was 2.10, 1.97, 2.23 and 1.98% in treatment group T_c, T_1, T_2 and T_3 respectively. Average specific growth rate (SGR) for different groups of fish are presented in Table 3. The specific growth rate was found to be highest in treatment group T_2 (2.23%) where fish fed with diet containing 36% crude protein, which was significant than other groups and lowest in T_1 (1.97%) where fish fed with diet containing 24% crude protein. The SGR of catla, rohu and mrigal were showed significantly ($p < 0.05$) higher in T_2 i.e. 2.36, 2.28 and 2.18% respectively followed by T_c, T_3 and the lowest in treatment group T_1 as shown in Table 3. Whereas, Kumar *et al*. (2011) found significantly ($p < 0.05$) higher specific growth rate of stunted fingerlings of *Labeo rohita* fed with diet containing 25% protein level in manured pond. Ramaswamy *et al*. (2013) observed highest specific growth rate in stunted fingerlings of catla with 25% protein level in diet in the presence of natural food.

Feed conversion ratio (FCR)

In the present study, the feed conversion ratio in catla, rohu and mrigal showed better in treatment group T_2 (36%) i.e 2.18, 2.18 and 2.46 than the other groups respectively where fish were fed with diet containing 36% crude protein, while the poorest FCR was obtained at 24% crude protein level. FCR increased with increasing weight of fish and decreased with increasing dietary protein. Singh *et al* .(2005) found that *Labeo rohita* showed better FCR fed with diet containing 30% protein level (1.89). The FCR of catla fingerlings calculated by Dars *et al*. (2010) was 3.90 when fed with diet containing 35% protein level. However, Parveen and Sheri (1994) found IMC showed better FCR with diet containing 40% crude protein. Feed conversion ratios of different treatment groups were calculated and are shown in Table- 3. Overall feed conversion ratios were calculated as 2.29, 2.40, 2.18 and 2.39 in treatment group T_c, T_1, T_2 and T_3 respectively. All the species showed significantly ($p < 0.05$) better feed conversion ratio with 36% crude protein level.

Protein efficiency ratio (PER)

In the present study, the lowest values of protein efficiency ratio (PER) was observed in treatment group T_3 (42% CP) followed by T_2 (36% CP) and T_c (30% CP) and highest in T_1 (24% CP). The protein efficiency ratio (PER) of IMC were 1.48, 1.7, 1.33 and 1.01 in different treatment groups T_c, T_1, T_2 and T_3 respectively. The highest value of PER of the fingerlings was obtained from treatment group T_1 (1.70) where fish were fed with diet containing 24% crude protein level followed by T_c (1.48) and T_2 (1.33), while lowest was recorded in T_3 (1.01). All the three species i.e. catla, rohu and mrigal showed significantly ($P<0.05$) higher PER with 24% crude protein level and lowest with 42% crude protein level (Table - 3). This observation coincides with the results of Ahmad *et al*. (2004) and Kumar *et al*. (2011) which may be due to the fact that major part of the weight gain is related to the deposition of protein and the protein accretion is a balance between protein anabolism and catabolism. Further, gastric emptying rate or solubility of the protein has been shown to affect the utilization of dietary protein (Niwas *et al*., 2013, Nalawade *et al.,* 2011, Higuera *et al.,* 1998; Espe *et al.,* 1997).

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