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Effect of varying dietary protein levels on the growth response of *Labeo rohita* (Rohu) fingerlings under semi-intensive culture system

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Abstract

Labeo rohita (Rohu) is commercially high valued culturable fish species in Pakistan. In the present study, different feeding trials were conducted to determine the efficacy of varying dietary protein levels on the growth response of *Labeo rohita* fingerlings (average body weight and length; 10.94g, 9.70cm) reared under semi-intensive system. Four different diets having crude protein levels 25, 30, 35 and 40% were formulated using locally available feed ingredients (Rice polish, Maize gluten 30%, 60%, Fish meal, Soybean meal and Bypass fat) and tested for a period of three months. Fishes were fed twice a day at the rate of 3% of their wet body weights. Mean body length and weight gain, percentage weight gain, specific growth rate, average daily weight gain and survival rate were calculate at the end of this study to evaluate the growth performance of Rohu fingerlings under different treatments. Percentage weight gain and specific growth rate were found significantly higher for diet having 35% CP followed by 40%, 30% and 25% CP levels. The survival rate was 100% for all the treatments. Water quality parameters such as dissolved oxygen, temperature and pH were found approximately constant during the study period. The results of this study will be beneficial for researchers and fish farmers for rearing this fish under semi-intensive culture system fed with optimum dietary protein level.

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Introduction

Labeo rohita (Rohu), a freshwater carp is commercially and economically high valued culturable fish species in Pakistan. Along with other carps (Major and Chinese carps) it's being widely cultured under semi-intensive polyculture system all over the Punjab. Rohu is highly nutritious and most significant fish compared to other carps in Pakistan (Khan *et al*., 2004).

Protein is an integral component of fish feed providing essential and non-essential amino acids to the fish which are necessary for its muscles building, enzymatic functions and also providing energy for maintenance (Yang *et al*., 2003). The accurate optimization of dietary protein levels in formulated fish feed is necessary for taking higher growth rates (Singh *et al*., 2006). The excess amount of protein in fish diet is wasteful and makes feed expensive (Ahmad, 2000). Protein is the most costly ingredient of formulated fish feeds and thus carefully used to meet the needs of fish (Abdel-Tawwab *et al*., 2010). Reducing feed cost could be a key factor for prosperous growth of aquaculture.

Aquaculture is a feed centered industry with above 60% of the operational cost coming from feed sources alone (Pandian *et al*., 2001). In fish farming, fish diet is critical as feed represent 40-50% of production costs (Craig and Helfrich, 2002).The success of semi-intensive and intensive fish culturing system mainly depends on application of suitable feed formulated by using locally available feed ingredients. The growth of fish biomass depends on several factors most notably feeding regimes. The cost of feed is mainly reliant on the sources and levels of protein which is an integral and most expensive component of fish diet. Therefore, accurate optimization of protein level in fish diet is indispensable.

Fewer studies have been carried out in Pakistan regarding the accurate optimization of dietary protein level in fish feed. The objective of this feeding trial was to assess optimum protein level in Rohu diet by using locally available feed ingredients.

Materials and methods

Experimental site and design

Feeding trial was conducted at Fish nutrition laboratory, Fisheries Research and Training Institute, Manawan Lahore for three months (Mid-April to Mid-July 2017). Healthy Rohu fingerlings (average body weight and length; 10.94g, 9.70cm) were procured from the Central fish seed hatchery, Manawan and were acclimatized for fifteen days prior to this feeding trial.

The experiment designed contained 12 cemented tanks and thirty fingerlings were randomly stocked into each tank. Each feeding trial was conducted in triplicates. All fish were fed daily twice a day at 08.30– 09.00h and 15.30- 16.00h at the rate of 3% of their wet body weight per day. The tank water was partially renewed daily. The water quality parameters such as Dissolved oxygen, Temperature and pH were monitored and maintained throughout the experiment. The fish were weighed fortnightly and feeding ration adjusted accordingly.

Preparation of experimental diets

Four experimental diets were formulated by using locally available feed ingredients (Rice polish, Fish meal, Soybean meal, and Maize gluten 30%, 60%) to contain 25%, 30%, 35% and 40% crude protein on dry matter basis Table 1.

Growth parameters and data analysis

Growth performance of the experimental fish was determined by using the formulas of Weight Gain (WG), Percentage Weight Length Gain (%WG), Percentage Length Gain (%LG), Average Daily Weight Gain (ADWG), Specific Growth Rate (SGR) and Percentage Survival Rate (%SR).

Data on growth was subjected to one way analysis of variance(ANOVA) followed by Fisher·s Least Significant Difference (LSD) post hoc test to evaluate the statistical significance of differences among all the treatments. Differences between the treatment means were considered significant at $p<0.05$. All the

statistical analysis was performed using IBM SPSS (version 20).

Results

Four diets having different dietary protein levels (25%, 30%, 35% and 40%) were tested. The data for body weight and length gain was noted on fortnightly basis (Table 2). A significant difference for final mean body weight and length was noted between all the treatments ($P<0.05$). The highest body weight and length gain (56.85±0.10g; 17.67±0.76cm) was recorded for 35% protein level (Diet: 03) followed by 40% protein level (52.17±0.12g; 16.75±0.11). The lowest value for body weight and length gain (38.55±0.54g; 15.20±0.68cm) was recorded for 25% protein level (Diet: 01).

Table 1. Formulation of the test diets on dry weight basis.

Ingredients	Dietary protein levels (%)			
	Group:01 (Diet:01 25%CP)	Group:02 (Diet:02 30% CP)	Group:03 (Diet:03 35% CP)	Group:04 (Diet:04 40% CP)
Fish meal	15	25	31	12
Soybean meal	12	21	30	28
Maize gluten 30%	25	22	22	-
Maize gluten 60%	-	-	-	35
Rice polish	41	25	3	13
By-pass fat	6	6	13	11
Vitamin premix	1	1	1	1
Total	100	100	100	100

The growth parameters such as weight gain, percentage weight and length gain, average daily weight gain and specific growth rate were calculated for all the treatments (Table. 3). The significant difference was found between all the groups for all the studied growth parameters except for the percentage length gain ($p= 0.070$). The growth parameters which showed significant difference between the groups were further subjected to LSD post hoc test. The post hoc test showed significant difference within all the groups for the growth parameters (final mean body weight and length gain).

Table 2. Fortnight variation in average body weight (g) and length (cm) of *Labeo rohita* (Rohu) fingerlings.

Fortnight	Dietary Protein Levels							
	25% CP		30% CP		35% CP		40% CP	
	W	L	W	L	W	L	W	L
0	11.02±0.79	9.49±0.42	10.86±1.05	9.41±0.37	10.88±0.73	9.42±0.34	11.01±0.87	10.5±0.89
1	12.50±0.39	10.05±0.39	13.76±0.11	10.55±0.50	14.68±0.11	10.94±0.46	14.05±0.11	11.98±0.15
2	14.03±0.83	10.57±0.47	15.76±1.39	11.12±0.66	17.19±1.10	11.55±0.67	16.21±1.45	12.80±0.16
3	15.25±0.63	13.18±0.76	18.48±1.69	13.99±0.79	18.35±0.98	13.73±0.75	17.66±0.16	13.92±0.74
4	16.54±1.20	13.50±0.67	20.65±0.29	14.67±1.01	19.62±0.14	14.49±1.01	19.22±0.22	14.61±0.92
5	29.73±0.53	14.47±0.51	37.6±0.65	15.60±0.90	41.77±0.87	16.43±0.69	40.97±0.79	15.93±0.82
6	38.55±0.54	15.20±0.68	47.54±0.91	16.25±0.99	56.85±0.10	17.67±0.76	52.17±0.12	16.75±0.11

The other growth parameters (weight gain, percentage weight gain, average daily weight gain and specific growth rate) showed significant difference within all the groups except within the two groups (group 2 versus group 4 and group 3 versus group 4) which showed insignificant difference.

The highest values of % WG and SGR was noted for 35% CP level (Diet: 03) and lowest for 25% CP level (Diet: 01). The highest value of average daily weight gain was for diet: 03 followed by diets: 04, 02 and 01 respectively. The survival rate of fishes for all the studied treatments was 100% and was unaffected by

different dietary protein levels. The mean values of water quality parameters such as DO, pH, temperature, alkalinity and hardness (5.2mg/L, 7.65, 25.05°C, 378mg/L and 156mg/L respectively) were optimum for fish growth during whole the study period.

Discussion

The present study showed a significant difference of dietary protein levels on the growth performance of *Labeo rohita* fingerlings reared under semi-intensive system. Percentage weight gain and specific growth rate significantly increased with increasing dietary protein levels from 25% CP to 35% CP levels. Therefore, diet: 3 having 35% CP is considered best for rearing Rohu fingerlings under semi-intensive system. Growth performance of major carp *Labeo rohita* fingerlings fed with three commercial diets (Rice bran, 12.3%CP; Miracle, 46.92%CP and Tokyo, 34.69%CP) showed significant higher growth rate for feed having 35%CP (Ahmed *et al.*, 2012). The results of their study support our findings.

Table 3. Growth parameters of *Labeo rohita* (Rohu) fingerlings fed with different dietary protein levels diets.

Growth parameters	Dietary protein levels				ANOVA	
	Group: 01 25%CP	Group: 02 30% CP	Group: 03 35% CP	Group: 04 40% CP	F- crit	Sig.
Initial mean body weight	11.02±0.79	10.86±1.05	10.88±0.73	11.01±0.87	-	-
Initial mean body length	9.49±0.42	9.41±0.37	9.42±0.34	10.5±0.89	-	-
Final mean body weight	38.55 ± 0.54^{a}	47.54 ± 0.91^{b}	56.85 ± 0.10^{c}	52.17 ± 0.12^{d}	2.629	0.000
Final mean body length	15.20 ± 0.68^{a}	16.25 ± 0.99^{b}	17.67 ± 0.76^{c}	16.75 ± 0.11^{d}	2.629	0.000
[1]WG	27.53^{a}	36.68^{bc}	45.97^{d}	41.17^{cd}	4.066	0.001
[2]%WG	249.9^{a}	337.3^{bc}	429.4^{d}	367.9^{cd}	4.066	0.001
[3]%LG	60.19	72.63	87.56	61.33	4.066	0.070
[4]ADWG	0.30^{a}	0.40^{bc}	0.51^{d}	0.46^{cd}	4.066	0.001
[5]SGR	1.39^{a}	1.63^{bc}	1.83^{d}	1.71^{cd}	4.066	0.0007
[6]SR (%)	100	100	100	100	-	-

Means in the same row with different superscript are significantly different ($P<0.05$).

[1]Weight Gain (WG) = W2 (g) - W1 (g)

[2]Percentage Weight Gain (%WG) = W2 (g) - W1 (g) /W1 (g) × 100

[3]Percentage Length Gain (%LG) = L2 (g) - L1 (g) /L1 (g) × 100

[4]Average Daily Weight Gain (ADWG) = WG (g) / T (Days)

[5]Specific Growth Rate (SGR) = 100 (lnW2 – lnW1) / T (Days)

[6]Percentage Survival Rate (%SR) = Final fish number / Initial fish number × 100

Where W1 and W2 are the initial and final fish weight; L1 and L2 are the initial and final fish length respectively, and T is the number of days in the feeding period.

The growth rate of Indian major carp *Labeo rohita* was evaluated using slaughter house waste as major source of protein (Singh *et al.*, 2006). Among the tested diets, diet containing 30%CP showed significant increase in growth compared with other diets. *Labeo rohita* fingerlings fed with 45%CP feed showed significant increase in growth compared to low protein levels diets (Abid and Ahmed, 2009).The percentage weight gain and specific growth rate of Rohu fingerlings were found significantly higher for diet containing 45%CP in comparison with low protein level diets (Umer *et al.*, 2014). The results of these studies are contradicting to the present findings. Different fish sizes, culturing system and water quality parameters could be the reasons for such dissimilarities.

The growth parameters of *Labeo rohita* fingerlings fed with different crude protein levels was found to be significantly increased with increasing dietary protein levels (Debnath *et al.*, 2007). The growth performance of *Cirrhinus mrigala* fingerlings fed

with different dietary protein levels diets was evaluated (Abid and Salim, 2004). The diet having 40%CP showed significantly higher growth rate compared to the low crude protein levels diets (30 and 35%). *Oreochromis niloticus* juveniles were fed with varying dietary protein levels diets 17, 25, 30 and 35%). The diet having 30%CP showed optimum growth compared to other diets (Bahnasawy, 2009).

Conclusion

The results of the present study indicated that a diet having 35% CP level showed optimum growth of *Labeo rohita* fingerlings. So, diet containing 35% crude protein level is recommended for rearing Rohu fingerlings under semi-intensive system.

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