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Changes in Body Growth of *Labeo rohita* in Relation to Dietary Carbohydrate Content and Protein Levels using Gelatinized and Non-Gelatinized Corn

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Abstract

For a twelve week experiment, three varying crude protein levels (30, 35 and 40%) were considered to observe the growth and meat composition changes in *Labeo rohita* raised on six semi purified diets (T1: G, 30% CP; T2: NG, 30% CP; T3: G, 35% CP; T4: NG, 35% CP; T5: G, 40% CP and T6: NG, 40% CP) formulated with either gelatinized or nongelatinized corn starch followed by two replicates for each diet. Fish reared on T5 (G, 40% CP) exhibited highest average body weight (3.63 ± 0.00 g) followed by T3 (3.51 ± 0.00 g), T6 (3.50 ± 0.00 g), T1 (3.49 ± 0.00 g), T4 (3.38 ± 0.00 g) and T2 (3.36 ± 0.00 g) respectively. The statistical differences among these diets were non-significant. Correspondingly, average total length achieved by fingerlings was capital (3.30 ± 0.00 cm) treated on T5 (G, 40% CP), followed by T3 (3.28 ± 0.00 cm), T1 (3.20 ± 0.00 cm), T4 (3.19 ± 0.00 cm), T6 (3.16 ± 0.00 cm) and T2 (3.15 ± 0.00 cm) indicating non-significant differences among diets. Many factors can affect meat quality on the way from producer to consumer. Meat Science is a broad research field where these factors are evaluated in relation to a range of production and quality parameters. Protein, fat and ash content deposition was maximum in fish body meat raised on T5 while dry matter and gross energy retention was highest in T6. Convincingly, it is concluded that gelatinized corn starch at 40% protein level is promising fish feed ingredient for excellent outcomes of quality of meat and growth excellence.

Keywords: Corn; Digestibility; Gelatinized; *Labeo rohita*

Introduction

Pakistan faces multiple and interrelated challenges ranging from the impact of the current economic and financial crisis to a greater vulnerability to climate change and extreme weather events. At the same time, we also have to balance the satisfaction of urgent needs for food and nutrition for a growing population with limited natural resources. Corn is rich source of complex carbohydrates, which are chains of simple sugars consist essentially of starch and fibers that occurs in all plant foods. Energy is supplied 4 calories per gram, as well as proteins and also prevents the organic load in ecosystems that ultimately increase pollution. It has been reported that appropriate levels of fat and carbohydrate sources in fish feed can reduce protein breakdown [1]. Rohu, one of three carp (IMC) and an omnivorous fish, has the ability to use carbohydrates to 43% in the diet without adverse health effects [2]. This study aimed to determine the effect of corn on meat quality being main source of carbohydrates and make a comparison of important aspects of growth performance of *L. rohita* fed corn feed (G/NG) at three protein levels i.e. 30%, 35% and 40% in practical and economic systems for commercially available species of carp. These new formulations can minimize the cost of fish and improve the growth and body profile regarding composition and quality of meat.

In fish farming nutrition is critical because feed represent 40-50% of production costs. The general problem of high feed cost associated with fish culture has been addressed by studies on the use of cheaper ingredients as protein sources. Another approach to reduce feed cost is to develop appropriate feeding management strategies and other improvements in husbandry [1]. Keeping in view the economic importance of fish feeding, present study was carried out to determine the growth response of *Labeo rohita* fingerlings fed with different feeding regimes under intensive rearing.

Materials and Methods

Experimental diets

The basic feed ingredient i.e. corn was procured and ground to make powder which were added approximately 80% of water (v/w) and autoclaved at 15 psi for one hour to obtain maximum gelatinization. These gelatinized corn ingredients were spread over a tray and dried in

Ingredient	30% CP	35% CP	40% CP
Casein %	26.57	30.57	35.2
Gelatin %	4	8	5
Corn%G/NG	42.43	42.43	42.4
Cellulose %	15	7	7.4
Sunflower: Codliveroil (2:1)%	8	8	6
Carboxymethyl cellulose %	1	1	1
Vitamin+mineral mix %	2.6	2.6	2.6
Vitamin C %	0.1	0.1	0.1
Vitamin B %	0.1	0.1	0.1
Glycine %	0.2	0.2	0.2
BHT %	0.2	0.2	0.2

(*the antioxidant ButylatedHydroxy Toluene was added at 0.02% of the added oil)

Table 1: Percentage composition of test diets.

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oven at 60°C. The dried mass was then pulverized through a hammer mill with 0.5 mm screen. Protein source was gelatin and fat free casein, while lipid source was sunflower oil and cod liver oil and carbohydrate source was corn (G or NG). All these ingredients (Table 1) were ground and sieved to incorporate into diets and mixed well for 30 minutes, then fish oil was slowly added, while mixing thoroughly. Then the dough was given steam for 5 min in an autoclave. Vitamin-mineral premix was added after cooling the dough and then pellets of 2 mm were made by hand pelletizer. The pellets were dried in a drying oven for 48 hours and stored until use. Three different crude protein levels (30%, 35% and 40%) were used to formulate six semi purified diets (T1: G, 30% CP; T2: NG, 30% CP; T3: G, 35% CP; T4: NG, 35% CP; T5: G, 40% CP and T6: NG, 40% CP) with either gelatinized or non-gelatinized cornstarch.

Experimental design and feeding protocol

Labeo rohita fingerlings purchased from government fish seed hatchery, Satiana road, Faisalabad were allowed to acclimate at ambient conditions fed on control diet (NG, 30% CP) for one week before initiating the trial. After acclimatization, fingerlings were transferred randomly into glass aquaria [90 L×30 W×45 H (cm) with 29 L water capacities each]. For each treatment there were two replicates and in each replica forty fingerlings were stocked. Fish were given test diets at the rate of 4% live wet body weight twice a day (morning and afternoon) in the feeding aquarium.

Growth studies

The morphometric characteristics i.e. body length (cm) and body weight (g) of fingerlings taken from each replicate on express sampling time as day basis were measured and recorded. After obtaining the data, the fishes were released back into their respective aquaria.

Meat quality analysis

At the end of the experiment, representative samples of fish body meat from each replica were homogenized individually using a mortar pestle and analyzed chemically by AOAC procedures: dry matter (DM) by oven drying at 105°C; crude protein (CP) by microkjeldahl analysis, crude fat by chloroform methanol extraction method through 10454 soxtec system HTz, crude fiber by ash-free residue digested with alkali and acid, ash through electric furnace. After finding the possible results, data of growth and body composition was subjected to analysis of variance (ANOVA), SPSS for statistical analysis and mean ± SE values were calculated.

Determination of meat quality

Most reindeer producers in Alaska use an extensive management system where animals are allowed to free-range over large designated grazing ranges on the Seward Peninsula, St Lawrence and Nunivak Islands and the Aleutian Chain. These ranges are large and remote with no or limited availability of slaughtering, processing and transportation infrastructure. Some reindeer producers want to shift the management and location of their operations to more intensively managed farms in Interior Alaska to utilize cereal grain and forage production, slaughtering facilities, and transportation and distribution networks. Currently voluntary state inspection is utilized for reindeer field-slaughter but a federal inspection program is in the process of being initiated. Therefore it is anticipated that more meat from Alaska's reindeer herd will be marketed to consumers and restaurants where questions about meat quality and sensory attributes will arise.

Results

Growth

Values of average increase in body weights of fish fed on three diets are given in Figure 1. At the termination of experiment, fish reared on T5 (G, 40% CP) showed the highest final average body weight (3.63 g) with the initial average body weight (2.68 g) as compared to the other diets. The maximum and minimum gain in

body weight of *Labeo rohita* in test T5 (G, 40% CP) was recorded (0.19 g) and (0.01 g) during 7th express sampling time as day (April) and 1st express sampling time as day (January) followed by T3 (3.51 ± 0.00 g), T6 (3.50 ± 0.00 g), T1 (3.49 ± 0.00 g), T4 (3.38 ± 0.00 g) and T2 (3.36 ± 0.00 g) respectively. Values for average total length and gain in total length of rohu for all diets

are in Table 2 and in Figure 2. Average total length achieved by fingerlings was capital (3.30 ± 0.00 cm) treated on T5 followed by T3 (3.28 ± 0.00 cm), T1 (3.20 ± 0.00 cm), T4 (3.19 ± 0.00 cm), T6 (3.16 ± 0.00 cm) and T2 (3.15 ± 0.00 cm).

Meat quality

The results obtained after body meat analysis of rohu (Table 3) and its body composition compared under all diets is shown in Figures 3-7. The result of this analysis showed that all diets and their interaction have pronounced effect on body of fish. The dry matter (%) deposition was found maximum (Figure 3) in fish body meat reared on T6: NG, 40% CP (98.89%) and minimum in fish body meat reared on T1: G, 30% CP (96.00%). The retention of ash content (%) was found maximum (Figure 4) in fish body meat reared on T5: G, 40% CP (87.59%) and minimum in fish body meat reared on T4: NG, 35% CP (82.50%). The crude fat (%) deposition was found maximum (Figure 5) in fish body meat reared on T5: G, 40% CP as 38% and minimum in fish body meat reared on T2: NG, 30% CP (22%). Crude protein (%) retention was found maximum (Figure 6) in fish body meat reared on T5: G, 40% CP as 39.02% and minimum in fish body meat reared on T2: NG, 30% CP (31.23%). Gross energy (%) retention was found maximum (Figure 7)

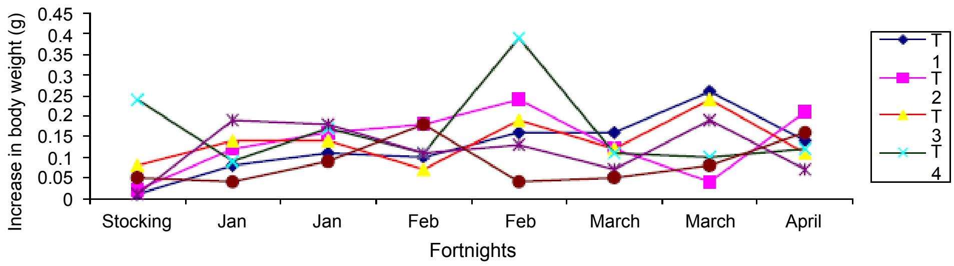

Figure 1: Increase in body weight of *Labeo rohita* reared under different test diets (G/NG) on express sampling time as day basis.

Express sampling time as day	Date of observation	T1		T2		T3		T4		T5		T6	
		Average body length (cm)	Increase in body length (cm)	Average body length (cm)	Increase in body length (cm)	Average body length (cm)	Increase in body length (cm)	Average body length (cm)	Increase in body length (cm)	Average body length (cm)	Increase in body length (cm)	Average body length (cm)	Increase in body length (cm)
Stocking	11/120012	1.75		1.85		2.05		2.2		2.16		1.9	
1	4/1)2013	1.9	0.15	1.99	0.14	1.21	0.16	2.27	0.07	2.26	0.1	2.15	0.25
2	18/1/2013	2.05	0.15	2.16	0.17	2.35	0.14	2.36	0.09	2.42	0.16	2.26	0.11
3	7/2/2013	2.3	0.25	2.27	0.11	2.53	0.18	2.44	0.08	2.63	0.21	2.47	0.21
4	11/1/2013	2.51	0.11	2.35	0.08	2.78	0.25	2.6	0.16	2.85	0.22	2.6	0.13
5	8/7/2013	2.75	0.24	2.44	0.09	2.97	0.19	2.71	0.11	2.95	0.1	1.72	0.12
6	2/31/2013	3.05	0.3	2.82	0.38	3.08	0.11	2.86	0.15	3.09	0.14	2.9	0.18
7	5/4/2013	3.16	0.11	3.01	0.19	3.2	0.12	2.99	0.13	3.19	0.1	3	0.1
8	15/4/2013	3.2	0.04	3.15	0.14	3.28	0.08	3.19	0.2	3.3	0.11	3.16	0.16
Total increase in length			1.45		1.3		1.23		0.99		1.14		1.26

Table 2: Express sampling time as daily increase in average total body length (cm) of *Labeo rohita* reared under different test diets (G/NG).

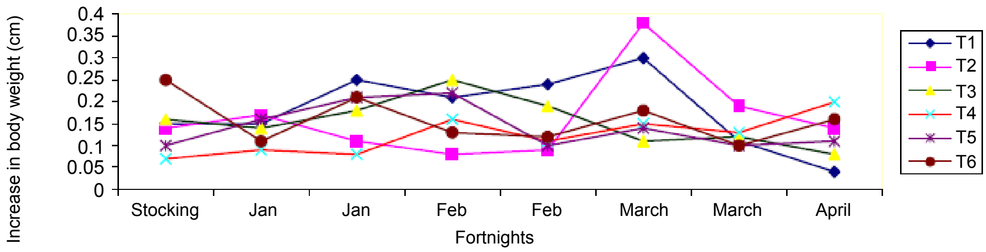

Figure 2: Increase in body length of *Labeo rohita* reared under different test diets (G/NG) on express sampling time as day basis.

Treatment	Body weight	Body length
T1 (30 G)	2.87 ± 0.53 A	2.52 ± 0.54 A
T2 (30 NG)	2.77 ± 0.53 A	2.49 ± 0.52 A
T3 (35 G)	2.92 ± 0.55 A	2.72 ± 0.53 A
T4 (35 NG)	2.75 ± 0.55 A	2.63 ± 0.50 A
T5 (40 G)	3.15 ± 0.57 A	2.76 ± 0.53 A
T6 (40NG)	3.12 ± 0.56 B	2.57 ± 0.52 B

Table 3: Comparison of means of body weight and total length of *Labeo rohita* reared under different test diets (G/NG).

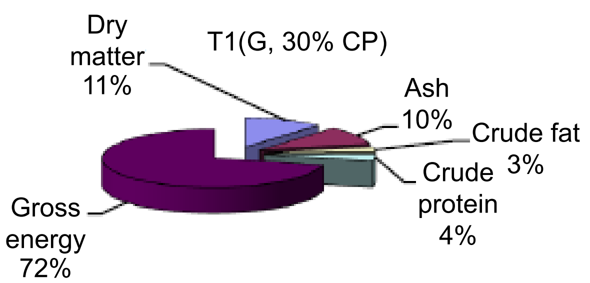

Figure 3: Percentage body composition of fish meat of *Labeo rohita* reared under T1 (G, 30%CP).

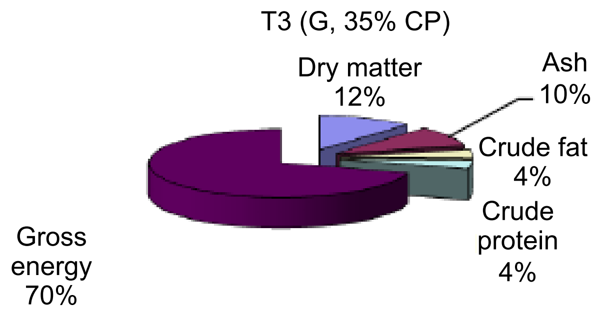

Figure 4: Percentage body composition of fish meat of *Labeo rohita* reared under T3 (G, 35%CP).

in fish body meat reared on T6: NG, 40% CP (649.20%) and minimum in fish body meat reared on T2: NG, 30% CP (597.80%) (Table 4). Conclusively protein, fat and ash content deposition was maximum in fish body meat raised on T5 while dry matter and gross energy retention was highest in T6 (Figure 8).

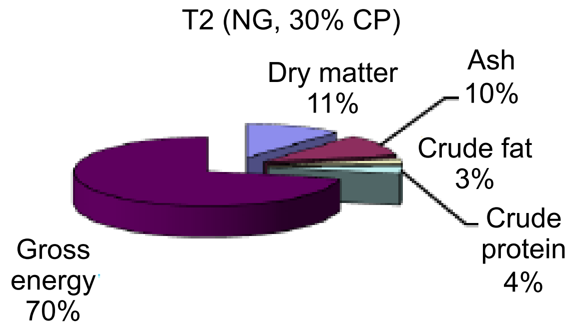

Figure 5: Percentage body composition of fish meat of *Labeo rohita* reared under T2 (NG, 30%CP).

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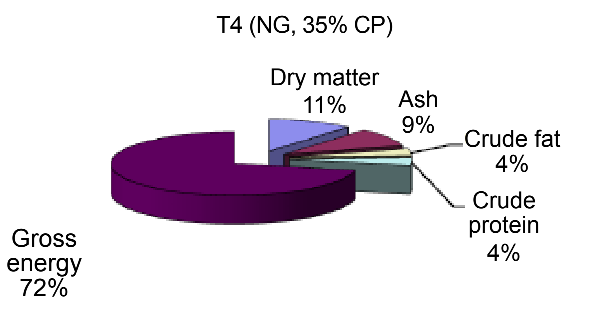

Figure 6: Percentage body composition of fish meat of *Labeo rohita* reared under T4 (NG, 35%CP).

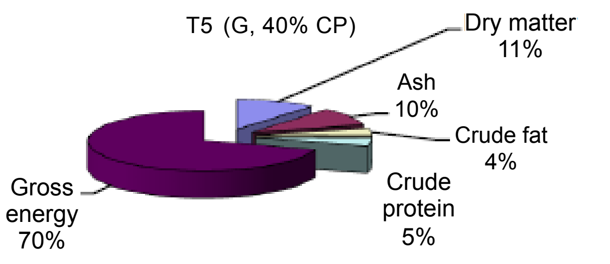

Figure 7: Percentage body composition of fish meat of *Labeo rohita* reared under T5 (G, 40%CP).

Express sampling time as days	Body weight	Body length
Stocking	2.49 ± 0.58 A	1.99 ± 0.54 A
1	2.52 ± 0.58 A	2.13 ± 0.56 A
2	2.63 ± 0.58 A	2.27 ± 0.58 A
3	2.77 ± 0.62 A	2.44 ± 0.58 A
4	2.90 ± 0.65 A	2.62 ± 0.58 AB
5	3.09 ± 0.69 B	2.76 ± 0.58 B
6	3.20 ± 0.70 B	2.97 ± 0.68 B
7	3.34 ± 0.70 B	3.09 ± 0.70 B
8	3.48 ± 0.70 C	3.21 ± 0.70 C

Table 4: Means sharing similar letter in a column are statistically non-significant (P>0.05).

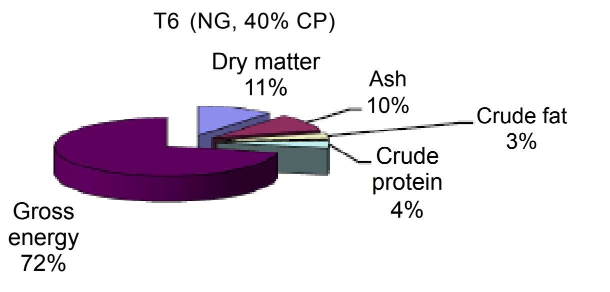

Figure 8: Percentage body composition of fish meat of *Labeo rohita* reared under T6 (NG, 40%CP).

Discussion

At the termination of experiment, fish reared on T5 (G, 40% CP) showed the highest final average body weight which is in agreement with Yengkokpam [3] that 40% CP level improves the growth of fish. Greater the level of gelatinization of corn, higher the level of growth observed in Indian major carps [1]. On contrary, higher level of gelatinization has negative influence on growth of *Labeo rohita* [2].

Comparison of means of body weight and total length of *Labeo rohita* on express sampling time as day basis and among treatments showed nonsignificant variations among them as reported by Mohapatra [4]. Protein, fat and ash content deposition was found maximum in fish body meat raised on T5 (G, 40% CP) while dry matter and gross energy retention was highest in T6 (NG, 40% CP) which indicated the protein level in fish feed has pronounced effects on meat profile. On contrary, dietary protein level has no effect on fish body meat [5]. Gelatinization of feed has significant effect on fat and protein deposition in fish body meat at varying protein levels [6,7] which favors the present results.

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