International Journal of Agriculture Innovations and Research
Volume 2, Issue 6, ISSN (Online) 2319-1473
Manuscript Processing Details (dd/mm/yyyy) :
Received : 27/05/2014 | Accepted on : 13/06/2014 | Published : 23/06/2014

Growth and Body Composition Changes in *Labeo rohita* in Relation to Dietary Carbohydrate Content (Gelatinized and Non-Gelatinized Corn) and Protein Levels

Farkhanda Asad, Mahwish Qamer, Asma Ashraf

***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 (T_1: G, 30% CP; T_2: NG, 30% CP; T_3: G, 35% CP; T_4: NG, 35% CP; T_5: G, 40% CP and T_6: NG, 40% CP) formulated with either gelatinized or non-gelatinized corn starch followed by two replicates for each diet. Fish reared on T_5 (G, 40% CP) exhibited highest average body weight (3.63±0.00 g) followed by T_3 (3.51±0.00 g), T_6 (3.50±0.00 g), T_1 (3.49±0.00 g), T_4 (3.38±0.00 g) and T_2 (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 T_5 (G, 40% CP), followed by T_3 (3.28±0.00 cm), T_1 (3.20±0.00 cm), T_4 (3.19±0.00 cm), T_6 (3.16±0.00 cm) and T_2 (3.15±0.00 cm) indicating non-significant differences among diets. Protein, fat and ash content deposition was maximum in fish body meat raised on T_5 while dry matter and gross energy retention was highest in T_6. 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*.**

I. 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.

II. Materials and Methods

2.1 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 oven at 60 ^{0}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 I) 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 (T_1: G, 30% CP; T_2: NG, 30% CP; T_3: G, 35% CP; T_4: NG, 35% CP; T_5: G, 40% CP and T_6: NG, 40% CP) with either gelatinized or non-gelatinized corn starch.

Table I: Percentage composition of test diets.

Ingredients	30% CP	35% CP	40% CP
Casein %	26.57	30.57	35.20
Gelatin %	4.00	8.00	5.00
Corn%G/NG	42.43	42.43	42.4
Cellulose %	15.00	7.00	7.40
Sunflower:Codliver oil (2:1)%	8.00	8.00	6.00
Carboxymethyl cellulose %	1.00	1.00	1.00
Vitamin+mineral mix %	2.60	2.60	2.60
Vitamin C %	0.10	0.10	0.10
Vitamin B %	0.10	0.10	0.10
Glycine %	0.20	0.20	0.20
BHT %	0.02	0.02	0.02

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

2.2 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 [90L×30W×45H (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.

2.3 Growth studies

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

2.4 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 [3] 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.

III. RESULTS

3.1 Growth

Values of average increase in body weights of fish fed on three diets are given in table II and in figure 1. At the termination of experiment, fish reared on T_5 (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 T_5 (G, 40% CP) was recorded (0.19 g) and (0.01 g) during 7th fortnight (April) and 1st fortnight (January) followed by T_3 (3.51±0.00 g), T_6 (3.50±0.00 g), T_1 (3.49±0.00 g), T_4 (3.38±0.00 g) and T_2 (3.36±0.00 g), respectively. Values for average total length and gain in total length of rohu for all diets are in table III and in figure 2. Average total length achieved by fingerlings was capital (3.30±0.00 cm) treated on T_5 followed by T_3 (3.28±0.00 cm), T_1 (3.20±0.00 cm), T_4 (3.19±0.00 cm), T_6 (3.16±0.00 cm) and T_2 (3.15±0.00 cm).

3.3 Meat Quality

The results obtained after body meat analysis of rohu (Table IV) and its body composition compared under all diets is shown in fig. 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 T_6: NG, 40% CP (98.89%) and minimum in fish body meat reared on T_1: G, 30% CP (96.00%). The retention of ash content (%) was found maximum (Figure 4) in fish body meat reared on T_5: G, 40% CP (87.59%) and minimum in fish body meat reared on T_4: NG, 35% CP (82.50%). The crude fat (%) deposition was found maximum (Figure 5) in fish body meat reared on T_5: G, 40% CP as 38% and minimum in fish body meat reared on T_2: NG, 30% CP (22%). Crude protein (%) retention was found maximum (Figure 6) in fish body meat reared on T_5: G, 40% CP as 39.02% and minimum in fish body meat reared on T_2: NG, 30% CP (31.23%). Gross energy (%) retention was found maximum (Figure 7) in fish body meat reared on T_6: NG, 40% CP (649.20%) and minimum in fish body meat reared on T_2: NG, 30% CP (597.80%). Conclusively protein, fat and ash content deposition was maximum in fish body meat raised on T_5 while dry matter and gross energy retention was highest in T_6.

Table II: Fortnightly increase in average total body weight (g) of Labeo rohita under different test diets (G/NG).

Fortnights	Date of observation	T_1		T_2		T_3		T_4		T_5		T_6	
		Average body weight (g)	Increase in body weight (g)	Average body weight (g)	Increase in body weight (g)	Average body weight (g)	Increase in body weight (g)	Average body weight (g)	Increase in body weight (g)	Average body weight (g)	Increase in body weight (g)	Average body weight (g)	Increase in body weight (g)
Stocking	21/12/2012	2.47	-	2.27	-	2.41	-	2.05	-	2.68	-	2.81	-
1	4/1/2013	2.48	0.01	2.29	0.02	2.49	0.08	2.29	0.24	2.69	0.01	2.86	0.05
2	18/1/2013	2.56	0.08	2.41	0.12	2.64	0.14	2.38	0.09	2.88	0.19	2.90	0.04
3	7/2/2013	2.67	0.11	2.57	0.16	2.78	0.14	2.55	0.17	3.06	0.18	2.99	0.09
4	22/2/2013	2.77	0.10	2.75	0.18	2.85	0.07	2.66	0.11	3.17	0.11	3.17	0.18
5	8/3/2013	2.93	0.16	2.99	0.24	3.04	0.19	3.05	0.39	3.30	0.13	3.21	0.04
6	22/3/2013	3.09	0.16	3.11	0.12	3.16	0.12	3.16	0.11	3.37	0.07	3.26	0.05
7	5/4/2013	3.35	0.26	3.15	0.04	3.40	0.24	3.26	0.10	3.56	0.19	3.34	0.08
8	15/4/2013	3.49	0.14	3.36	0.21	3.51	0.11	3.38	0.12	3.63	0.07	3.50	0.16
Total increase in weight			1.02		1.09		1.09		1.33		0.95		0.69

International Journal of Agriculture Innovations and Research
Volume 2, Issue 6, ISSN (Online) 2319-1473

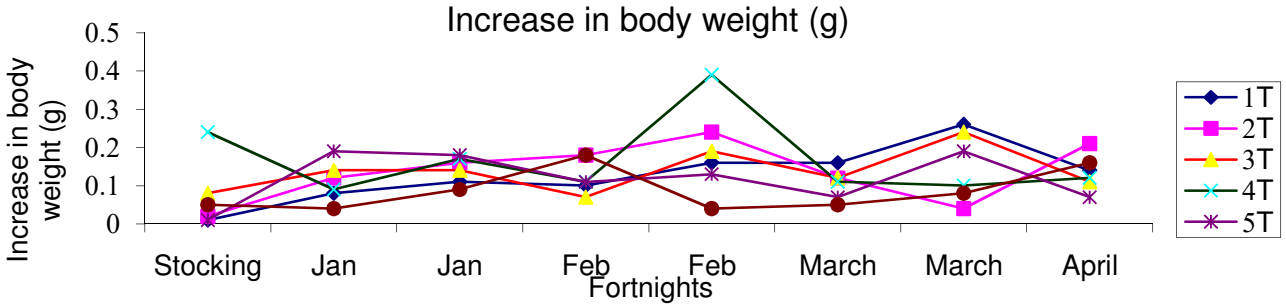

Fig.1. Increase in body weight of Labeo rohita reared under different test diets (G/NG) on fortnight basis.

Table III: Fortnightly increase in average total body length (cm) of Labeo rohita reared under different test diets (G/NG).

Fortnights	Date of observation	T_1		T_2		T_3		T_4		T_5		T_6	
		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	21/12/2012	1.75	-	1.85	-	2.05	-	2.20	-	2.16	-	1.90	-
1	4/1/2013	1.90	0.15	1.99	0.14	2.21	0.16	2.27	0.07	2.26	0.10	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	2.30	0.25	2.27	0.11	2.53	0.18	2.44	0.08	2.63	0.21	2.47	0.21
4	22/2/2013	2.51	0.21	2.35	0.08	2.78	0.25	2.60	0.16	2.85	0.22	2.60	0.13
5	8/3/2013	2.75	0.24	2.44	0.09	2.97	0.19	2.71	0.11	2.95	0.10	2.72	0.12
6	22/3/2013	3.05	0.30	2.82	0.38	3.08	0.11	2.86	0.15	3.09	0.14	2.90	0.18
7	5/4/2013	3.16	0.11	3.01	0.19	3.20	0.12	2.99	0.13	3.19	0.10	3.00	0.1
8	15/4/2013	3.20	0.04	3.15	0.14	3.28	0.08	3.19	0.20	3.30	0.11	3.16	0.16
Total inc in length			1.45		1.30		1.23		0.99		1.14		1.26

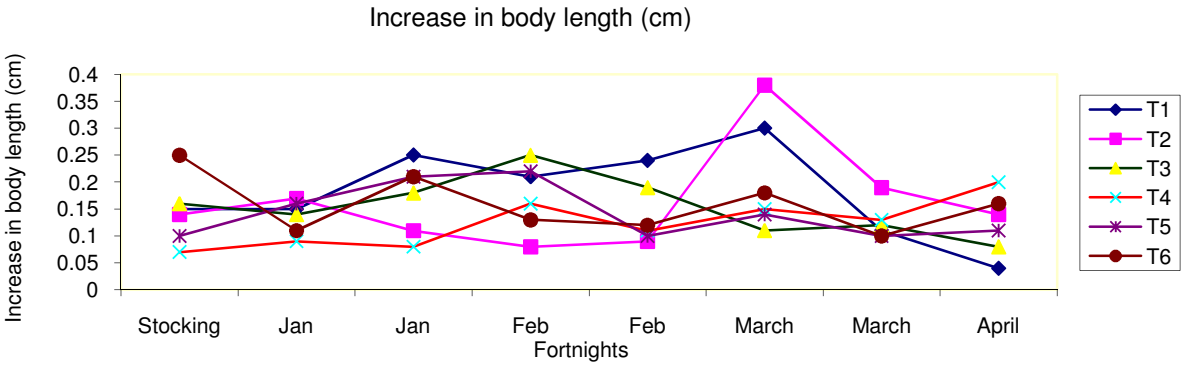

Fig.2. Increase in body length of Labeo rohita reared under different test diets (G/NG) on fortnight basis.

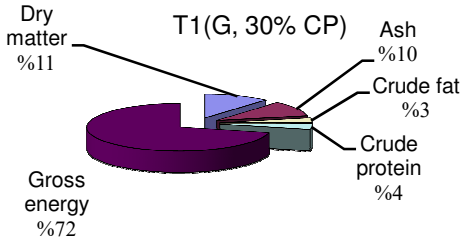

Fig.3. Percentage body composition of fish meat of Labeo rohita reared under T_1 (G, 30%CP).

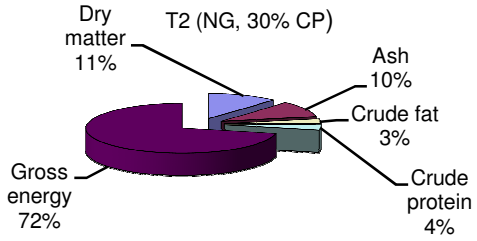

Fig.4. Percentage body composition of fish meat of Labeo rohita reared under T_2 (NG, 30%CP).

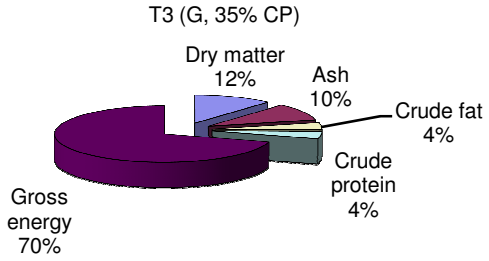

Fig.5. Percentage body composition of fish meat of Labeo rohita reared under T_3 (G, 35%CP).

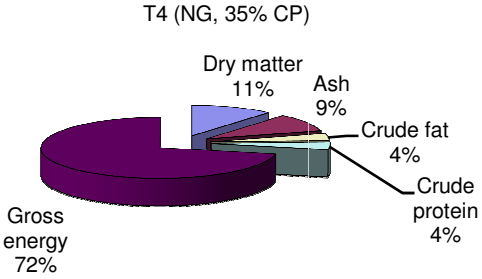

Fig.6. Percentage body composition of fish meat of Labeo rohita reared under T_4 (NG, 35%CP).

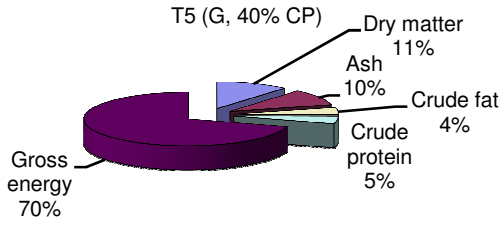

Fig.7. Percentage body composition of fish meat of Labeo rohita reared under T_5 (G, 40%CP).

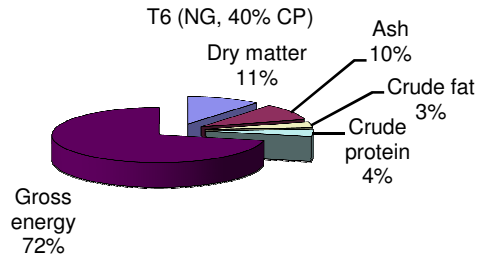

Fig.8. Percentage body composition of fish meat of Labeo rohita reared under T_6 (NG, 40%CP).

IV. Discussion

At the termination of experiment, fish reared on T_5 (G, 40% CP) showed the highest final average body weight which is in agreement with [4] 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].

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

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

Fortnights	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

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

Comparison of means of body weight and total length of *Labeo rohita* on fortnight basis and among treatments showed non-significant variations among them as reported by [5]. Protein, fat and ash content deposition was found maximum in fish body meat raised on T_5 (G, 40% CP) while dry matter and gross energy retention was highest in T_6 (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 [6]. Gelatinization of feed has significant effect on fat and protein deposition in fish body meat at varying protein levels [7] which favors the present results.

V. Conclusion

Non-gelatinized corn at 40% protein level proved as a promising fish feed ingredient being more efficiently utilized and gave better growth and tissue deposition results in *Labeo rohita*. While, 35% protein level in the fish feed showed overall good effects on the growth of rohu as compared to other protein level. Therefore, it can be incorporated in fish for maximum growth performance while gelatinized corn showed excellent results in case of body meat at 40% protein level.

REFERENCES

[1] Singh, R. K., Balange, A. K & Ghughuskar, M. M. (2006). Protein sparing effect of carbohydrates in *Cirrhinus mrigala* (Hamilton, 1822) fry. *Aquaculture,* 258: 680-684.

[2] Kumar, V., Sahu, N. P., Pal, A. K., Kumar, S & Gupta, S. K. (2007). Gelatinized to non-gelatinized starch ratio in the diet of *Labeo rohita:* effect on digestive and metabolic response and on growth. *Journal of Animal Physiology and Animal Nutrition,* 92: 492-501.

[3] Association of Official Analytical Chemists (AOAC), (1990). Official Methods of Analysis, 15th Ed, p. 1094. Association of Official Analytical chemists, Washington D.C. USA.

[4] Yengkokpam, S., Sahu, N. P., Pal, A. K., Mukherjee, S. C & Debnath, D. (2007). Gelatinized carbohydrates in the diet of *Catla catla* fingerlings: Effect of levels and sources on nutrition utilization, body composition and tissue enzyme activities. *Journal of Animal Science,* 2: 89-99.

[5] Mohapatra, M., Sahu, N. P & Chaudhari, A. (2002). Utilization of gelatinized carbohydrate in diets of *Labeo rohita* fry. *Aquaculture nutrition*, 9: 189-196.

[6] Khattab, Y. A. E., Ahmed, M. H., Shalaby, A. M. E & Abdel-Tawwab, M. (2003). Response of Nile Tilapia from different locations to different dietary protein levels. Egypt. *Aquatic Biology and Fisheries,* 4: 295-311.

[7] Hutchins, C. G., Rawles, S. D & Gatlin, D. M. (2011). Effects of dietary carbohydrate kind and level on growth, body composition and glycemic response of juveniles sunshine bass. *Aquaculture,* 161: 187-199.

AUTHOR'S PROFILE:

Dr. Farkhanda Asad
Ph.D (Zoology and Fisheries 2011);
Field of Specialization: Fish Nutrition;
Assistant Professor, Department of Zoology, Wildlife and Fisheries, Government College University, Faisalabad, Pakistan.