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EFFECT OF DIFFERENT FEED INGREDIENTS ON GROWTH, SENSORY ATTRIBUTES AND BODY COMPOSITION OF *LABEO ROHITA*

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ABSTRACT

Comparative studies on effect of different feed ingredients on growth, sensory attributes and body composition of *Labeorohita* were conducted in fiber glass tanks having dimensions 12 ft x 4ft x 3 ft (length x width x depth) for a period of 3-months. *Labeorohita* (n = 10), having average body weight 200±2.33g were stocked in each fiberglass tank and were fed @ 4% of total fish biomass. Plant origin feed ingredients viz. guar meal, soybean meal, cotton seed meal and canola meal were used as treatment diets while fishmeal served as control. Each ingredient was considered as a separate treatment and there were three replicates for each of the treatment and control diets. Statistically significant ($P \leq 0.05$) differences were observed in growth, FCR and specific growth rates among treatment and control diets. Weight gain was highest in fish fed with guar meal while the same was lowest for fishmeal diets. Although, there were differences in chemical composition of different feed ingredients however, statistically non-significant differences were observed in sensory attributes of fish flesh and the body composition of fish. Statistically, significant ($P \leq 0.05$) variations in mineral content viz. Na, Ca, Fe, Zn, and Cu were recorded in fish flesh among treatment and control diets. It can be concluded from present study that plant origin feed ingredients viz. guar meal, soybean meal, cotton seed meal and canola meal can be safely used for feed formulations of herbivorous fish species while guar meal is recommended for better growth performance of *Labeorohita*.

Key words: *Labeorohita*, feed ingredients, proximate analysis, mineral composition, growth

INTRODUCTION

Fish is a rich source of animal protein, contains higher unsaturated fatty acid contents, low levels of cholesterol (Arts *et al.*, 2001; Fawole *et al.*, 2007) and are preferred over red meats (Mozaffarian *et al.*, 2003; Foran *et al.*, 2005). The nutrient profile of the fish however varies among the individuals of the same species and between the members of other species when cultured under different environments and culture systems. Among herbivorous fish species, *Labeorohita* is preferred by the consumers due to its typical taste and texture and by the fish culturists due to better growth performance, varying feeding habits, tolerant to temperature and salinity fluctuations (Khan *et al.*,2004; Hussain *et al.*,2011). Major hindrance in the development of fish industry are the expensive feed stuffs as more than 60% of the total cost is the cost of feed. Feed stuffs have pronounced effect on fish growth, its nutritional values and adjunct qualities (Shioya *et al.*,2011). Additionally it determines lipid profile, mineral content of produced fish and ultimately the market response (Rasmussen, 2001; Izquierdo *et al.*, 2003).

Cost effective feed stuffs that are compatible with fish type, easily digested and readily available are the demand of the industry and can play pivotal role in the advancement of fish industry (Iqbal *et al*., 2015). The present study was therefore planned to find out the effect of individual feed ingredients on fish growth, meat quality and body composition of *Labeorohita* which can pave the way for formulation of biologically effective and cost efficient feeds.

MATERIALS AND METHODS

This 3-month feeding trial on effect of different feed ingredients on growth, sensory attributes and body composition of *Labeorohita* was conducted at Department of Fisheries and Aquaculture, Ravi Campus, University of Veterinary and Animal Sciences, Lahore. Feed ingredients viz. guar meal, soybean meal, cotton seed meal and canola meal were offered individually and each ingredient was considered as a treatment while fishmeal served as control. The proximate analysis of the experimental and control diets is given in Table 1. There were three replicates for each of the treatment and control diets. A total of 150 *Labeorohita* with an average body

weight of 200±2.23g were collected from earthen ponds and were randomly stocked in 15 fiber glass tanks (10 fish/tank) having dimensions 12ft x 4ft x 3 ft (length x width x depth). Fish in each tank were uniformly fed @ 4% of their wet biomass twice daily during dawn and dusk hours. The body weight and length of individual fish were recorded at the initiation of experiment and thereafter increase in fish weight and length was recorded on fortnightly basis. At the end of feeding trials, average weight gain (AWG), average increase in length (AIL) and specific growth rate (SGR) were determined for each of the treatment and control feeds using following formulae (Iqbal *et al*., 2015):

Ave. weight gain (g) = Ave. final weight – ave. initial weight

Ave. increase in length (cm) = Ave. final length – ave. initial length

$$S\ G\ R\ (\%) = \frac{Fn\ (\text{final body weight}) - \ln\ (\text{initial body weight})}{\text{Number of days}} \times 100$$

At the end of trial, 5 fish from each of the treatment and control tanks were randomly collected using hand net. The captured fish were degutted and cleaned with tap water. Uniform sized fillets (3.5 x 6.5 cm) with an average weight of 27g were prepared and processed further in presentable and consumable form following Iqbal *et al*. (2014a). These fillets were presented to 15-membered semi-trained panel from students and faculty members of University of Veterinary and Animal Sciences, Lahore, Pakistan for organoleptic test. The descriptors for various sensory attributes were color, intensity of color (whitish/creamish); typical of steamed fish flesh, flavor; intensity of perceived taste of typical steamed fish flesh, juiciness; intensity of juiciness of steamed fish flesh while chewing, tenderness; intensity of softness perceived at the time of chewing, oiliness; intensity of oiliness that perceived taste of a typical steamed fish flesh and overall acceptability; overall impression of the steamed fish flesh based on above attributes. Sensory tests for each treatment were performed on the same day under white incandescent lights (Meilgaard *et al*., 2007; Khan *et al.,* 2011).

Fish body composition and composition of experimental ratio (Table 1) was carried out following Iqbal *et al*. (2014b). The water quality parameters viz. dissolved oxygen (DO) was determined using DO meter (YSI 55 Incorporated, Yellow Springs, Ohio, 4387, USA), pH through pH meter (LT-Lutron pH-207 Taiwan) while electrical conductivity, water temperature, salinity and total dissolved solids were determined through conductivity meter (Condi 330i WTW 82362 Weilheim Germany).The obtained data was analyzed through statistical software SAS 9.1 and Analysis of Variance (ANOVA) was applied to compare the means.

Table 1. Proximate and mineral analysis of Feed ingredients

Analysis	Fish meal	Cotton seed meal	Canola meal	Guar meal	Soybean Meal
		Proximate analysis			
Protein %	40.96±0.07	41.37±0.08	39.64±0.07	33.81±0.06	35.41±0.08
Fat %	8.76±0.03	0.55±0.07	0.88±0.056	2.515±0.06	0.00±0.00
Moisture %	6.06±0.08	8.59±0.09	8.49±0.071	5.56±0.07	10.67±0.06
Ash %	25.37±0.06	13.995±0.06	5.745±0.05	10.61±0.08	10.89±0.05
		Mineral analysis			
Ca (ppm)	0.565±0.04	1.155±0.05	1.170±0.07	1.195±0.06	3.970±0.28
Mg (ppm)	2.135±0.08	1.450±0.07	1.695±0.04	2.615±0.07	2.210±0.03
Na (ppm)	48.000±0.14	4.550±0.07	5.250±1.49	5.400±1.27	3.400±0.57
K (ppm)	68.950±1.63	84.550±2.76	71.200±12.16	76.950±11.81	106.500±6.36
Fe (ppm)	3.410±0.11	4.245±0.11	2.900±0.09	3.295±0.12	7.950±0.51
Zn (ppm)	0.265±0.02	0.350±0.04	0.275±0.04	0.180±0.04	0.270±0.04
Cu (ppm)	0.065±0.02	0.085±0.01	0.045±0.01	0.075±0.01	0.130±0.01

RESULTS AND DISCUSSION

During present study average weight gain, average increase in length and SGR of fish varied significantly ($P \leq 0.05$) between the treatment and control diets. The fish fed with guar meal showed significant increase in SGR than rest of the feed ingredients (Table 2) having relatively higher protein contents. Abid and Ahmed (2009a) documented that increase in CP levels of feed do not affect fish growth. During present study, fish fed with plant based feed ingredients showed better growth performance than fishmeal which is contradictory to the findings of Shabir *et al.* (2003) and Jabeen *et al.* (2004) who observed higher growth in *Cirrhinusmrigala* fingerlings fed on fishmeal than cotton seed meal. However, Hasan *et al.* (1997) documented non-significant variations in growth responses of common carp, *Cyprinuscarpio* fed on plant and animal origin feeds. Our findings are comparable to the results of Latif *et al.* (2008) who concluded that plant based feeds generally and guar and cotton seed meal particularly can be the alternates of fishmeal for *Labeorohita.*

During present study statistically significant differences were observed in FCR for different feed

ingredients. Better FCR values were recorded in fish fed with guar meal (4.54±0.20) diets while the same was poor for fishmeal (9.31±0.73) (Table 2). Although the FCR values are relatively higher but can be justified by the results of Ng *et al*. (2000) who documented that in larger fish, FCR decreases with increase in weight of the fish.

Table 2. Average weight gain, average length increase, FCR and SGR

Feed ingredients	Average weight gain (g)	Average length increase (cm)	FCR	SGR %
Guar Meal	134±68±2.50[a]	6.17±0.26[a]	4.54±0.20[d]	0.26±0.02[a]
Canola Meal	121.39±1.39[ab]	5.27±0.07[ab]	4.76±0.41[cd]	0.25±0.01[a]
Soybean Meal	110.50±6.50[b]	5.95±0.22[a]	6.18±0.26[bc]	0.21±0.01[b]
Cotton Seed Meal	93.94±1.50[c]	5.44±0.24[a]	7.40±0.31[b]	0.18±0.02[bc]
Fish Meal	76.45±4.21[d]	4.48±0.37[b]	9.31±0.73[a]	0.16±0.01[c]

Values with the same superscript are not significantly different

During present study, non-significant differences were recorded in sensory attributes and no effect of plant based feed ingredients was observed on color, flavor, juiciness, tenderness, oiliness and overall acceptability of the fish flesh (Table 3). Our results are in line with the findings of Bjerkeng *et al*. (1997) who did not observe any significant difference in flavor, flavor freshness, bitterness, sourness, rancidity or off-flavor when evaluated Atlantic salmon fed with soybean meal and the fishmeal-based diets. Similarly, Khan *et al.* (2011) documented non-significant differences in meat quality of fish reared on natural or artificial feed. Brinker and Reiter (2011) replaced fishmeal with plant protein and guar gum in trout feeds. Despite major differences in quality of ingredients, slight variations were observed in organoleptic characteristics of flesh.

Table 3. Sensory attributes score of fish flesh

	Color	Flavor	Tenderness	Juiciness	Oiliness	Overall acceptability
CSM	6.58±0.58[a]	6.83±0.39[a]	6.42±0.45[a]	6.42±0.42[a]	6.58±0.58[a]	6.33±0.47[a]
CM	6.42±0.53[a]	6.00±0.35[a]	6.17±0.44[a]	6.83±0.27[a]	6.08±0.61[a]	6.00±0.53[a]
FM	6.67±0.58[a]	6.83±0.47[a]	6.18±0.44[a]	6.83±0.44[a]	6.08±0.48[a]	7.25±0.35[a]
SBM	6.42±0.61[a]	6.67±0.53[a]	6.18±0.57[a]	6.50±0.45[a]	6.08±0.54[a]	7.00±0.46[a]
GM	6.58±0.64[a]	6.08±0.58[a]	5.50±0.62[a]	6.33±0.58[a]	5.58±0.54[a]	5.83±0.50[a]

Cotton Seed Meal (CSM), Canola Meal (CM), Fishmeal (FM), Soybean Meal (SBM) and Guar Meal (GM)
Note: The results show organoleptic evaluation test marks out of ten; Values with same superscript letters in columns are not significantly different from each other at p>0.05

Proximate analysis of fish fed on different feeds showed significant ($P \leq 0.05$) differences in fat and ash while non-significant variations were recorded in protein and moisture contents. The protein contents were highest (72.63±14.86%) in fish flesh fed with guar meal while lowest (66.94±3.06%) for cotton seed meal diets. Similarly, fat contents (7.10±0.12%) were highest in fish fed on canola meal diets while same were lowest (4.89±0.84%) for fishmeal diets. Highest moisture contents (76.00±1.05%) were observed in fish reared on fishmeal diets while the same were lowest (71.01±1.00%) for cotton seed meal diets (Table 4). Our results are in line with the findings of Umer and Ali (2009) who observed significant differences in fat content of fish flesh when compared animal and plant origin diets in *Labeorohita* while non-significant variations were recorded in protein content. Similarly, Khan *et al.*(2012) documented that replacement of fishmeal with plant origin feeds did not affect body composition of Indian major carp.

During present study, mineral composition of whole grinded *Labeorohita* showed statistically significant ($P \leq 0.05$) in Na, Ca, Fe, Zn and Cu content (Table 4). Iqbal *et al.* (2014) observed that composition of feed affects mineral composition of fish flesh. Similarly, Toko*et al.* (2008) concluded that composition of feed has pronounced effect on the mineral body composition of fish.

During present study, the physico-chemical parameters of water viz. temperature, dissolved oxygen, pH, salinity, TDS and electrical conductivity remained within the permissible limits (Table 5) and can be corroborated with previous findings (Ali *et al.*, 2000; Abid and Ahmed, 2009 a, b).

Table 4. Proximate and mineral analysis of *Labeorohita* on different feed ingredients

Proximate analysis					
Analysis	**Fish meal**	**Cotton seed meal**	**Canola meal**	**Guar meal**	**Soybean Meal**
Protein %	68.25±1.75^{a}	66.94±3.06^{a}	67.81±2.19^{a}	72.63±14.86^{a}	68.19±0.94^{a}
Fat %	4.89±0.84^{b}	5.23±0.23^{b}	7.10±0.12^{a}	6.83±0.28^{a}	5.53±0.21^{ab}
Moisture %	76.00±1.05^{a}	71.01±1.00^{a}	71.50±2.50^{a}	73.00±1.06^{a}	75.00±1.21^{a}
Ash %	17.50±2.50^{b}	15.00±1.01^{b}	23.50±1.50^{a}	14.50±1.50^{b}	14.00±2.12^{b}
Mineral analysis					
Ca (ppm)	11.110±0.19^{c}	12.940±0.23^{bc}	15.095±1.55^{a}	13.180±0.24^{b}	12.955±0.37^{bc}
Mg (ppm)	2.865±0.08^{a}	3.065±0.12^{a}	2.785±0.13^{a}	3.015±0.21^{a}	3.005±0.16^{a}
Na (ppm)	25.600±2.69^{b}	20.350±0.12^{b}	32.850±3.75^{a}	24.950±0.64^{b}	22.200±1.41^{b}
K (ppm)	55.850±6.15^{a}	54.550±4.66^{a}	53.600±5.37^{a}	57.550±16.33^{a}	53.100±2.82^{a}
Fe (ppm)	1.620±0.05^{c}	1.360±0.11^{d}	2.710±0.07^{a}	2.260±0.14^{b}	1.535±0.07^{dc}
Zn (ppm)	0.675±0.05^{b}	0.730±0.03^{b}	1.305±0.09^{a}	0.480±0.06^{c}	0.959±0.06^{bc}
Cu (ppm)	0.030±0.01^{a}	0.030±0.01^{a}	0.030±0.01^{a}	0.020±0.00^{b}	0.010±0.00^{c}

Mean ± SD, mean in rows with the same letter are not significantly different

Table 5.Average physicochemical parameters in different feed ingredients.

Ingredients	DO	pH	Temperature	EC	TDS	Salinity (ppt)
Soybean Meal	5.69±0.06	7.532±0.04	33.59±0.42	2.77±0.03	971.51±11.76	0.87±0.02
Canola Meal	4.15±0.08	8.05±0.05	34.66±0.47	2.62±0.04	1074.63±33.04	1.02±0.03
Guar Meal	6.28±0.09	7.73±0.04	32.68±0.37	2.60±0.03	970.80±9.11	0.96±0.01
Cotton Seed Meal	4.86±0.07	8.38±0.03	34.97±1.54	2.65±0.06	987.72±8.32	0.84±0.05
Fish Meal	5.955±0.7	8.07±0.18	33.78±0.92	2.50±1.08	937.17±31.09	0.81±0.01

It can be concluded from present study that guar meal enhances growth in *Labeorohita* and can be used as replacement of fishmeal while formulating fish feeds. It is further explained that the feed ingredients viz. fishmeal, cotton seed meal, canola meal, guar meal and soybean meal did not affect sensory attributes and body composition of fish.

REFERENCES

Abid, M. and M.S. Ahmed (2009a). Growth response of *Labeorohita*fingerlings fed with different feeding regimes under intensive rearing. J. Anim. Plant Sci. 19(1): 45-49.

Abid, M. and M.S. Ahmed(2009b).Efficacy of feeding frequency on growth and survival of *Labeorohita*(Ham.) fingerlings under intensive rearing. J. Anim. Plant Sci.19(2):111-113.

Ali, M., A. Salam, A. Azeem, M. Shafiq and B.A. Khan (2000). Studies on the effect of seasonal variations on physical and chemical characteristics of mixed water from River Ravi and Chenab at union site in Pakistan. J. Res. (Sci.) 11: 11-17.

Arts, M.T., R.G. Ackman and B. J. Holub (2001). Essential fatty acids in aquatic ecosystems: a crucial link between diet and human health and evolution. Can. J. Fish.Aquat. Sci. 58: 122-137.

Bjerkeng, B., S. Refstie, K.T. Fjalestad, T. Storebakken, M. Roedbotten, and A. J. Roem (1997).Quality parameters of the flesh of Atlantic salmon (*Salmosalar*) as affected by dietary fat content and full-fat soybean meal as a partial substitute for fish meal in the diet.Aquacult. 157: 297-309.

Brinker A. and R. Reiter (2011). Fish meal replacement by plant protein substitution and guar gum addition in trout feed, part I: effects on feed utilization and fish quality. Aquacult. 310: 350-360.

Fawole, O.O., M.A. Ogundiran, T.A. Ayandiran and O.F. Olagunju (2007). Mineral composition in some selected fresh water fishes in Nigeria. J. Food Safety. 9: 52-55.

Foran, J.A., D.O. Carpenter, M.C. Hamilton, B.A. Knuth and S.J. Schwager (2005). Risk- based consumption advice for farmed Atlantic and wild pacific salmon contaminated with dioxins and dioxin-like compounds. Environ. Health Persp. 33: 552-556.

Hasan, M. R., D.J. Macintosh and K. Jauncey (1997). Evaluation of some plant ingredients as dietary protein sources for common carp (*Cyprinuscarpio L.*) fry. Aquacult. 151: 55-70.

Hussain, S.M., S.A. Rana, M. Afzal and M. Shahid (2011). Efficacy of phytase supplementation on mineral digestibility in *Labeorohita* fingerlings fed on corn gluten meal (30%) based diets. Pakistan J. Agri. Sci. 48:237-241.

Iqbal, K. J., M. Ashraf, A. Javid, F. Abbas, M. Hafeez-ur-Rehman, F. Rasool, N. Khan, S. Abbas and M. Altaf (2014a). Effect of feed on the mineral composition of *Labeorohita*. Intl. J. Farm. Alli. Sci. 3(9):952-955.

Iqbal, K. J., M. Ashraf, F. Abbas, A. Javid, M. Hafeez-ur-Rehman, S. Abbas, F. Rasool, N. Khan, S. A. Khan and M. Altaf (2014b). Effect of Plant-Fishmeal and Plant by Product Based Feed on Growth, Body Composition and Organoleptic Flesh Qualities of *Labeorohita.* Pakistan J. Zool. 46(1):253-260.

Iqbal, K. J., M. Ashraf, N.A. Qureshi, A. Javid, F. Abbas, M. Hafeez-ur-Rehman, F. Rasool, N. Khan and S. Abbas (2015). Optimizing Growth Potential of Labeorohita Fingerlings Fed on Different Plant Origin Feeds. Pakistan J. Zool. 47(1): 31-36

Izquierdo, M.S., A. Obach, L. Arantzamendi, D. Montero, L. Robaina and G. Rosenlund (2003). Dietary lipid sources for seabream and sea bass: growth performance, tissue composition and flesh quality. Aquacult. Nutr. 9:397-407.

Jabeen, S., M. Salim and P. Akhtar (2004). Feed conversion ratio of major carp *Cirrhinusmrigala* fingerlings fed on cotton seed meal, fish meal and barley. Pakistan Vet. J. 24: 42-45.

Khan, M. A., I. Ahmed and S.F. Abidi (2004).Effect of ration size on growth, conversion efficiency and body composition of fingerling mrigal, *Cirrhinusmrigala* (Hamilton). Aquacult. Nutr. 10: 47-53.

Khan, N., M. Ashraf, N. A. Qureshi, P. K. Sarker, G. W. Vandenberg and F. Rasool (2012). Effect of similar feeding regime on growth and body composition of Indian major carps (*Catlacatla, Cirrhinusmrigala* and *Labeorohita*) under mono and polyculture. Afr. J. Biotechnol. 11(44): 10280-10290.

Khan, N., N. A. Qureshi, M. Nasir, F. Rasool and K. J. Iqbal (2011). Effect of artificial diet and culture systems on sensory quality of fried fish flesh of Indian major carps (*Labeo rohita, Catlacatla* and *Cirrhinusmrigala*). Pakistan J. Zool. 43(6): 1177-1182.

Meilgaard, M. C., G. V. Civille and B. T. Carr (2007). Sensory evaluation techniques, 4th Edition, CRC Press, Boca Raton, FL USA.

Mozaffarian, M.D., N.L. Rozenn, H.K. Lewis, L.B. Gregory, P.T. Russell and S.S. Davis (2003). Cardiac benefits of fish consumption may depend on type of fish meal consumed. Circulation. 107:1372-1382.

Ng, W.K., K.S. Lu, R. Hashim and A. Ali (2000).Effects of feeding rate on growth, feed utilization and body composition of a tropical bagrid catfish. Aquacult. Int. 8: 19-29.

Rasmussen, R.S. (2001). Quality and farmed salmonids with emphasis on proximate composition, yield and sensory characteristics. Aquacult. 32: 767-786.

Shabir, S., M. Salim and M. Rashid (2003). Study on the feed conversion ratio in major carp *Cirrhinusmrigala* fingerlings fed on sunflower meal, wheat bran and maize gluten 30%. Pakistan Vet. J. 23: 1-3.

Shioya I., K. Inoue, A. Abe, A. Takeshita and T. Yamaguchi (2011). Beneficial effects on meat quality of yellowtail *Seriolaquinqueradiata* induced by diets containing red pepper. Fisheries Sci. 77: 883-889.

Umer, K. and M. Ali (2009). Replacement of fishmeal with blend of canola meal and corn gluten meal, and an attempt to find alternate source of milk fat for Rohu (*Labeorohita*). Pakistan J. Zool. 41(6): 469-474.