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EFFECTS OF CRUDE PROTEIN DIETS FROM FISH MEAL ON GROWTH PERFORMANCE IN PACU, *Piaractus brachypomus* (Cuvier 1818)

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ABSTRACT
In the present investigation, attempts have been made to find out the protein requirement of Pacu juveniles for better growth and survival. Three treatments were carried out in experiments and the diets were prepared from the fish meal with 25, 30 and 35% of crude protein. The control diet was maintained with the mixtures of rice bran, groundnut oil cake enriched with vitamin and mineral supplements. The experimental animals were fed at a rate of 5.0% of their total biomass under each treatment for 90 days. The Pacu juveniles fed with different protein treatments showed the average gain in weight, at the end of 30 days, 60 days and 90 days of experimentation were recorded respectively. A significant difference in terms of increment in weight gained was observed in the diet containing 35% protein. The study concluded that fish meal is a suitable substitute from shrimp waste meal for incorporation in the diet of Pacu juveniles.

KEYWORDS*:* *Piaractus brachypomus*, fish meal, protein requirement, increment in weight.

INTRODUCTION

Pacu is an exotic fish species from Amazon River of South America and commonly known as Red Pomfret or Pacu or Rupchandi[1]. Pacu has several advantages for its inclusion under fresh water aquaculture system to boost the fresh water fish production of the country[2-3]. The culture of Pacu is slowly gaining importance these days because of their high survival rate, better food conversion efficiency, faster growth rate, better flesh conversion percentages, better market demand and greater consumer preference [3]. The basic purposes of introduction of these species to the culture ponds were due to their faster growth rate in a very short duration, immediate return to meet the local market demand. The present study was conducted to evaluate the protein requirement for *P. brachypomus* under laboratory conditions with supplemental feeds comprising of fish meal as main sources of protein.

MATERIALS AND METHODS

The experiments were conducted for a period of 90 days to study the growth performance of the fingerlings of *P. brachypomus* under laboratory conditions with supplemental feeds comprising of fish meal as main sources of protein.

Experimental diets

Three experimental diets were prepared from locally available different feed ingredients like fish meal, ground nut oil cake, rice bran, corn flour, vegetable oil, vitamin and mineral premix were procured and pelleted feeds were formulated after following the standard procedures varying the protein levels [4].

Preparation of the Experimental diet

The feed ingredients were procured and dried properly before preparation of the experimental diet. The quantity of individual ingredients required to formulate a kg of diet was worked out using Pearson's square method to balance protein and energy levels. All the weighed ingredients were mixed thoroughly in a pulveriser and oil was added to the dry ingredients. Subsequently all the ingredients were hand mixed to ensure homogenous mixing followed by addition of required quantity of boiled water and hand needed to form dough. The dough thus prepared was sterilized in an autoclave at 121 PSI for 15 mins. Sterilized dough then cooled under room temperature. After proper cooling, required quantity of weighed vitamin and mineral premix was added, mixed properly by hand kneading to prevent immobilization of vitamin and mineral premix, which were further palletized by using a hand pelletizer to form experimental feed pellets. The pellets thus formed were oven dried at 100^0C. Finally, the dried pellets were powdered to approximate sizes before feeding to the experimental animals.

Proximate composition

The proximate composition of six experimental diets and one control were analyzed following the procedures recommended by **AOAC** (1975)[5].

Growth studies

The growth rates in term of percentage weight gain, daily weight gain (gm), percentage specific growth rate, food conversion ratio (FCR), protein efficiency ratio were calculated by following the standard procedures which are as follows:

$$\text{Percentage weight gain} = \frac{\text{Final weight of fish} - \text{Initial weight of fish}}{\text{Initial weight of fish}} \times 100$$

$$\text{Daily weight gain (g)} = \frac{\text{Final weight of fish} - \text{Initial weight of fish}}{\text{Total no. of experimental days}}$$

$$\text{Percentage of specific growth rate} = \frac{(\log_e \text{ Final body weight} - \log_e \text{ Initial body weight}}{\text{Total no. of experimental days}} x100$$

$$\text{Food conversion ratio} = \frac{\text{Total dry food intake(g)}}{\text{Total live weight gain(g)}}$$

$$\text{Protein efficiency ratio} = \frac{\text{Total weight gain (g)}}{\text{Total protein intake (g)}}$$

$$\text{Feed efficiency ratio} = \frac{\text{Total weight gain (g)}}{\text{Total protein intake (g)}}$$

Test animals

Fingerlings of Pacu were procured from a private fish seed rearing unit and brought to the laboratory under oxygen packing. Fingerlings were acclimatized under laboratory conditions in FRP tanks of 300 liter capacity for a period of 4 to 5 days with supplemental diet and daily water exchange to eliminate the weaker ones prior to starting up of the present investigation.

Test containers

The present investigation was carried out in glass aquaria of 40liter capacity in the Aquaculture laboratory of the college. All the treatments were conducted in triplicates with a control to avoid experimental error. Each tank is stocked with 10 numbers of 30 days old fingerlings for the experimental purpose with more or less similar body weight and length.

Water exchange and aeration

Daily 30% of the total volume of water from each glass aquaria was exchanged to remove the accumulated faecal matter from the experimental containers with replenishment of filtered, aged and well aerated water. Continuous uninterrupted aeration facilities were provided to each of the experimental container for maintenance of good water quality.

Feeding schedule

The test animals in each treatment tank were fed with the formulated feed specially developed for this set of investigation at 5% of their body weight during morning and evening hours. The feed quantity was readjusted based on average bodyweight gain recorded at fortnightly intervals.

Water quality Parameters

Water quality parameters like pH, temperature, dissolved oxygen, alkalinity were measured from each of the experimental containers at fortnightly intervals by following the standard procedures (APHA, 1985)[6].

RESULTS AND DISCUSSION

The ingredient proportion in experimental diet with fish meal as protein source and proximate composition of fish meal formulated in experimental diet used in assessment of growth performance of *Piaractus brachypomus* juveniles under laboratory condition is depicted in Table 1 and 2.

TABLE 1. Ingredient proportion in experimental diet

Source of Ingredient (%)	Experimental diets			
	T_0	T_1	T_2	T_3
Rice bran	47.50	60.00	52.00	48.00
Groundnut oil cake	47.50	16.00	20.00	22.00
Fishmeal	-	16.00	20.00	22.00
Corn flour	04.00	04.00	04.00	04.00
Vegetable oil	-	03.00	03.00	03.00
Vitamin mineral premix.	01.00	01.00	01.00	01.00

TABLE 2. Proximate composition of fish meal formulated in experimental diet

Proximate composition	Experimental diets			
	T_0	T_1	T_2	T_3
Moisture	10.00	8.50	8.50	8.50
Crude Protein	15.25	25.40	30.50	35.25
Crude Fat	6.38	7.37	7.78	6.10
Total Ash	18.80	14.80	12.40	10.92
Crude Fibre	38.40	14.00	14.20	12.62

The growth performance of *Piaractus brachypomus* juveniles under laboratory condition fed with supplemental diet with varied levels of crude protein from fish meal is illustrated in Table 3 and 4. The Pacu juveniles in T_0 fed with the basal diet containing as the mixture of rice bran and oil cake. The average initial weight of Pacu juveniles under control (T_0) was 5.57 ± 0.08 g. The average weight increased in T_0 varied from 5.57 ±0.08 g to 5.89 ±0.16 g within 30 days; 5.89 ±0.16 g to 7.16 ±0.11 g within 60 days and 7.61 ±0.11 g 7.96 ± 0.28 g within 90 days. Along with the increment in weight, a simultaneous increment in length from 4.25 ±0.24 cm to 7.52 ±0.31 cm was recorded for the control group of fishes within 90 days (Table 3 and 4).

In contrast to the control group, Pacu juvenile fed with different levels of crude protein in the diet exhibited a

different trend in their growth patterns. The average initial weight of Pacu juvenile in T_1 at the initiation of experiment was 5.86 ± 0.008 g. The Pacu juveniles in T_1 fed with the diet containing 25% crude protein from fish meal exhibited average weight gain of 6.89 ± 0.17 g, 7.93 ± 0.15 g and 9.81 ± 0.37g after a lapse of 30 days, 60 days and 90 days respectively (Table 3). The size in terms of increment in length was increased initially from 4.48 ± 0.25 cm to 7.71 ± 0.32 cm within the experimental period of 90 days **(**Table 4**).**

The Pacu juveniles in T_2 fed with 30 % crude protein from the fish meal. The average initial weight of Pacu juveniles under T_2 was 5.96 ±0.10 g. The average weight increased in T_2 varied from 10.81 ±0.11 g to 12.39 ±0.57 g after 60 days and 90 days respectively. There was also a simultaneous increment in length of Pacu from 4.51 ±0.20 cm to 8.60 ±0.24 cm with in a time gap of 90 days (Table 3 and 4).

The treatment (T_3) had 35% crude protein level with the source from fish meal. The average initial weight of Pacu juveniles at the time of initiation of the experiment was 6.20±0.15 g. Pacu juveniles in T_3 registered a significant increasing trend in weight gain from 10.55±0.33 g, 17.42±0.61 g and 25.09±0.60 g at the end of 30 days, 60 days and 90 days of experimentation respectively. The average initial length at the time of stocking was worked out to be 4.50±0.24 cm which was subsequently increased to 13.96±0.58 cm within an experimental period of 90 days (Table 4).

The least feed conversion ratio of 1.63±0.28 was reported for the treatment (T_3) where the crude protein content was 35%. The protein efficiency ratio ranged from 0.61±0.028 to 1.80±0.008. The highest value of protein efficiency ratio has been obtained from the control group of fishes containing low protein percentages from the source of fish meal. In all the three different treatments as well as control 100% survival rate was recorded.

The data was statistically analyzed with ANOVA/t-test for calculating significant fish growth rates.

TABLE 3. Growth performances of Pacu, *Piractus brachypomus* fed on fish meal with varying levels of crude protein

Duration / Treatment	Replications	Initial weight (g)	Average initial weight ± S. D.	Weight gained After 30 Days (g)	Average Weight ± S. D.	Weight gained After 60 Days (g)	Average Weight ± S. D.	Weight gained After 90 Days (g)	Average Weight ± S. D.
Control (Rice bran	R_1	5.50	5.57±	5.78	5.89±	7.65	7.61±	7.87	7.96±
+ Ground nut oil	R_2	5.55	0.08	5.81	0.16	7.70	0.11	8.28	0.28
cake)	R_3	5.66		6.08		7.48		7.73	
T_1 (Basal feed	R_1	5.79	5.86±	7.03	6.89±	8.05	7.93±	9.38	9.81±
with 25% crude	R_2	5.84	0.008	6.94	0.17	7.76	0.15	10.04	0.37
protein)	R_3	5.95		6.70		7.98		10.02	
T_2 (Basal feed	R_1	5.86	5.96±	7.73	7.78±	10.68	10.81±	12.34	12.39±
with 30% crude	R_2	5.96	0.10	7.76	0.06	10.86	0.11	11.85	0.57
protein)	R_3	6.07		7.85		10.89		12.99	
T_3 (Basal feed	R_1	6.15	6.20±	10.89	10.55±	16.76	17.42±	24.48	25.09±
with 35% crude	R_2	6.38	0.15	10.56	0.33	17.52	0.61	25.68	0.60
protein)	R_3	6.08		10.22		17.98		25.12	

TABLE 4. Growth parameters of Pacu, *Piaractus brachypomus* fed on supplementary feed prepared out of fish meal with varying level of crude protein

Growth Parameters	Diet			
	T_0	T_1	T_2	T_3
Fish meal crude protein	-	25%	30%	35%
No.of fish stocked/ container	10	10	10	10
Duration of the experiment	90 days	90 days	90 days	90 days
Initial length (cm)	4.25 ± 0.24	4.40 ± 0.25	4.51 ± 0.21	4.50 ± 0.24
Initial weight (g)	5.57 ± 0.08	5.86 ± 0.008	5.96 ± 0.10	6.20 ± 0.15
Final length (cm)	7.52 ± 0.31	7.71 ± 0.32	8.60 ± 0.24	13.96 ± 0.58
Final weight (g)	7.96 ± 0.28	9.81 ± 0.37	12.39 ± 0.57	25.09 ± 0.60
Increment in length	3.27 ± 0.19	3.31 ± 0.28	4.09 ± 0.22	9.46 ± 0.34
Increment in weight	2.39 ± 0.20	3.95 ± 0.18	6.43 ± 0.26	18.89 ± 0.30
Mean daily weight gain	0.026 ± 0.006	0.043 ± 0.08	0.071 ± 0.04	0.21 ± 0.06
Feed conversion ratio	2.87 ± 0.40	2.52 ± 0.80	2.37 ± 0.4	1.63 ± 0.28
Specific growth rate	0.39 ± 0.04	0.57 ± 0.02	0.81 ± 0.040	1.55 ± 0.16
Feed efficiency ratio	0.40 ± 0.001	0.42 ± 0.02	0.15 ± 0.02	0.10 ± 0.03
Protein efficiency ratio	1.80± 0.038	1.33 ± 0.024	0.72 ± 0.04	0.61 ± 0.028
Overall survival (%)	100 %	100 %	100 %	100 %
Percentage weight gain (%)	42.90 %	67.40 %	107.88 %	304.67 %

The main function of the protein in the diet is not only to facilitate the growth and maintenance of animal tissue but also helps extensively for providing energy in routine metabolism of the fish [7]. Hence, protein in the diet is considered as an essential nutrient for both maintenance and growth of the animal [8]. Fish diet primarily depends on animal proteins for which fish meal remains the important choice as protein source. Therefore, evaluation of alternate animal protein sources needs to be investigated for incorporation in the diet for Pacu [3]. The

quality of supplementary feed mainly depends on the quality and quantity of crude protein level in the diet [8].

According to NRC (1993)[9], the average protein requisites in diets for growth of the fish in the world aquaculture oscillate between 31 to 55%. The present study reveals that, the group of fishes fed with 35 % crude protein in the experimental diet registered an increasing trend in the growth in terms of increment in weight as well as length which is significantly different from the other group of fishes fed with 25 % and 30 % protein in diet. Walter, *et al.*, (2011) [10] attempted to study the optimum dietary crude protein requirement for juveniles of *Piaractus brachypomus* and his study indicated a gradual increment in weight up to 46.5 ± 5.0g with the feed provided containing 32 % crude protein. In contrast, the group of fishes fed with the diets containing crude protein levels beyond 36 % did not produced any significant additional growth. Similar observations were made in present experimental studies carried out in Pecu fish. Wilson (2002)[11] also reported that protein is the need for the growth of fish species and the growth decreases with the decrease of protein based feed.

In the investigation carried out, the differences in weight gain in relation to the crude protein levels in the diet is in agreement with the earlier studies conducted for different species of fishes [12-13]. In earlier studies it is reported that, 29.8 % protein in the diet is adequate for the better growth and survival of *P. Brachypomus* juveniles. The studies conducted on growth performances and body composition of Pacu to dietary protein and energy level reveals a dietary protein content of 26 to 30 % of crude protein in the diet is superlative for the growth of species which is similar to the results obtained [14-16]. In the present study, the maximum weight gain in the juveniles of *Piaractus brachypomus* was observed with 35 % of protein level from the source of fish meal which is in confirmation with the results of Gutierrez, (1996)[17].

CONCLUSION

The findings of present investigation indicated higher growth rate in Pacu juveniles fed with diet containing 35% fish meal crude protein. It is therefore felt that the feed formulated with fish meal protein would be suitable substitute from shrimp meal for successful fish farming.

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