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EFFECT OF SOYBEAN MEAL, MAIZE GLUTEN 30% AND FEATHER MEAL ON THE GROWTH PERFORMANCE AND FEED CONVERSION RATIO OF HYBRID (*LABEO ROHITA* X *CATLA CATLA*) FINGERLINGS

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ABSTRACT

Growth performance and feed conversion ratio (FCR) of hybrid (*Labeo rohita* x *Catla catla*) fingerlings fed for six weeks on soybean meal, maize gluten 30% and feather meal were evaluated. The feed trails were replicated for each of the ingredients. The feed was supplied at the rate of 4% of wet body weight of fingerlings twice a day. The hybrid (*Labeo rohita* x *Catla catla*) fingerlings gained highest body weight (2.07 ± 0.01g) on maize gluten 30%, followed by feather meal (1.88 ± 0.04g) and soybean meal (1.66 ± 0.01g) and these values were significantly different from each other ($p<0.05$). The growth measured in terms of total length was significantly higher on maize gluten 30% (6.85 ± 0.04 cm) than feather meal (6.20 ± 0.05 cm) and soybean meal (6.15 ± 0.04 cm). The difference between the latter two groups was, however, non significant. FCR calculated for three ingredients was lower (better) on maize gluten 30% (1.90 ± 0.06), followed by feather meal (1.97 ± 0.04) and soybean meal (2.06 ± 0.08). The FCR value on maize gluten 30% was significantly better than soybean meal but non significantly different from feather meal. It was concluded that maize gluten 30% could be included in the feed formulation for fingerling hybrids.

Key words: Hybrids, *Labeo rohita, Catla catla,* growth performance, FCR, soybean meal, maize gluten, feather meal.

INTRODUCTION

The development of fish in culture conditions depends upon the availability of essential nutrients in the diet, feed stability in water, digestibility and feed conversion ratio (FCR). These parameters are considered as the basis for growth for the fish (Khan *et al*., 2004).

The FCR is calculated from the amount of feed in kg that is consumed to produce one kg of fish. Two additional terms are used by farmers: the biological FCR and economic FCR. Biological FCR is the net amount of feed used to produce one kg of fish. While the economic FCR takes into account all the feed used including feed losses and mortalities (Pickering, 1993). The FCR values for various fish feed ingredients for carp under controlled conditions have been estimated (Jabeen *et al.*, 2004; Ali and Salim, 2004; Saeed *et al.*, 2005; Gul *et al.*, 2005).

Hybridization in fish is a natural phenomenon and it is assumed that hybrids have better growth rate and high resistance against unfavorable ecological conditions (Reddy, 2000). Hybrids of major carps are being successfully produced in Pakistan and other Asian countries in the public and private sector hatcheries. The purpose of the present study was to evaluate soybean meal, maize gluten 30% and feather meal in terms of growth performance and FCR of hybrid (*Labeo rohita* x *Catla catla*) fingerlings kept under climatic conditions of Pakistan.

MATERIALS AND METHODS

Aquaria

The experiment was conducted in six glass aquaria in the Fish Nutrition Laboratory, Department of Zoology and Fisheries, University of Agriculture, Faisalabad, Pakistan. The working dimensions of each aquarium were 37 x 29 x 45 cm^3. Each aquarium was filled with water up to level of 30 cm and this level was maintained throughout the experimental period of six weeks (March-April, 2006).

Experimental fish

One hundred fingerlings of hybrid (*Labeo rohita* x *Catla catla*) were purchased from Government Fish Seed Hatchery, Faisalabad, Pakistan. The fingerlings were acclimatized in glass aquaria for two weeks. During this period, the fingerlings were fed on rice polishing.

Feed ingredients

The three feed ingredients i.e. soybean meal, maize gluten 30% and feather meal were purchased from a

local commercial feed mill. The ingredients were dried and ground to powder form. Percentage composition of these ingredients, estimated using AOAC (1995), is shown in Table 1.

Table 1: Composition of basic feed ingredients

Ingredients	Dry matter (%)	Crude protein (%)	Crude fat (%)	Gross energy (kcal/kg)
Soybean meal	92.33	46.60	8.50	2720
Maize gluten 30%	90.91	26.15	9.54	1625
Feather meal	93.20	45.00	5.00	2900

After acclimatization, 10 hybrid fingerlings were randomly transferred to each of the six aquaria. The mean initial body weight of fingerlings was 1.23g. Two replicates were followed for each treatment. The feed was supplied at the rate of 4% of wet body weight of the fingerlings throughout the six weeks experimental period. The feed was administered twice daily (morning and evening) in two equal portions. The morning feeding was done at 8:00 am and the evening feed was applied at 2:00 pm. Water quality parameters including water temperature, dissolved oxygen and pH in each aquarium were monitored through digital meters. The level of dissolved oxygen was maintained using air pump. The range of water quality parameters were: water temperature 22-26^{o}C; pH 6.5-7.3; dissolved oxygen 4.9-5.2 mg/L throughout the experimental period. Two hours after each feeding, water from the aquaria was removed and the unconsumed feed from each aquarium was collected in separate petri dishes. Each aquarium was filled with water again immediately after the removal of unconsumed feed. The feed so collected was dried in an oven and weighed. The fingerlings were taken from each replicate on weekly basis after removing water from the aquarium. The morphometric characteristics i.e. body weight and total length were recorded to observe their growth performance. The fingerlings were released in water immediately after body measurements. The feed was stopped a day before the weight was recorded. The mean weight of fingerlings in each aquarium was calculated to work out the feeding rate for the next week. The FCR was calculated as follows:

FCR = $F/(W_f-W_0)$, where

F is the weight of food consumed by fish during the study period.

W_0 is the live weight of fish at the beginning of the study period.

W_f is the live weight of fish at the end of the study period.

Statistical analysis

The data on body weight, total length and FCR were subjected to statistical analysis, using analysis of variance technique (ANOVA) following completely randomized design. The differences between means were compared by Duncan's multiple range test (Steel *et al.,* 1996). The statistical software MSTATS was used for the analysis of data.

RESULTS

The final body weight of hybrids (Table 2) was the highest on maize gluten 30% (2.07 ± 0.01g), followed by feather meal (1.88 ± 0.04g) and soybean meal (1.66 ± 0.01g). The effect of three feed ingredients on body weight of fish during six weeks was significant ($P<0.05$). The interaction between ingredients and weeks was also significant ($P<0.05$).

The comparison of body weight on three feed ingredients during six weeks revealed that during the first week, the mean body weight for soybean meal was significantly lower than for maize gluten 30% and feather meal whereas, mean body weight for maize gluten 30% and feather meal was non significantly different from each other. During second, third, forth, fifth and sixth weeks, body weights on three ingredients showed similar trend and were significantly different from each other. The values were highest for maize gluten 30%, followed by feather meal and soybean meal ($P<0.05$).

Table 2: Weekly variations in body weight (g) of hybrid fingerlings fed on three feed ingredients (mean ± SE)

Weeks	Soybean meal	Maize gluten 30%	Feather meal
0	1.24 ± 0.04	1.23 ± 0.01	1.23 ± 0.01
1	1.29 ± 0.05^{b}	1.36 ± 0.02^{a}	1.33 ± 0.08^{a}
2	1.36 ± 0.08^{c}	1.51 ± 0.08^{a}	1.43 ± 0.08^{b}
3	1.43 ± 0.01^{c}	1.65 ± 0.01^{a}	1.54 ± 0.08^{b}
4	1.51 ± 0.01^{c}	1.79 ± 0.05^{a}	1.63 ± 0.01^{b}
5	1.58 ± 0.04^{c}	1.91 ± 0.01^{a}	1.74 ± 0.01^{b}
6	1.66 ± 0.01^{c}	2.07 ± 0.01^{a}	1.88 ± 0.04^{b}

Mean values with different superscripts within a row differ significantly ($P<0.05$).

At the end of study, the maximum total length gained by the fish (Table 3) was on maize gluten 30% (6.85 ± 0.04 cm), followed by feather meal (6.20 ± 0.00 cm) and soybean meal (6.15 ± 0.04 cm). The effect of three feed ingredients on total length gained by the fish during six weeks was significant ($P<0.05$). The interaction between ingredients and weeks was also significant ($P<0.05$). During the first week, fingerlings fed on soybean meal and feather meal showed higher body length than those fed on maize gluten 30%. The difference between former two groups was non significant. In the second week, all test ingredients were non significantly different from each other. During the third, forth, fifth and the sixth week, total length

showed almost similar trend. The values were higher for maize gluten 30% than those on soybean meal and feather meal, the difference between latter two groups was non significant (Table 3).

Table 3: Weekly variations of total length (cm) of hybrid fingerlings fed on three feed ingredients (mean ± SE)

Weeks	Soybean meal	Maize gluten 30%	Feather meal
0	4.75 ± 0.04	4.55 ± 0.04	4.55 ± 0.04
1	5.00 ± 0.05^{a}	4.850 ± 0.04^{b}	5.10 ± 0.05^{a}
2	5.15 ± 0.04^{a}	5.15 ± 0.04^{a}	5.25 ± 0.04^{a}
3	5.40 ± 0.08^{b}	5.55 ±0.04^{a}	5.45 ± 0.04^{b}
4	5.65 ±0.04^{b}	6.00 ± 0.05^{a}	5.75 ± 0.04^{b}
5	5. 95 ± 0.04^{b}	6.35 ± 0.04^{a}	5.95 ±0.04^{b}
6	6.15 ±0.04^{b}	6.85 ± 0.04^{a}	6.20 ± 0.05^{b}

Mean values with different superscripts within a row differ significantly (P<0.05).

Better (lower) feed conversion ratio (Table 4) was observed for maize gluten 30% (1.90 ± 0.06). The FCR values for feather meal and soybean meal were 1.97 ± 0.04 and 2.06 ± 0.08, respectively. The effect of three feed ingredients on FCR during six weeks was significant (P<0.05). The interaction between weeks and ingredients was however, non significant. The over all mean FCR values of soybean meal and maize gluten 30% were significantly different from each other, while they did not differ from feather meal (Table 4).

Table 4: Weekly variations of feed conversion ratio of hybrid fingerlings fed on three ingredients (mean ± SE)

Weeks	Soybean meal	Maize gluten 30%	Feather meal
1	1.82 ± 0.02^{a}	1.82 ± 0.04^{a}	1.82 ± 0.04^{a}
2	1.89 ± 0.04^{a}	1.88 ± 0.04^{a}	1.88 ± 0.04^{a}
3	1.98 ± 0.08^{a}	1.88 ± 0.08^{a}	1.96 ± 0.04^{a}
4	2.06 ± 0.06^{a}	1.91 ± 0.08^{b}	2.01 ± 0.04^{a}
5	2.12 ± 0.08^{a}	1.95 ± 0.08^{b}	2.05 ± 0.08^{b}
6	2.49 ± 0.04^{a}	1.98 ± 0.08^{b}	2.09 ± 0.00^{b}
Overall mean	2.06 ± 0.08^{a}	1.90 ± 0.06^{b}	1.97 ± 0.04^{ab}

Mean values with different superscripts within a row differ significantly (P<0.05).

DISCUSSION

The hybrid fingerlings (*Labeo rohita* x *Catla catla*) gained maximum weight on maize gluten 30%, followed by feather meal and soybean meal. The higher growth rate on maize gluten 30% showed that fingerlings digested this ingredient more efficiently. Aslam (2003) also reported that *Labeo rohita* gained higher weight (3.60 ± 0.10 g) on maize gluten 30%. Saeed *et al.* (2005) noted that fingerlings of *Labeo rohita* gained higher weight (10.18 ± 0.08g) on corn gluten compared to soybean meal (8.83 ± 1.41g). However, body weight (0.23 ± 0.01g) gained by *Cirrhinus mrigala* fingerlings on maize gluten (Shabbir *et al.*, 2003) was lower than the body weight gained by hybrids (2.07 ± 0.01 g) in the present study. According to Inayat and Salim (2005), *Cirrhinus mrigala* showed better growth on soybean meal (0.90 ± 0.05g) compared to maize gluten (0.54 ± 0.02g). Besides species, better growth rate in hybrids (Reddy, 2000) can be responsible for these differences.

The comparatively low growth rate on feather meal compared to maize gluten 30% observed in the present study may be due to the processing method used to prepare the feather meal, which could possibly denature the protein quality. The quality of animal by-product meals may considerably depend on the quality and relative quantity of different waste products present in the meal (Gaylord and Galtin, 1996).

The probable reason for the lowest growth rate observed on the soybean meal may be the presence of anti-nutritional factor tannin in soybean meal. As low as 0.5% dietary tannin causes growth depression in chickens (Vohra *et al.,* 1966) and there are also reports on the toxicity of tannin to fish (Hossain and Jauncey, 1989). Several studies have reported reduced growth at higher levels of soybean meal inclusion in fish diets (Webster *et al.,* 1992; Khan and Jafri, 1994; Olli *et al.,* 1995; Fagbenro and Davies, 2001). Researchers who noted reduced weight gain in fish fed higher levels of soybean meal suggested sub optimal amino acid balance (Cowey *et al.,* 1971; Jackson *et al*., 1982) and presence of anti-nutritional factors, especially trypsin inhibitor (Wilson and Poe, 1985; Olli *et al.* 1994) as possible causes of relatively slow growth rate for this ingredient.

The feed conversion ratio (FCR) was higher for soybean meal (2.06 ± 0.08) than maize gluten 30% (1.90 ± 0.06). This shows that greater quantity of soybean meal was used by hybrids for a unit weight gain, whereas maize gluten 30% was used in low quantity for a unit weight gain of fish. These findings revealed that maize gluten 30% was readily acceptable ingredient for fish compared to soybean meal. Low (better) FCR value for maize gluten 30% was also reported by Aslam (2003). On the other hand, Saeed *et al.* (2005) reported higher FCR values for corn gluten (4.30 ±0.80) than soybean meal (3.03 ± 0.82). Shabbir *et al.* (2003) also noted high FCR value for maize gluten. Inayat and Salim (2005) reported higher FCR value for maize gluten (2.23), followed by soybean meal (1.70).

In conclusion, the information generated on the basis of growth performance and feed conversion ratio maize gluten 30% can be included in the feed formulation for hybrid fingerlings (*Labeo rohita* x *Catla catla*).

REFERENCES

Ali, T. and M. Salim, 2004. Studies on the growth response and feed conversion ratio (FCR) of *Labeo rohita* fingerlings fed on rice polish, fish meal and sunflower meal. Int. J. Agri. Biol., 6(5): 914-917.

Aslam, N., 2003. Studies on feed conversion ratio of *Labeo rohita* fingerlings fed on rice broken, wheat bran and maize gluten 30%. MSc Thesis, Univ. Agri., Faisalabad, Pakistan.

AOAC, 1995. Official Methods of Analysis. 16th Ed., Association of Official Analytical Chemists International, Arlington, VA, USA.

Cowey, C. B., J. A. Pope, J. W. Adron and A. Blair, 1971. Studies on the nutrition of marine flatfish: growth of plaice *Pleuronectes platessa* on diets containing proteins derived from plants and other sources. Mar. Biol., 10: 145-153.

Fagbenro, O. A. and S. J. Davies, 2001. Use of soybean flour (dehulled, solvent-extracted soybean) as a fish meal substitute in practical diets for African catfish, *Clarias gariepinus* (Burchell 1822): growth, feed utilization and digestibility. J. Appl. Ichthyol, 17: 64-69.

Gaylord, T. G. and D. M. Galtin, 1996. Determination of digestibility coefficients of various feedstuffs for red drum (*Sciaenops ocellatus*). Aquaculture, 139: 303-314.

Gul, Y., M. Salim, K. Shahzad and U. Noreen, 2005. Study on the growth performance and feed conversion ratio of *Labeo rohita* fed on soybean meal, blood meal and corn gluten 60%. Indus J. Biol. Sci., 2(4): 556-562.

Hossain, M. A. and K. Jauncey, 1989. Nutritional evaluation of some Bangladeshi oilseed meals as partial substitutes for fish meal in the diet of common carp, *Cyprinus carpio* (L). Aqacult. Fish. Management, 20: 255-268.

Inayat, L. and M. Salim, 2005. Feed conversion ratio of major carp, *Cirrhins mrigala* fingerlings fed on soybean meal, maize gluten and maize. Pakistan Vet. J., 25(1): 13-17.

Jabeen, S., M. Salim and P. Akhtar, 2004. Feed conversion ratio of major carp *Cirrhinus mrigala* fingerlings fed on cottonseed meal, fish meal and barley. Pakistan Vet. J., 24(1): 42-46.

Jackson, A. J., B. S. Copper and A. J. Matty, 1982. Evaluation of some plant proteins in complete diets for the tilapia, *Sarotherodon mossambicus*. Aquaculture, 27: 97-109.

Khan, M. A. and A. K. Jafri, 1994. Replacement of fish meal with soybean meal in diets formulated for fingerling carp, *Labeo rohita* Hamilton. Proc. 3rd Asian Fisheries Forum, Asian Fisheries Society, Manila, Philippines, PP: 663-666.

Khan, M. A., I. Ahmed and S. F. Abidi, 2004. Effect of ration size on growth, conversion efficiency and body composition of fingerlings mrigala *Cirrhinus mrigala* (Hamilton). Aquacult. Nutr., 10: 47-48.

Olli, J. J., K. Hjelmeland and A. Krogdahl, 1994. Soybean trypsin inhibitors in diets for Atlantic salmon (*Salmo salar* L.): effects on nutrient digestibility and trypsin in pyloric caeca homogenate and intestinal content. Comp. Biochem. Synopsis, 109A: 923-928.

Olli, J. J., A. Krogahl and A. Vabeno, 1995. Dehulled solvent extracted soybean meal as a protein source in diets for Atlantic salmon, (*Salmo salar* L.). Aquacult. Res., 26: 167-174.

Pickering, A. D., 1993. Growth and stress in fish production. Aquaculture, 111: 51-63.

Reddy, P. V. G. K., 2000. Genetic resources of Indian major carp. FAO Fisheries Technical Paper No. 387, FAO, Rome, Italy.

Saeed, M., M. Salim and U. Noreen, 2005. Study of the growth performance and feed conversion ratio (FCR) of *Labeo rohita* fed on soyabean meal, blood meal and corn gluten 60%. Pakistan Vet. J., 25(3): 121-126.

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

Steel, R. G. D., J. H. Torrie and D. A. Dinkkey, 1996. Principles and Procedures of Statistics. 2nd Ed., McGraw Hill Book Co., Singapore.

Vohra, P., F. H. Kratzer and M. A. Joslyn, 1966. The growth depressing and toxic effects of tannins to chicks. Poultry Sci., 46: 135-142.

Webster, C. D., D. H. Yancey and J. H. Tidwell, 1992. Effect of partially or totally replacing fish meal with soybean meal on growth of blue catfish (*Ictalurus furcatus*). Aquaculture, 103: 141-152.

Wilson, R. P. and W. E. Poe, 1985. Effects of feeding soybean meal with varying trypsin inhibitor activities on growth of fingerlings channel catfish. Aquaculture, 46: 19-25.