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# Growth Response, Survival, Feed Conversion and Protein Utilization in Fingerlings of Rohu, *Labeo Rohita* (Hamilton) to Diets of Different Protein Levels

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**Abstract:** A growth experiment was conducted to determine the optimum protein level for fingerlings of *Labeo rohita* (initial average weight 1.82±0.02 g). Four practical diets were formulated contain four protein levels (25, 30, 35 and 40%). Each diet was randomly assigned to four replicate groups of 10 fish per aquarium (60×30×30 cm). Fish were fed twice daily (08.30-09.00 h and 16.00-16.30) to apparent satiation for 7 weeks. The results showed that the growth was significantly influenced by protein levels ($p<0.01$). Fish fed the diet with 30 % protein had the higher specific growth rate (2.48±0.01) and protein efficiency ratio (1.75±0.07) than those with 25, 35 and 40% protein. While survival rate is best with 30-35% protein level. Carcass composition also revealed higher accumulation of protein and lipid in fish fed on diet containing 30% protein. These findings suggest that about 30% protein in diet appears to be sufficient for obtaining optimum growth in *Labeo rohita*.

**Key words:** Fish feed, growth, protein levels, protein utilization, *Labeo rohita* fingerlings

## Introduction

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). Feed cost plays a vital role in dictating the economic feasibility of fish culture practice. The cost of feed is largely influenced by the level and sources of protein which is the most expensive component of a fish diet. The dietary protein contributes to over 60% of the diet cost and 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. However, studies on the dietary protein requirements of carps feeding on dry formulated feeds are few (Mohanty *et al*., 1990; Seenappa and Devaraj, 1995; Chakraborty *et al*., 1999; Rangacharyulu *et al*., 2000). The present study deals with the optimization of dietary protein levels of the feed for *Labeo rohita* fingerlings.

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## Materials and Methods

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.

Fingerlings of *Labeo rohita,* procured from the Nursery prdo, Department of Fisheries, Indira Gandhi Agricultural University were given a prophylactic dip in dilute $KMnO_4$ solution before stocking in glass aquaria (60×30×30 cm). After 15 days of acclimation to the formulated diet consisting of rice bran and mustard oil cake, the fingerlings were sorted out to almost identical size (Ave. wt. 1.83±0.02 g) group.

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). 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).

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 h 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).

Feeding ingredients, experimental diets, faecal matter sample and the fish muscle were analysed for proximate composition following AOAC (1989) procedures.

Water quality was monitored at weekly interval for temperature, pH, dissolved oxygen, free carbon di-oxide and total alkalinity (APHA, 1990)

Table 1: Ingredients (%) and proximate composition of the experimental diets (% on dry matter basis)

| Ingredients | Diets | | | |
|---|---|---|---|---|
| (g 100 $g^{-1}$) | $D_1$ | $D_2$ | $D_3$ | $D_4$ |
| Rice bran | 58.38 | 48.68 | 39.59 | 30.48 |
| Mustard oil cake | 20.00 | 20.00 | 20.00 | 20.00 |
| Slaughter house waste | 14.62 | 24.32 | 33.91 | 43.52 |
| Soybean oil | 2.0 | 2.0 | 1.5 | 1.0 |
| Vitamin-mineral mixture * | 2.0 | 2.0 | 2.0 | 2.0 |
| Carboxy methyl cellulose | 3.0 | 3.0 | 3.0 | 3.0 |
| Proximate composition** | | | | |
| 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 | 9.30 | 8.46 |
| Crude fibre | 13.12 | 11.47 | 9.94 | 8.40 |
| Total ash | 10.10 | 9.95 | 9.67 | 9.47 |
| Metabolizable energy kcal 100 $g^{-1}$ | 363.34 | 367.22 | 369.13 | 369.93 |

*Vitaminate forte, Roche India Ltd., **On dry matter basis

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

*Data Collection*

$$\text{Percent live weight gain} = 100\times(BW_f - BWi)/BWi$$

$$\text{Specific Growth Rate (SGR) (\% day}^{-1}) = [(\text{In } BW_f - \text{InBWi})/\text{day on trial}]\times 100$$

Where, BWi and BWf were initial and final body weights of the fish, respectively.

$$\text{Protein Efficiency Ratio (PER)} = \text{Wet weight gain of fish (g)/protein consumed (g)}$$

$$\text{Food Conversion Ratio (FCR)} = \text{Feed intake (g)/ Live weight gain (g)}$$

$$\text{Survival rate \%} = [\text{Total number of surviving fish/Total number of fish stocked}]\times 100$$

## Results

The water quality parameters were within the normal range (Table 2). The reason for the narrow range of fluctuation in the water quality parameters may be attributed to the periodical removal of waste feeds, excreta and exchange of water besides continuous aeration.

Growth in terms of net weight gain (g) and Specific Growth Rate (SGR) were significantly ($p<0.01$) higher in fish fed on $D_2$ containing 30% crude protein compared to all the other diets (Fig. 1). With further increase in dietary protein levels a decrease in net weight gain and SGR (Table 3).

Feed Conversion Ratio (FCR) remained significantly low (1.89) in fish fed on $D_2$ containing 30% crude protein in comparison with the fish fed on low (25%) or high protein (35 and 40%) diets indicating the best conversion rate among all the diets. On the other hand, Protein Efficiency Ratio (PER) was significantly ($p<0.01$) high in fish fed on $D_2$. Survival rates recorded highest (100%) in the fish reared with the 30 and 35% protein diet. There was no significant difference in survival rate of fishes between all the treatments ($p<0.01$).

Table 2: Water quality parameters observed during the experimental period

| Parameters | Range |
|---|---|
| Water temperature (°C) | 18.70-26.0 |
| Dissolved oxygen (mg $L^{-1}$) | 6.65-7.20 |
| pH | 7.45-7.82 |
| Free carbon dioxide (mg $L^{-1}$) | 0.00-2.32 |
| Alkalinity (mg $L^{-1}$) | 80.00-100 |

Table 3: Weight gain, Specific Growth Rate (SGR), Feed Conversion Ratio (FCR), Protein Efficiency Ratio (PER) and survival of rohu fingerlings fed with diets containing various levels of protein for 49 days

| | Diets | | | |
|---|---|---|---|---|
| Details | $D_1$ | $D_2$ | $D_3$ | $D_4$ |
| Initial weight | 1.82±0.01 | 1.83±0.02 | 1.81±0.01 | 1.81±0.01 |
| Final weight | 3.79±0.01 | 4.63±0.02 | 4.51±0.01 | 4.27±0.02 |
| Net weight gain | 1.96±0.01$^{d}$ | 2.80±0.01$^{a}$ | 2.69±0.01$^{b}$ | 2.44±0.02$^{c}$ |
| Specific Growth Rate (g $day^{-1}$) (SGR) | 1.73±0.01$^{d}$ | 2.48±0.01$^{a}$ | 2.38±0.02$^{b}$ | 2.16±0.01$^{c}$ |
| Food Conversion Ratio (FCR) | 2.50±0.02$^{a}$ | 1.89±0.01$^{d}$ | 1.93±0.01$^{c}$ | 2.07±0.01$^{b}$ |
| Protein Efficiency Ratio (PER) | 1.61±0.03$^{b}$ | 1.75±0.07$^{a}$ | 1.48±0.06$^{c}$ | 1.19±0.11$^{d}$ |
| Survival (%) | 97.25±2.5$^{a}$ | 100±0.0$^{a}$ | 100±0.0$^{a}$ | 95.0±2.88$^{a}$ |

±SEM, Values in the same rows with different superscripts differ significantly ($p<0.01$)

Table 4: Carcass composition of fish before and after the feeding experiment

| Nutrient | Initial value | Diets | | | |
|---|---|---|---|---|---|
| | | $D_1$ | $D_2$ | $D_3$ | $D_4$ |
| 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$^{ab}$ |
| Crude protein (DM%) | 55.71±0.13 | 58.34±0.11$^{b}$ | 59.21±0.25$^{a}$ | 58.34±0.10$^{b}$ | 57.17±0.20$^{c}$ |
| Crude fat (DM%) | 10.90±0.09 | 13.53±0.08$^{a}$ | 13.21±0.05$^{a}$ | 12.99±0.12$^{a}$ | 12.52±0.17$^{c}$ |
| Total ash (DM%) | 20.17±1.1$^{a}$ | 17.41±1.4$^{c}$ | 14.61±0.9$^{d}$ | 16.50±1.0$^{c}$ | 18.15±0.9$^{b}$ |

±SEM, Values in the same rows with different superscripts differ significantly ($p<0.01$)

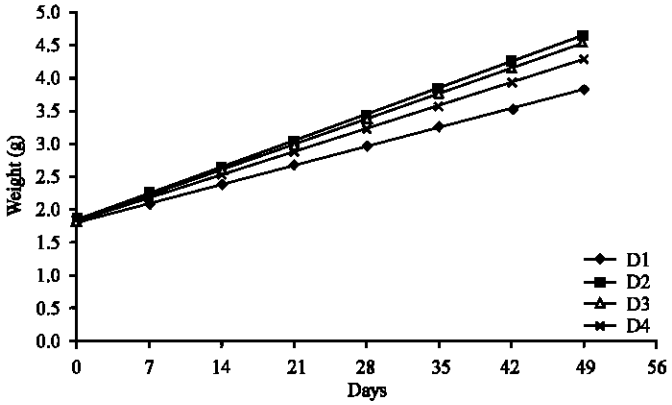


Fig. 1: Growth of fish during experimental period

The carcass compositions were significantly different in terms of moisture, lipid, protein and ash content of the fish fed with different diets. Protein and lipid deposition in the muscle of the experimental fish increased over the initial in all the dietary treatments (Table 4). The fish fed with 30% protein diet resulted higher amount of protein and lipid deposition in the muscle compared to all the other diets. All these values are significantly higher ($p<0.01$) in $D_2$ than those with the other diets.

## Discussion

The present study shows that specific growth rate, food conversion ratio and protein utilization 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 (Gangadhara *et al*.,1997; Rangacharyulu *et al*., 2000; Paul and Mohanty, 2002). Results on optimum protein levels for *Labeo rohita* are broad agreement with those of Gangadhara *et al*. (1997), Chakraborty *et al*. (1999), Rangacharyulu *et al*. (2000) and Paul and Mohanty (2002) on *L. rohita*. These authors obtained high growth and feed efficiency in fish when fed on a diet containing 30-35% crude protein. Further, growth depressing effect of high protein levels has been reported for rohu (Khan and Jafri, 1992; Chakraborthy *et al*., 1999; Saha and Ray, 1998; Nandeesha *et al*. 2002).

Results of the present study revealed lower moisture content in fish body tissue feeding different protein levels. The fat content and protein levels increased in all dietary groups as compared to initial body tissue level and significantly higher in $D_2$. Similar trends were reported by Jayaram and Shetty

(1995) and Brinda and Arvindum (1995) for rohu fingerlings. Decrease in ash content may be due to dilution effect of carcass fat and not because of the influence of protein levels.

From the present study it is concluded that growth of rohu was best at 30 percent protein level. So, there is no need to go with higher level of dietary protein and slaughter house waste is an efficient animal protein source for rohu as a feed ingredient.

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