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Effect of Varying Protein Levels on the Growth of Indian Major Carp Rohu, *Labeo rohita* (Hamilton)

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Abstract: A forty-nine day feeding experiment conduced to determine protein requirement of fingerlings of *Labeo rohita* (average weight 1.83±0.02 g) feeding on four formulated diets with varying protein levels (25, 30, 35 and 40%) using slaughter house waste as the major protein source. In terms of growth, food conversion ratio, protein efficiency ratio, survival and ratios of protein and lipid deposition in muscle, diet containing 30% protein level revealed a significantly ($p<0.01$) better performance of the fish in comparison with the fish fed on other diets containing lower or higher protein levels. These findings suggest that about 30 percent crude protein with 370 kcal/100 g energy content in diet appears to be sufficient for obtaining optimum growth in *Labeo rohita*.

Key words: Fish nutrition, protein level, growth, *Labeo rohita* fingerlings

Introduction

Aquaculture is a feed based industry with over 60% of the operational cost coming from feed sources alone (Pandian *et al*., 2001). The cost of feed is largely influenced by the level and sources of protein which is the most expensive component of a fish diet. It is the major dietary components which influence growth of fish. Insufficient as well as excess level of protein in feed is not desirable, the former results in poor growth, while the latter would be wasted by diverting for energy. Hence, dietary protein level in fish feed needs to be optimized accurately. The most economic source of protein is from natural food stuffs of plant and animal origins, particularly animal wastes and non-conventional feed sources. Animal proteins in general are superior over the plant proteins because these are rich in all essential amino acid and are easily digestible. The Indian Major Carps are highly nutritious and most prestigious of all fishes in India. Moreover, the carp constitute nearly 90% of India's total production. Among the Indian Major Carps, rohu (*Labeo rohita*) is most preferred species and constitute about 35% of the Indian Major Carps production (FAO, 2000). However, studies on the dietary protein requirements of carps feeding on dry formulated feeds are few (Renukardhya and Varghese, 1986; Mohanty *et al*., 1990; Seenappa and Devaraj, 1995; Chakraborty *et al*., 1999; Rangacharyulu *et al*., 2000). In the present study, the optimum dietary protein requirements for optimum growth, food utilization and body carcass composition of *Labeo rohita* feeding on four slaughter house waste based diets having 25, 30, 35 and 40% protein content have been investigated.

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Materials and Methods

Experimental Site

The present experiment was conducted at Aquaculture Lab, Department of Fisheries, Raipur and feed analysis part was done at Department of Animal Nutrition, Anjora, Durg of Indira Gandhi Agricultural University, Raipur, Chhattisgarh, India during period of December to February, 2003-04.

Preparation of Experimental Diets

Four experimental diets with 25, 30, 35 and 40% protein level , respectively were prepared and named as D_1, D_2, D_3 and D_4, respectively. The ingredients selected were slaughter house waste, mustard oil cake, rice bran, soybean oil, vitamin-mineral mixture and carboxy methyl cellulose (Table 1 and 2). For feed preparation, the ingredients were grounded separately in an electric grinder and sieved to remove large particles. The required quantity of feed ingredients boiled with water in a pressure cooker for 30 min. The boiled mixture was allowed to cool and then vitamin-mineral mixture was added and mixed well. These mixtures are processed through a hand pelletizer for preparing pellets, which were then dried in room temperature for two days. Prior to the formulation of the feeds, the ingredients were analyzed for proximate composition following the standard methods (AOAC, 1990).

Experimental Design

The acclimatised *Labeo rohita* fingerlings (mean body weight 1.83±0.02 g) were randomly distributed at the rate of 10 fish per aquarium with four replicates of each dietary treatment. All fish were fed daily twice a day at 08.30- 09.00 and 16.00-16.30 h, the feeding being at 4% body weight day^{-1}. The aquaria water was partially renewed daily. The fish were weighed at weekly intervals and feeding rate adjusted accordingly. Fish were exposed to the respective diet for 3 h during each ration and the uneaten feed was siphoned out, stored and dried separately for calculating the Food Conversion Ratio (FCR).

Table 1: Proximate composition of feed ingredients used in the formulation of diets (% dry matter basis)

Ingredients	Moisture (%)	Crude protein (%)	Crude fat (%)	Crude fibre (%)	Total ash (%)	NFE
Rice bran	9.0±0.16	13.56±0.36	10.22±0.11	19.33±0.19	10.53±0.07	37.36
Mustard oil cake	8.5±0.10	38.00±0.50	8.44±0.12	7.5±0.10	14.06±0.04	23.50
Slaughter house waste	7.8±0.20	65.00±1.88	6.11±0.25	2.33±0.17	7.93±0.02	10.83

± SEM

Table 2: Composition of experimental diets

Ingredients (g100 g^{-1})	Diets			
	D_1	D_2	D_3	D_4
Rice bran	58.38	48.68	38.96	29.25
Mustard oil cake	20.00	20.00	20.00	20.00
Slaughter house waste	14.62	24.32	34.04	43.75
Soybean oil	2.00	2.00	2.00	2.00
Carboxy methyl cellulose	3.00	3.00	3.00	3.00
Vitamin-mineral mixture**	2.00	2.00	2.00	2.00

** Vitamin A (as acetate): 5000 IV; Cholecalciferol: 1000 IU;Vitamin A (as acetate); Thiamin monocitrate: 10.00 mg; Riboflavin: 10.00 mg; Pyridoxine hydrochloride: 5.00 mg; Cyanacobalamin: 15.00 g; Nicotinamide: 75.00 mg; Calcium pentathenate: 10.00 mg; Ascorbic acid:150.00 mg; α tocopheryl acetate: 25.00 mg; Biotin: 5.00 mg; Folic acid: 5.00 mg; Menadione: 100.00 mg; Choline chloride: 50.00 mg; PABA: 5.00 mg; Myoinocitol: 10.00 mg; Calcium lactate: 0.125 mg; Magnesium oxide: 60.00 mg; Dried ferrous sulphate: 30.00 mg; Copper sulphate: 2.00 mg; Manganese sulphate: 2.00 mg; Zinc sulphate: 2.00 mg; Sodium molybdate dihydrate: 0.25 mg; Sodium borate: 0.80 mg; Potassium iodate: 20.00 mg; Bicalcium phosphate: 0.10 g; Cobalt chloride: 20.00 mg

Analytical Analysis

Water quality was monitored at weekly interval for temperature, pH, dissolved oxygen, free carbon di-oxide and total alkalinity (APHA, 1989)

Feeding ingredients, experimental diets and the fish muscle were analysed for the proximate composition following standard methods (AOAC, 1990).

Statistical Analysis

Data were tested for significance employing one-way analysis of variance (Snedecor and Cochran, 1968) and Duncans (1955) Multiple Range Test.

Data Collection

Absolute growth	=	Final weight-initial weight
Relative Growth Rate (RGR) (%/d)	=	Absolute growth/initial wt.×100
Specific Growth Rate (SGR)	=	Log_e Final wt.-Log_e Initial wt./Experimental period (days) × 100
Food Conversion Ratio (FCR)	=	Feed intake (g)/Live weight gain (g)
Protein Efficiency Ratio (PER)	=	Wet weight gain of fish (g)/Protein consumed

Results

Physico-chemical Parameters of Water

The water quality parameters in different treatments were with in the optimal range for carp culture. Temperature ranged from 19.7 to 27°C, with dissolved oxygen fluctuating between 5.63 to 7.41 mg L^{-1}. Water pH ranged from 7.45- 8.82, total alkalinity from 80 to 100 mg L^{-1} and free carbon di-oxide fluctuating between 0.0-2.32 mg L^{-1}.

Growth Performance

Growth performance indicated by absolute growth, percentage increase in live weight and Specific Growth Rate (SGR) and survival rate when subjected to analysis of variance revealed significant influence of protein level (Table 4 and 5). Data indicate that the fish fed with diet having 30% protein (D_2) reflected best growth in terms of live weight gain (153.2%) with the specific growth rate being 2.48%. The lowest live weight gain (96.26) and specific growth rate (1.55%) were recorded with D_1 having 25% protein. Growth performance and feed utilization showed significant ($p<0.01$) difference between D_2 and D_1. Similar trends were also found with D_2 and D_4 and between D_2 and D_3.

The average initial and final weight of rohu fingerlings were between 1.81 g to 1.83 g and 3.58 to 4.63 g, respectively in different dietary treatment. Weekly grouth rate a experimental fish during experimental period was preseuted in Table 4. It is evident from the table that-increase in weight of fish at wee was highest in D_2 having 30% protein leve showing optimum protein requirment for *Labeo rohita* in relation to growth performence.

Food Conversion Ratio and Protein Efficiency Ratio

The Food Conversion Ratio (FCR) and Protein Efficiency Ratio (PER) are also influenced by the protein level in the diets (Fig. 1). The food consumption and wet weight production plays an important role in the increase or decrease of food conversion ratio. In the present experiment the diet with 30 % protein level showed the minimum FCR whereas maximum FCR was recorded for the rohu fed with 25% protein diet. The highest PER at 30% protein level in the diet indicates that protein is efficiently utilized and growth was also better than all the other diet groups. The low PER values were recorded above 30% protein level.

Table 3: Proximate composition of the experimental diets (% on dry matter basis)

	Diets			
Parameters (g100 g^{-1})	D_1	D_2	D_3	D_4
Moisture (%)	8.30	8.20	8.15	8.35
Crude protein (%)	25.00	30.00	35.00	40.00
Crude fat (%)	10.55	10.15	9.74	9.16
Crude fibre (%)	13.12	11.47	9.82	8.17
Total ash (%)	10.10	9.95	9.61	9.36
Metabolizable energy kcal/ 100 g^{-1}	363.34	367.22	369.13	369.93

Table 4: Weekly growth rate of rohu fingerlings under different dietary treatments

	Weight (g/fish) (in weeks)							
Diets	0	1	2	3	4	5	6	7
D_1	1.82±0.01	2.11±0.02	2.38±0.01	2.67±0.02	2.95±0.01	3.25±0.02	3.52±0.01	3.79±0.01
D_2	1.83±0.02	2.22±0.01	2.61±0.02	3.01±0.01	3.41±0.02	3.81±0.01	4.22±0.01	4.63±0.02
D_3	1.81±0.01	2.21±0.02	2.60±0.01	2.99±0.02	3.37±0.01	3.76±0.01	4.15±0.02	4.51±0.01
D_4	1.81±0.01	2.17±0.01	2.51±0.02	2.86±0.02	3.20±0.01	3.56±0.02	3.91±0.01	4.27±0.02

±SEM

Table 5: Effect of dietary protein levels on the growth and carcass composition in *Labeo rohita*

	Diets			
Details	D_1	D_2	D_3	D_4
Initial length (mm)	55±14.2	55±13.4	55±14.5	55±15.2
Initial weight (g)	1.82±0.01	1.83±0.02	1.81±0.01	1.81±0.01
Final length (mm)	71±19.2	74±25.1	72±22.2	71±21.4
Final weight (g)	3.79±0.01	4.63±0.02	4.51±0.01	4.27±0.02
Absolute growth (g)	$1.96±0.01^{d}$	$2.80±0.01^{a}$	$2.69±0.01^{b}$	$2.44±0.02^{c}$
Relative growth rate (%)	107.39^{d}	153.27^{a}	148.52^{b}	133.52^{c}
Specific growth rate	$1.73±0.01^{d}$	$2.48±0.01^{a}$	$2.38±0.02^{b}$	$2.16±0.01^{c}$
Survival rate (%)	$97.25±2.5^{a}$	$100±0.0^{a}$	$100±0.0^{a}$	$95.0±2.88^{a}$
Muscle composition				
Moisture (%) (83.42±0.23)	$78.24±0.23^{b}$	$78.64±0.28^{bc}$	$79.16±0.23^{bc}$	$78.94±0.23^{bc}$
Dry matter (%) (27.58±0.34)	$21.76±0.23^{ab}$	$21.36±0.34^{ab}$	$20.84±0.23^{ab}$	$21.06±0.41^{ab}$
Protein (Initial value: 55.71)	$58.34±0.11^{b}$	$59.21±0.25^{a}$	$58.34±0.10^{b}$	$57.17±0.20^{c}$
Lipid (Initial value: 10.90)	$13.21±0.15^{b}$	$13.53±0.08^{a}$	$13.17±0.18^{b}$	$12.52±0.17^{c}$

± SEM, Values in the same rows with different superscript (s) differ significantly ($p<0.01$), values in prenthesis (±) shows intial values

Carcass Composition

The protein and lipid in the muscle of the experimental fish increased over the initial in all the dietary treatments (Table 5). The fish fed with 30% protein level resulted highest amount of protein and lipid in the muscle.

Survival

Survival rates were recorded highest in the reared with 30 and 35% protein diet. Survival rate decreased with increased or decreased level of protein.

Discussion

Present studies on Indian Major Carp, *Labeo rohita* has revealed high growth and high accumulation of carcass protein in fish fed on a diet containing 30% protein.

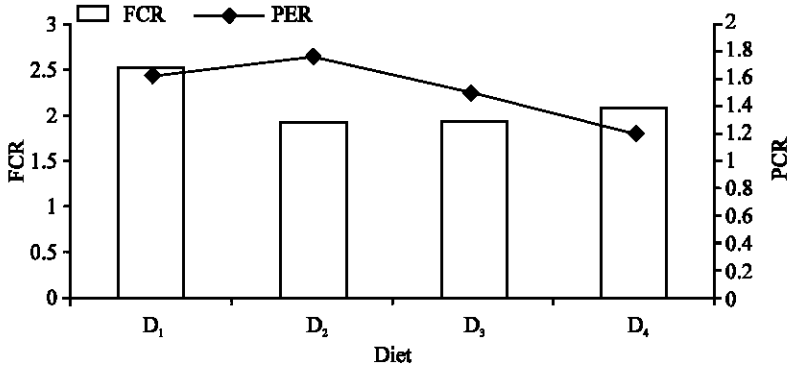

Fig. 1: Food conversion ratio and protein efficiency ratio of *Labeo rohita* fed on diets having different protein levels

The present study shows that specific growth rate and food conversion ratio in *Labeo rohita* are influenced by the dietary protein content. Studies on effect of protein level on growth performance of fishes clearly indicate that while feeding with slaughter house waste based diets gives optimum growth occurs between 30-35% dietary protein levels. The present results recorded the maximum growth performance by *Labeo rohita*, feeding on 30% dietary protein and hence lie within the range reported by other workers for rohu and other fishes (Renukardhya and Varghese, 1986; Seenappa and Devaraj, 1995; Gangadhara *et al*., 1997; Chakraborty *et al*., 1999; Rangacharyulu *et al*., 2000).

The finding point to the fact that under a given condition better performance in growth means, better digestion, better absorption and eventually better conversion of nutrients to flesh. Greater degree of protein (Jafri and Anwar, 1995) and energy (Jafri and Hassan, 1999) digestibility of goat offal has been reported for *Labeo rohita* justify the performance of this diet in producing maximum live weight gain. In a review, Nandeesha *et al*. (1991) stated that the growth attained by carps on slaughter house waste based diet was superior compared to that fed on fish meal. Hassan *et al*. (1999) also found best growth with diet containing slaughter house waste.

FCR and PER are known to be decrease with increasing dietary protein content (Jauncey, 1982) similar trends were found in present experiment.

Of the various factors which govern the carcass quality nutrient composition protein and lipid level exerts the strongest influence. In the present experiment, although the diets were isocaloric and different protein level, the influence of different protein levels on body composition was clearly seen.

The study, thus, clearly indicated that slaughter house waste is one of the good animal proteins in terms of feed, protein conversion and growth efficiency and 30% protein level is optimum for growth of *Labeo rohita*.

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