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Growth and Feed Utilization Efficiency of *Osteobrama belangeri* Fed Diets Containing Different Levels of Protein

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Osteobrama belangeri (Valenciennes), having mean initial body weight of 5.44±0.01g were fed different pelleted diets containing, 20%, 25%, 30%, 40% and 50% crude protein. Fish meal was used as the source of protein. Growth performance and feed utilization efficiency of diets containing 30-40% protein were satisfactory. Best results were observed with diet containing 40% protein, with a daily average weight gain of 0.161 g. There was no improvement in the growth and carcass protein content of fishes fed 50% protein compared to the fish fed 40% protein. The increase in body weight was proportional to the protein content in diet.

Key words: Fish feed, protein utilization, growth, *Osteobrama belangeri*

Protein is the most expensive component in fish feed. Protein requirements of culturable Asian fishes like carp, tilapia, mullet and milk fish are in the range of 25-30%. Studies on protein requirements of carps have been undertaken by many workers using casein based synthetic diets (Ogino & Saito, 1970, Dabrowski, 1977; Sen *et al.*, 1978; Takeuchi *et al.*, 1979; Singh & Bhanot, 1988). There are also reports on the feeding experiments based on commercial diets (Das & Ray, 1991; Swamy & Mohanty, 1988 and Mohanty *et al.*, 1990) *Osteobrama belangeri* (Valenciennes) is a medium sized carp highly relished by the people of Manipur for its food value. Attempts are being made to culture this fish, which is vanishing from the water bodies of the state. In the present study, growth and dietary protein utilization of *O. belangeri* have been studied by feeding different diets containing different levels of crude protein, with fish meal as the protein source.

Materials and Methods

Five experimental diets were prepared containing 20, 25, 30, 40 and 50% crude protein, based on fish meal as the protein source (Table 1). Pelleted feeds were prepared, dried in oven and stored in air tight containers.

O. belangeri fry of average body weight of 5.44 g were procured from a fish farm. The fishes were acclimatized in a large plastic pool for one week. Ten fishes were distributed in each tank of 30 l capacity, which was connected to a recirculatory system. Each tank was aerated continuously. For each diet, duplicate tanks containing 10 fishes were used. The fishes were starved for 24 h prior to the feeding experiment. The fishes were weighed at the beginning, at every 5 day intervals and at the end of the experiment. All the fishes were fed at a fixed rate of 5.0% body weight per day. The quantity of feed supplied was adjusted according to the body weight. The experiments were continued for 30 days. Faeces were collected from the bottom of the aquaria, dried in an air oven at 105°C and kept in the refrigerator at 4°C, for later analysis.

Experimental diets and fish carcass were analyzed for their proximate composition i.e., moisture, crude protein, crude lipid and ash content (AOAC, 1960). Fibre contents of the feed ingredients and diets

were analyzed by acid based digestion method (AOAC, 1984). Gross energy content of diets was determined using a bomb calorimeter. Water quality parameters were monitored as per APHA (1981).

Protein efficiency ratio (PER) was calculated as described by Zeitoun *et al.* (1973). The maintenance nitrogen metabolism was calculated from the difference in the nitrogen content before and after the experiment with fish fed on a non-protein diet, plus the traces of nitrogen ingested with this diet. For this calculation, it was assumed that trace nitrogen in the non-nitrogen metabolism for *O. belangeri* amounted to 0.5001 mg N per g wet weight per day. The maintenance nitrogen metabolism was calculated according to Dabrowski (1977).

Daily weight gain, initial and final body nitrogen content for productive protein value (PPV), food conversion efficiency and protein efficiency ratio were calculated as follows:

Food conversion ratio (FCR) = Food intake, (dry weight, g) / Body weight gain (g)

Productive protein value (PPV) = Protein gain (g)/Protein intake (g)

Gross conversion efficiency = Growth (dry weight, g)/Feed intake (dry weight, g)

Statistical analysis of the results of feeding trial was made using analysis of variance (ANOVA). Duncan's multiple range test (Duncan, 1955) was used to evaluate the mean difference among individual diets at $p<0.05$ significant level.

Results and Discussion

During the experiment, there was no mortality of fish. The final weight gain of fish fed on the experimental diets is presented in Table 2 and the changes in weight gain during the experimental period is presented in Fig. 1. The weight gain of fishes increased with the increase of dietary protein level up

Table 1. Proportion of different components and proximate composition, pellet stability and energy content of the experimental diets

	Diet-1	Diet-2	Diet-3	Diet-4	Diet-5	Non-protein diet
Proportion ($g.100g^{-1}$) of different components						
Fish meal	20.00	27.00	40.00	55.00	70.00	–
Wheat flour	66.00	59.00	45.00	31.00	16.00	–
Groundnut oil (ml)	9.00	9.00	9.00	9.00	9.00	9.00
Mineral mixture	4.00	4.00	4.00	4.00	4.00	4.00
Vitamin mixture	1.00	1.00	1.00	1.00	1.00	1.00
Starch	–	–	–	–	–	36.00
Cellulose	–	–	–	–	–	30.00
Sucrose	–	–	–	–	–	20.00
Proximate composition ($g.100g^{-1}$)						
Moisture	3.80	4.60	4.62	4.72	4.78	5.85
Crude protein	20.79	24.80	32.60	41.60	50.60	–
Crude lipid	9.00	10.55	10.92	11.44	11.92	9.00
Crude fibre	1.52	1.60	1.43	0.93	0.78	–
Ash	12.22	12.02	11.24	12.24	13.40	9.80
NFE*	52.77	46.43	39.19	28.91	18.40	75.53
Pellet stability	88.12	88.80	82.40	80.20	74.30	
Gross Energy $kcal.100g^{-1}$	417.22	420.18	441.87	461.68	474.52	386.90

* NFE - nitrogen free extract

Table 2. Growth efficiency and feed utilization efficiency of *O. belangeri* fed different diets for 30 days

	Diet-1	Diet-2	Diet-3	Diet-4	Diet-5
Initial weight (g)	5.44[a]	5.45[a]	5.43[a]	5.44[a]	5.46[a]
Final weight (g)	7.61[a]	8.05[a]	9.76[b]	10.33[c]	9.76[b]
Daily weight increment (g/day)	0.07[a]	0.09[a]	0.14[b]	0.16[c]	0.14[b]
Specific growth rate (%)	1.32[a]	1.43[b]	2.65[b]	2.99[b]	2.62[b]
Food conversion ratio (FCR)	3.85[a]	2.98[a]	1.16[c]	1.09[d]	1.58[c]
Protein efficiency ratio (PER)	4.26[a]	3.84[b]	2.67[c]	2.20[d]	1.25[ac]
Gross conversion efficiency (%)	2.26[a]	0.37[a]	0.74[b]	0.92[c]	0.63[a]
Productive protein value (PPV)	0.28	2.29	4.20	8.31	2.58
Net protein utilization (NPU)	29.53	29.34	21.88	17.85	14.22

Figures with the same superscript do not differ significantly at $p<0.05$

to 40%. Good growth was observed in fish fed 30% and 40% protein diets. The percentage weight gain of the fishes fed different dietary levels was significantly different ($p<0.05$). However, there was decline in the weight gain at higher dietary protein beyond 40% in diet. The highest weight gain per day was obtained in fish fed diet containing 40% protein. The results show the high protein requirement of fish.

The best food conversion ratio (1.09), gross conversion efficiency (0.918) and productive protein value (8.305) were achieved at 40% dietary protein. The protein efficiency ratio (PER) increased with protein content of the diet, up to 40%, but declined thereafter. The Net Protein Utilization (NPU) values ranged between 14-30% (Table 2) and the relationship between NPU and the dietary protein level is presented in Fig. 2.

The carcass composition of fish fed on different experimental diets is presented in Table 3. Protein content of the body increased with increase in the dietary protein level and the difference between groups was statistically significant ($p<0.05$). Highest protein content was found in fish given diets containing 41.6% protein. Dabrowski (1977) had reported increase in both body protein and fat with the increase of protein level of the diet. Cowey *et al.* (1972) also has reported similar findings. However, protein content was lower in fish fed on diet containing 50% protein. There was no significant difference between groups in respect of lipid, ash and water contents of the muscle tissue.

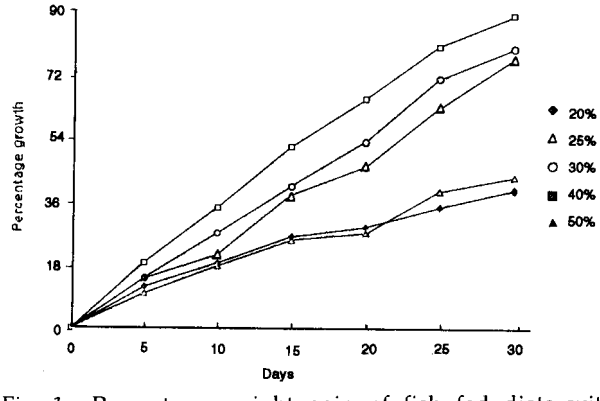

Fig. 1. Percentage weight gain of fish fed diets with different levels of protein

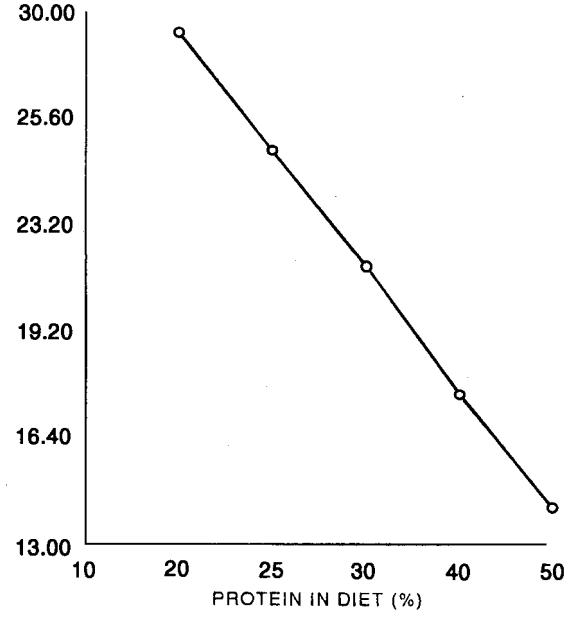

Fig. 2. Relationship between NPU and dietary protein level.

Table 3. Gross body composition of experimental fish at the beginning and end of the experiment (Values are expressed as % wet weight)

	Initial	Diet-1	Diet-2	Diet-3	Diet-4	Diet-5
Moisture	79.02±1.10	78.48[a]	78.27[a]	77.37[a]	76.50[a]	76.84[a]
Crude protein	12.15±0.31	13.81[a]	13.84[a]	14.01[b]	15.67[c]	14.22[d]
Crude lipid	2.50±0.01	2.80[a]	2.30[a]	2.43[a]	2.50[a]	2.32[a]
Ash	6.05±0.01	5.29[a]	5.01[a]	5.27[a]	5.28[a]	5.32[a]

Figures with the same superscript are not significant at $p<0.05$

At low protein diets (20-30%), the demand for protein is more for tissue building and repair and nitrogen metabolism, while in higher protein diet (50% crude protein), excess of protein is catabolised to provide energy for growth, thus depressing the protein conversion efficiency (Lee & Putnam, 1973). The negative effect of higher dietary protein levels on growth was also observed in plaice (Cowey *et al.*, 1972). Similar results were obtained in the present investigation also where the growth rate of *O. belangeri* came down at 50% dietary protein.

It has been established that a reduction of dietary energy utilization for normal growth may occur due to extra energy expenditure toward deamination and excretion of excess amounts of amino acids. Various authors have stated that essential amino acids supplied in excess of the optimum requirement may not necessarily enhance protein utilization of fish (Halver, 1957; Mertz, 1972). The optimum growth of fish is attained only if the diets contain sufficient nutrients in proper ratio (Cowey & Sergent, 1979). Dietary protein with proper amino acid balance and density is more important and protein level in diet can be reduced when such balanced diets are provided (Mertz, 1972).

The computed values for food conversion efficiency of *O. belangeri* in the present study indicated maximum utilization of diet at 40% dietary protein, with a decline on either side of the optimum level. Protein efficiency ratio increased progressively up to 40%. The significant fall in PER beyond the optimum level in *O. belangeri* was similar to the results obtained for plaice (Cowey *et al.*, 1972). The productive protein value also was highest at this level of protein. Hence it may be concluded that diet with 40% protein is best for rearing *O. belangeri*.

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