*Pakistan Vet. J., 25(3): 2005*

# STUDY ON THE GROWTH PERFORMANCE AND FEED CONVERSION RATIO OF *LABEO ROHITA* FED ON SOYBEAN MEAL, BLOOD MEAL AND CORN GLUTEN 60%

M. Saeed, M. Salim and U. Noreen

*Department of Zoology and Fisheries, University of Agriculture, Faisalabad, Pakistan*

## ABSTRACT

A seven weeks study was conducted to find out the growth performance and feed conversion ratio (FCR) for *Labeo rohita* fingerlings fed on reference and three test diets; test diet-1 (soybean meal), test diet-2 (blood meal), test diet-3 (corn gluten 60%). All the diets were iso-nitrogenous (30% crude protein) and iso-caloric (2700 kcal/kg). Fish were fed on 4% of wet body weight daily. Average body weight gain by *Labeo rohita* was highest for test diet-3 (10.1875 ± 0.8839g), followed by test diet-2 (9.9762 ± 0.859g), test diet-1 (8.83 ± 1.442g) and reference diet (9.390 ± 0.9226g). The best FCR value was (2.3167 ± 0.872) for test diet-3, followed by test diet-1 (3.4636 ± 0.697), test diet-3 (5.00 ± 1.2728) and reference diet (3.927 ± 0.1862).

**Key words:** *Labeo rohita,* growth performance, FCR, soybean meal, blood meal, corn gluten 60%.

## INTRODUCTION

Major carp, *Labeo rohita*, commonly known as rohu, is the prime carp species cultivated mainly as a component of polyculture systems with other indigenous and exotic carp species. To improve the production process of this species, it is important to understand dietary amino acid requirements in order to prepare balanced diets (Abidi and Khan, 2004).

Fish require adequate nutrition in order to grow and survive. Nature offers a great diversity of food to fish including plants and animals. Artificial feed plays an important role in semi intensive fish culture where it is required to maintain a high density of fish than the natural fertility of the water can support (Jhingran, 1991). The role of artificial feed in intensive fish farming cannot be ignored as nutritional requirements of fish depend upon the feed supplied. The quantity and quality of feed consumed have a pronounced effect on growth rate, efficiency of feed conversion and chemical composition of fish (Hassan *et al.,* 1996; Jena *et al., 1*998; Erfanullah and Jafri, 1998).

Feed conversion ratio (FCR) is calculated from the number of Kg of feed used to produce one Kg of fish. Two additional terms are used by the farmers, the biological FCR and the 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 the effects of feed losses and mortalities. The present study was designed to investigate the nutrient requirement of fish under intensive culture system and also to evaluate the FCR of different feed ingredients and there efficiency.

## MATERIALS AND METHODS

*Labeo rohita* fingerlings were collected from Government Fish Seed Hatchery, Faisalabad, and kept in glass aquaria for acclimatization for two weeks. During this period fish were fed on reference diet. The experiment was conducted in eight glass aquaria specially designed for the collection of rest diet in Fish Nutrition Lab, Department of Zoology and Fisheries, University of Agriculture, Faisalabad.

The ingredients in reference diet were included on the basis of previous research of Seema *et al*. (2002), Shabbir *et al*. (2003) and Tayyaba and Salim (2004). Diets were formulated by using win feed computer software on linear basis. Three test diets were composed of 70% reference diet and 30% test ingredient on dry weight basis (Table 1). The ingredients used in reference and test diets were sieved. All dry ingredients were mixed in mixer for 30 minutes; fish oil was gradually added while mixing constantly and 85 ml of water per 100g of feed was slowly blended into mixer resulting in suitability texture dough as for fish food (Lovell, 1989). Drying was carried out in convectional oven at 35$^{o}$C for 48 hours. The dry product was cut into pellets of 3 mm size.

After acclimatization, 10 fingerlings were randomly stocked in each aquarium. Two replicates were followed for each diet. The feed was applied at the rate of 4% of wet body weight twice a day in feeding chambers of aquaria. After two hours, fingerlings were shifted to non-feeding chamber and remaining diets were collected from the feeding chambers. Air pump

**Table 1: Percentage composition of different diets on dry matter basis (DMB)**

| Ingredients | Reference diet | Test diet-1 | Test diet-2 | Test diet-3 |
|---|---|---|---|---|
| Fish meal (g) | 59.03 | 34.69 | 26.99 | 47.74 |
| Rice broken(g) | 7.03 | 6.44 | 5.71 | 0.24 |
| Rice polish(g) | 13.34 | 10.03 | 10.03 | 6.89 |
| Wheat bran | 13.78 | 9.81 | 20.216 | 4.67 |
| Fish oil(g) | 4.83 | 7.04 | 6.42 | 8.46 |
| Vitamin premix(g) | 1 | 1 | 1 | 1 |
| Mineral premix(g) | 1 | 1 | 1 | 1 |
| Test ingredient-1(g) | - | 30 | 0 | 0 |
| Test ingredient-2(g) | - | 0 | 30 | 0 |
| Test ingredient-3(g) | - | 0 | 0 | 30 |
| Total (g) | 100.01 | 100.01 | 100.01 | 100.00 |

was used to maintain the level of dissolved oxygen. The range of water temperature remained between 25 to 27 $^{o}$C and that of pH between 7.14-7.38 during the study period.

The fingerlings were taken from each replicate on weekly basis. The morphometric characteristics i.e. body weight and total body lengths of randomly selected four fingerlings were recorded. Body weight of fingerlings was used to estimate the amount of feed for next week. The diet used by fingerlings was calculated by subtracting uneaten diet from quantity of diet given.

Feed conversion ratio (FCR) of reference and test diets was work out according to Jhingran (1991). Daily feed intake was estimated from dry matter content (drying at 105$^{o}$C for 24 hours). Uneaten feed was calculated from the formula (Hellan *et al., 1996).*

$$\text{Dry feed eaten}_{(g)} = \frac{A \times A_{DM}/100)-(W \times W_{DM}/R)}{A_{DM}/100}$$

A= Weight of feed pellets (g)
$A_{DM}$= Dry matter content of feed (%)
W= Weight of uneaten feed collected (g)
$W_{DM}$= Dry matter content of uneaten feed (%)
R= Recovery of dry mater of uneaten feed (%),
R is calculated as

$$R (\%) = 100 \times W \times W_{DM} / A \times A_{DM}$$

The FCR of test diets were determined by using the following modified formula of digestibility:

FCR = 100/30(FCR of TD-70/100*FCR of RD.)
RD = Reference diet
TD = Test diet

The data on body weight, total body length and feed conversion ratio were subjected to statistical analysis. The comparison of mean values of various parameters was made by using Duncan's Multiple Range (DMR) test, according to procedure described by Steel and Torrie (1996).

## RESULTS AND DISCUSSION

Body weight, total body length and FCR values in *Labeo rohita* fed on reference and test diets are given in Table 2. Statistical analysis revealed that effect of diets on body weight, total body length and FCR was significant ($P<0.05$). The comparison of mean values of average body weight, average total body length and FCR on reference and test diets is presented in Table 3. It indicates that mean body weight on test diet-1 (soybean meal) was significantly different from test diet-2 (blood meal) and test diet-3 (corn gluten 60%) but it was none significantly different from reference diet. The comparison among test diet-2 (blood meal) and test diet-3 (corn gluten 60%) revealed that they were non significantly different from each other but they were significantly different from reference and test diet-1 (soybean meal)

The comparison of mean values of total body length revealed that total body length on test diet-1 (soybean meal) was significantly different from reference diet, test die-2 (blood meal) and test diet-3 (corn gluten 60%). The body length for test diet-2 (blood meal) and test diet-3 (corn gluten 60%) was non significantly different among each other but was significantly different from test diet-1 (soybean meal).

Overall comparison of mean FCR values for reference and three test diets (Table-3) revealed that the FCR values of test diet-1 differed significantly from test diet-2 and test diet-3 but it was non significantly different from reference diet. The FCR value of test diet-2 (blood meal) differed non-significantly from test diet-3 (corn gluten 60%). But it differed significantly from test diet-1 and reference diet.

**Table 3: Overall comparison of average body weight, average total length and FCR of *Labeo rohita* fed on different diets**

| Diets | Reference diet | Test diet-1 | Test diet-2 | Test diet-3 |
|---|---|---|---|---|
| Body weight (g) | 7.81 ± 0.4127a | 7.23 ± 0.379a | 8.64 ± 0.412b | 9.01 ± 0.350b |
| Body length (cm) | 6.85 ± 0.582a | 5.11 ± 0.287b | 5.92 ± 0.401c | 6.06 ± 0.397c |
| FCR | 3.32 ± 0.335a | 3.04 ± 0.459a | 4.81 ± 0.581b | 4.33 ± 0.502b |

**Note**: Values followed by the same letters within a row are non significantly different (P> 0.05).

Regression lines (Figures 1 and 2) showed that body weight gain and increase in total body length by *Labeo rohita* fingerlings under the influence of four diets throughout experimental period was linear. Maximum linear increase ($r^2$=97.9%) in weight gain by fingerlings was for reference and test diet-3 (corn gluten 60%). Regression equations for test diet-1 were $T_1$=5.29+0.430X and $T_1$=3.86+0.326X for weight gain and length gain, respectively. The $r^2$ values for test diet-1 were $r^2$=97 % and $r^2$=99.3% for weight gain and body length gain. Whereas regression equations for test diet-2 were $T_2$=6.61+0.452X and $T_2$=3.86+0.448x, with $r^2$ values $r^2$=90.5 and $r^2$=94.1%, respectively.

The regression equations for test diet-3 were $T_3$= 7.68+0.295X and $T_3$=4.29+0.324X and $r^2$ values for this diet were $r^2$=97.9 % and $r^2$=96.6 %. Whereas the regression equations for reference diet were $T_R$ = 5.69+0.471X and $T_R$=3.48+0.342X. The values of $r^2$ for reference diet were $r^2$=97.9 % and $r^2$=98.1%. It showed that maximum linear increase was for test diet -3 (corn gluten 60%) and test diet -1 (blood meal). High values of $r^2$ (>90 %) for reference and test diets showed that increase in body weight and body length of fish was due to effect of these diets.

The best growth performance of *Labeo rohita* fingerlings on corn gluten 60% may be due to higher protein content in the corn gluten 60% than other diets. These results are in line with the findings of Rajbanshi *et al.* (1989), who proposed that 45 days old rohu fingerlings gave the highest growth rate on diets containing 39.18% protein than diets containing 25.4% protein. Similar results were obtained by Salim and Sheri (1999). They observed significant influence of diet having 45% protein on growth performance of *Labeo rohita* fingerlings than by the diet with 40% protein at 4% feeding level.

The results of the present study demonstrate that the highest growth was obtained in fish fed corn gluten 60% (test diet-3), however the values of FCR were comparable to that of soybean meal (test diert-1) and reference diet. Amongst several plant protein sources, soybean oil cake was reported to be most efficiently utilized by fingerlings *Labeo rohita* (Khan and Jafri 1991). But the results of present study do not match with that as it shows that growth performance and FCR of *Labeo rohita* fingerlings fed corn gluten 60% are more efficient as protein source in fish. This is also supported by the presence of anti nutritional factors in soybean meal. Tannin, an anti nutritional factor, has so far found only limited use as a dietary ingredient (Tacon, 1993). 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; Krogdahl, 1989).

Several studies have reported reduced growth at higher levels of soybean meal inclusion in fish diets (Viyakarn *et al.*, 1992; 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 suggested sub-optimal amino acid balance (Dabrowski *et al.*, 1989) and presence of antinutritionl factors, especially trypsin inhibitor (Olli *et al.*, 1994) as possible causes.

The overall feed conversion ratio (FCR) of test diet-2 (blood meal) was 4.810, followed by test diet-3 (corn gluten 60%) and soybean meal (test diet-1). This means that greater quantity of test diet-2 was required for unit weight gain of fish. These findings reveal that corn gluten 60% and soybean meal were more acceptable ingredients for fish as compared to blood meal. The possible reason might be the presence of higher protein levels in these diets as compared to blood meal. The results are in accordance with those presented by Das and Ray (1991). They observed the growth response and feed conversion in *Labeo rohita* at varying dietary protein levels. FCR increased with increasing dietary protein up to 35%.

Present study also reveals that as food availability increases, the quantity consumed by the fish will also increase, giving a linear increase in specific growth rate (SGR %) up to the point of maximum voluntary food intake. If fish are fed above their appetite, then the extra food will be wasted resulting in high FCR. So high FCR can result from both over-and under-feeding. Excessive dose not necessarily result in high growth. Beyond a certain level, excessive feeding has no influence on the growth and can result in a poor growth (De-Silva and Anderson, 1995).

Highest conversion value were achieved at a ration level of 3% which were not significantly different from the value achieved in fish fed at 4% body weight per day. This indicates that feeding fish in the range of 4-6% body weight per day results in maximum utilization of food for growth. Khan and Jafri (1994) reported gradual decline in conversion efficiency in fish fed

**Fig1: Regression lines for average body weight of *Labeo rohita* fed on reference and test diets**

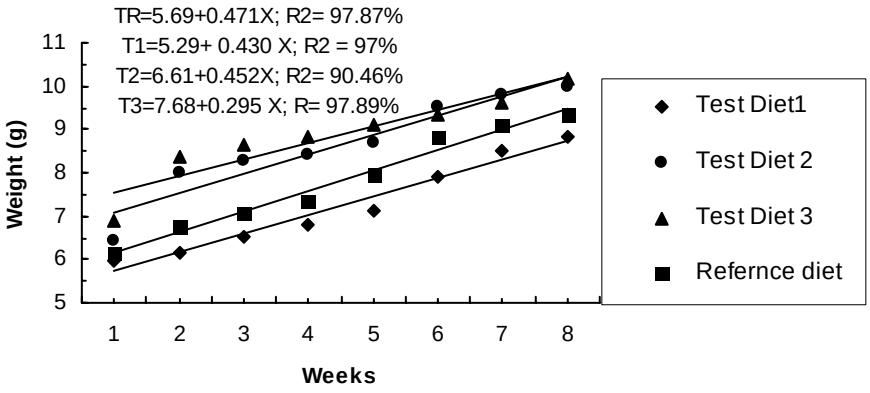
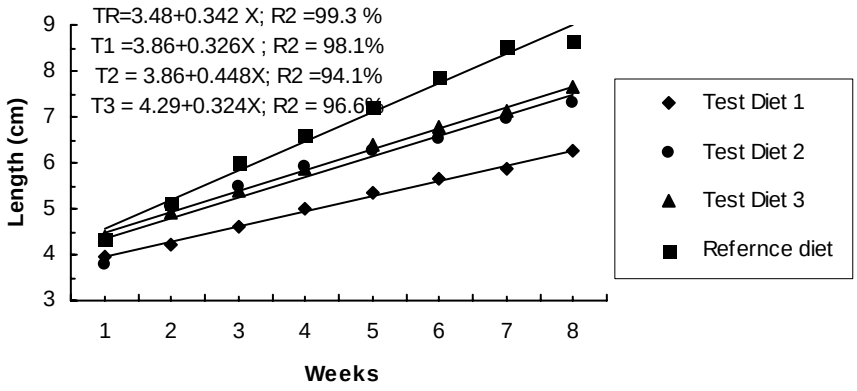



**Fig 2: Regression lines for average body length of *Labeo rohita* fed on refernce and test diets**




higher ration level in *Clarias batrachus*. Poor growth and FCR in fish fed at 2% body weight per day suggests that this ration size approximates only the maintenance requirements of nutrients, wherein major portion of ingested nutrients is utilized to maintain life and a smaller portion available for growth.

It may, therefore, be concluded that corn gluten 60% was most efficiently utilized by the *Labeo rohita* fingerlings, followed by soybean meal. It is also obvious from the above discussion that temperature and feeding rate may also affect the growth of *Labeo rohita*. Temperature between 20-30°C is optimum for best growth and feed utilization of *Labeo rohita* fingerlings. Similarly, the feeding rate of 3-4% of body weight is optimum for optimum growth of fingerlings *Labeo rohita.*

## REFERENCES

Abidi, S. F. and M. A. Khan, 2004. Dietary valine requirement of Indian major carp, *Labeo rohita* (Hamilton) fry. J. Applied Ichthyol., 20: 118-120.

Dabrowski, K., P. Poczyczynski, G. Kock and B. Berger. 1989. Effect of partially or totally replacing fish meal protein by soybean meal protein on growth, food utilization and proteolytic enzyme activities in rainbow trout (*Salmo gairdneri*). New in vivo test for exocrine pancreatic secretion. Aquaculture, 77: 29-49.

Das, I. and A. K. Ray, 1991. Growth response and feed conversion efficiency in *Cirrhinus mrigala* (Ham.) fingerling at varying dietary protein levels. J. Aquacult. Tropics, 6(2): 179-185.

De-Silva, S. S. and T. A. Anderson, 1995. Fish Nutrition in Aquaculture. Chapman and Hall, London, UK., pp: 319.

Erfanullah, J. K. and A. K. Jafri, 1998. Growth rate, feed conversion ratio and body composition of *Catla catla, Labeo rohita and Cirrhinus mrigala* fry fed diets of various sources. J. World Aquaculture Soc., 28(1): 84-91.

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): gowth, feed utilization and digestibility. J. Appl. Ichthyol.,17: 64-69.

Gomes, E. F., P. Rema and S. J. Kaushik, 1995. Replacement of fish meal by plant proteins in the diet of rainbow trout (*Oncorhynchus mykiss*): digestibility and performance. Aquaculture, 130: 177-186.

Hassan, M. A., A. K. Jafri, A. S. Alvi, S. Rana and U. Nazura. 1996. Dietary energy and protein interaction and approach to optimizing energy, protein ratio in Indian major carps, *Cirrhinus mrigala* (Ham.) fingerlings. J. Aquacult. Tropics, 10(3): 183-191.

Hellan, S. J., B. Grisdale-Helland and S. Nerland. 1996. A simple method for the measurement of daily feed intake of group fish in tanks. Aquaculture, 139:157-163

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). Aquaculture. Fish Management, 20: 255-268.

Jena, J. K., P. K. Aravidakshan, C. Suresh, H. K. Muduli, S. Ayyappan and S. Chandra, 1998. Comparative evaluation of growth and survival of Indian major carps and exotic carps in raising fingerlings. J. Aquacult. Tropics, 13(2): 143-149.

Jhingran, V. G., 1991. Fish and Fisheries of India, 2nd Ed, Hindustan Publishing Co. Delhi, India, p: 666.

Khan, M. A. and A. K. Jafri. 1991. Dietary protein requirement of two size classes of Indian major carps, *Catla Catla*. J. Aquacult. Tropics, 6(1): 79-87.

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

Krogdahl, A., 1989. Alternative protein sources from plants contain anti-nutrients affecting digestion in Salmonides. In: The Current Status of Fish Nutrition in Aquaculture. Proceedings of the Third Int. Symposium Feeding and Nutrition in Fish. Toba, Japan, pp: 253-261.

Lovell, R. T., 1989. Feed formulation and processing. In. Nutrition and Feeding of Fish. Van Nostrand Reinhold, New York, USA, pp: 260.

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

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

Rajbanshi, V. K., M. Mumtazuddin and K. F. Shim, 1989. Reciprocation of dietary protein with growth and its utilization in rohu, *Labeo rohita* (Ham.) fingerlings. Singapore J. Indus., 17(2): 128-131.

Salim, M. and A. N. Sheri, 1999. Influence of protein sources, levels of protein and levels of feeding on growth of rohu (*Labeo rohita)* fingerlings under intensive system. Pakistan J. Sci. Res., 51(3-4): 85-88.

Seema, R., M. Salim and M. Rashid, 2002. Performance of major carp, *Cirrhinus mrigala* fingerlings fed on rice polish, maize oil cake and rice broken. Int. J. Agri. Biol., 4(1): 195-196.

Steel, R. G. D. and J. H. Torrie, 1996. Principles and Procedures of Statistics, A biometrical approach, 3rd Ed. McGraw Hill Book Comp. Inc. New York. USA, pp: 336-352.

Shabir, S., M. Salim and M. Rashid, 2003. Study on the feed conversion ratio (FCR) in major carp *Cirrhinus mrigala* fed on sun flower meal, wheat bran and maize gluten 30%. Pakistan Vet. J., 23(1): 1-2.

Tacon, A. G. J., 1993. Feed Ingredients for Warm Water Fish: Fish Meal and Other Processed Feedstuffs. FAO Fisheries Circular No. 856. FAO, Rome.

Tayyaba, A. and M. Salim, 2004. Growth response and feed conversion ratio of *Labeo rohita* fingerlings for rice polishing, sunflower meal and fish meal. Int. J. Agri. Biol., 6 (5): 914-917.

Viyakarn, V., T. Watanabe, H. Aoki, H. Tsuda, H. Sakamoto, N. Okamoto, N. Iso, S. Satoh and T. Takeuchi, 1992. Use of soybean meal as a substitute for fishmeal in a newly developed soft-dry pellet for yellowtail. Nippon Suisan Gakkaishi, 58: 1991-2000.

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.