INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
ISSN Print: 1560–8530; ISSN Online: 1814–9596
07–304/2008/10–4–455–458
http://www.fspublishers.org

Full Length Article

Studies on Partial Replacement of Fish Meal with Oilseeds Meal in the Diet of Major Carps

MUHAMMAD ZAFAR IQBAL TAHIR[1], IFTIKHAR AHMED, ABDUL MATEEN, MUHAMMAD ASHRAF, ZAHID HUSSAIN NAQVI† AND HABIB ALI
Department of Zoology and Fisheries, University of Agriculture, Faisalabad, Pakistan
Fisheries Research Farm, Satiana Road, Faisalabad, Pakistan
†Government College, Samanabad, Faisalabad, Pakistan
[1]Corresponding author's e-mail: mzafartahir@yahoo.com

ABSTRACT

A year long experiment was carried out with seven treatments (T1–T7) to investigate the possibility of partial replacement of fish meal with sunflower seed meal and canola seed meal in the diet of major carps. A standard fish diet (30% crude protein) for treatment 1 (T1) was formulated using fish meal, cotton seed meal, maize gluten and rice polish. Experimental fish diets for the treatments T2, T3 and T4 were prepared by replacing fish meal from standard diet (T1) with sunflower seed meal on iso-nitrogenous basis at 20, 40 and 60% levels, respectively. Similarly experimental fish diets for the treatments T5, T6 and T7 were prepared by replacing fish meal from standard diet (T1) with canola seed meal on the above mentioned three levels. The results revealed that *Catla catla* and *Labeo rohita* performed the best in terms of final average body weight (1227.14 & 1065.99 g, respectively) and specific growth rate (1.067 & 0.997%, respectively) under the treatment T1 (receiving standard diet). Both the species showed lesser growth under the treatments receiving diets containing sunflower and canola seed meal (T2-T6). This trend of fish growth indicated that sunflower and canola seed meal may not be suitable for the diets of *C. catla* and *L. rohita*. However, *Cirrhina mrigala* performed the best (with final body weight of 1014.29 g & specific growth rate of 0.918%) in the treatment T5, where 20% N from fish meal was replaced with canola seed meal. This indicated the possibility of inclusion of canola seed meal in the diet of *C. mrigala*.

Key Words: Fish meal; Sunflower and canola seed meal; Specific growth

INTRODUCTION

Supplementary feeding has been successfully used in the polyculture of carps to enhance their growth. This success has stimulated intensive efforts to formulate inexpensive feeds. According to Pillay (1983) to develop successful aquaculture systems it is necessary to develop nutritious diets from locally available ingredients. Of all the available and commonly used feed ingredients, fish meal has been used extensively in fish feed, because of its unique nutrient specification, palatability and compatibility with the protein requirement of fish (Watanabe *et al*., 1997). However the increasing cost of fish meal and its uncertain availability has restricted its use as a protein source in fish diets. Therefore it is a matter of urgency that alternative cost effective protein sources for fish diets are found.

Plant proteins are considered to be the most viable alternatives to replace fish meal for economic fish production. Plant protein is generally supplied through different cereals, their byproducts and cakes/meals of oil seeds like cottonseed, sesame seed, sunflower seed, linseed, soybean and canola seed. Use of soybean and its products for the purpose of partial replacement of fish meal in diets of major carps with considerable success has been reported (Alam *et al*., 1996; Devi *et al*., 1998; Khan *et al*., 2003b). Khan *et al*. (2003a) reported that partial replacement of fish meal can be done in the diet of *Cyprinus carpio* using sun flower meal to reduce the cost without affecting growth rate. In Pakistan canola and sunflower cultivation is encouraged to meet the demands of edible oil of the country. The byproducts of these two oil seed crops are available at low cost as compared to other sources with comparable level of protein content. According to McDonald *et al*. (1999) canola meal and sunflower seed meal contain appreciable amounts of crude protein (38-40 & 45-48%, respectively) depending upon the quality of the crop. The use of these less expensive plant proteins in fish feed can reduce feed costs if formulated accurately.

Keeping in view these circumstances, the present experiment was planned to study the effect of partial replacement of fish meal with two locally available oil seed by-products viz. sunflower seed meal and canola seed meal on growth of major carps namely *Catla catla*, *Labeo rohita* and *Cirrhina mrigala* in semi-intensive fish culture system.

To cite this paper: Tahir, M.Z.I., I. Ahmed, A. Mateen, M. Ashrah, Z.H. Naqvi and H. Ali, 2008. Studies on partial replacement of fish meal with oilseeds meal in the diet of major carps. *Int. J. Agri. Biol.*, 10: 455–8

MATERIALS AND METHODS

The experiment was conducted in earthen ponds (0.02 ha each) under seven treatments at Fisheries Research Farms, University of Agriculture, Faisalabad, Pakistan for a period of one year. Fingerlings of *C. catla, L. rohita* and *C. mrigala* were procured from Fish Seed Hatchery Faisalabad, Pakistan. A standard fish diet for treatment 1 (T1) was formulated having 30% crude protein following Pearson's square method (Rath, 2000) using fish meal, cotton seed meal, maize gluten and rice polish. Vitamin pre-mix was also added @ 1% of the feed weight. Experimental fish diets for treatments 2, 3 and 4 (T2, T3 & T4) were prepared by replacing fish meal from standard diet (T1) with sunflower seed meal on iso-nitrogenous basis at 20, 40 and 60% levels, respectively. Similarly experimental fish diets for treatments 5, 6 and 7 (T5, T6 & T7) were prepared by replacing fish meal from standard diet (T1) with canola seed meal on iso-nitrogenous basis at 20, 40 and 60% levels, respectively. The composition of diets for all the seven treatments is given in Table I, while average wet body weights of fish at the time of stocking are given in Table II.

All the fish ponds were fertilized with buffalo manure on the basis of nitrogen content of the manure @ 0.1 g N 100 g^{-1} $day^{-1}$of wet fish body weight, while the feed was added @ 2% of wet fish body weight daily. Buffalo manure and feed were added by dusting method (Javed & Sial, 1991). Amounts of manure and feed to be added in fish ponds were determined on the basis of wet fish body weights recorded for each treatment every thirty days interval. After every 30-days interval (designated as month), a sample of one-third fish specimens of each cultured fish species was captured randomly from each of the treatment ponds and wet body weight (g) of sampled fish was measured and recorded and specific growth rate (SGR) was calculated by the formula (Dhawan & Kaur, 2002):

$$SGR = \frac{\ln(\text{Final wet body weight}) - \ln(\text{Initial wet body weight})}{\text{Time duration (days)}} \times 100$$

Statistical analysis of the data was done using SPSS (1999) package for Windows.

RESULTS AND DISCUSSION

Increase in wet body weight. *C. catla* showed the best final average body weight as 1227.14 g in the treatment receiving standard diet (T1) followed by T2 (1154.35 g) and T3 (1041.93 g). This fish performed significantly poor (864.69 g) in T7 than all the other treatments viz. T1 through T6 (Table III). The best growth performance of *L. rohita* for the final wet body weight was recorded under the influence of T1 (receiving standard diet) as 1065.99 g, which differed significantly from T2, T3, T4, T5, T6 and T7. The poor growth performance of the fish was recorded under T7 as 796.27 g, which remained significantly different from all other treatments (Table III). The best final wet body weight (1014.29 g) of *C. mrigala* recorded under T5 remained significantly different from T2, T3, T4, T6 and T7 while non-significantly different from T1. This fish species performed poor under T4 as 800.78 g, which was significantly different from rest of the treatments (Table III).

Statistical analysis revealed significant differences among the fish species ($P< 0.01$), treatments ($P< 0.01$) and treatment x species interaction ($P< 0.01$) for the final average body weight values of the fish. *C. catla* performed significantly better than *L. rohita* and *C. mrigala* under treatments T1, T2, T3 and T4, while under the treatment T5 there were non-significant differences between final average body weight of *C. catla* and *C. mrigala* (Fig. 1). The maximum net weight gain by *C. catla* under the treatments T1 through T4 may be due to its inherent capacity to attain better weight than *L. rohita* and *C. mrigala* when reared under semi-intensive polyculture conditions (Javed *et al.*, 1990). Under T6 and T7 *C. mrigala* performed significantly better than the other fish species (Fig. 1).

The results of the experiment revealed that average increase in body weight of three fish species varied significantly from one another under different treatments. In general, replacement of fish meal with sunflower seed meal and canola seed meal resulted in comparatively lower growth performance of fish in terms of gain in average body weight. Tacon (1993) also found that the replacement of fish meal with plant protein in the diet of different fish species caused a significant decrease in fish production. The observations of the present experiment are in accordance with the earlier reporting of Alam *et al.* (1996) who observed that of all the available and commonly used feed ingredients for fish, fish meal is considered to be the best ingredient due to its compatibility with the protein requirements of the fish. These results are also similar to the findings of Fontainhas-Fernandes *et al.* (1999) who recorded the highest final body weight of Tilapia fed the diet containing only animal protein, while the diet containing 100% vegetable protein showed the lowest value of final

Fig. 1. Final average body weight (± SE) three fish species under seven treatments (T1-T7)

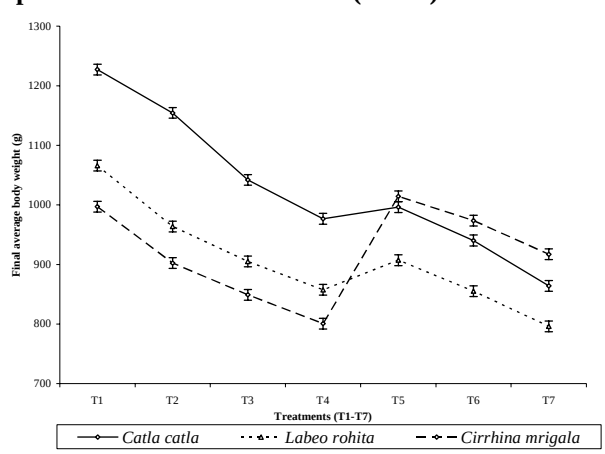

Table I. Composition of fish feed used in the experiment

Ingredients (g/100 gm)	Standard diet	Diets for Treatments (T1-T7) Levels of N replacement from fish meal with sun flower seed meal			Levels of N replacement from fish meal with canola seed meal		
		(20%)	(40%)	(60%)	(20%)	(40%)	(60%)
	T1	T2	T3	T4	T5	T6	T7
Fish meal	23.80	19.04	14.28	9.52	19.04	14.28	9.52
Cotton seed meal	23.80	23.80	23.80	23.80	23.80	23.80	23.80
Maize gluten	26.20	26.20	26.20	26.20	26.20	26.20	26.20
Rice polish	26.20	26.20	26.20	26.20	26.20	26.20	26.20
Sunflower seed meal	_	6.16	12.32	18.48	_	_	_
Canola seed meal	_	_	_	_	6.54	13.08	19.62
Vitamin pre-mix	1.00	1.00	1.00 .00	1.00	1.00	1.00	1.00
Crude protein (%)	30.00	30.00	30.00	30.00	30.00	30.00	30.00

Table II. Average body weights of three fish species under seven treatments (T1-T7) at the time of stocking

Fish Species	No. Stocked	Standard Diet	Treatments Levels of N replacement from fish meal with sun flower seed meal			Levels of N replacement from fish meal with canola seed meal		
			(20 %)	(40 %)	(60 %)	(40 %)	(20 %)	(60 %)
		T1	T2	T3	T4	T5	T6	T7
		Average Body Weight (g)						
Catla catla	27	26.35 ± 1.03	26.60 ± 1.17	25.89 ± 1.01	26.22±0.78	26.66± 0.85	26.75±1.05	27.35±1.08
Labeo rohita	65	29.42 ± 0.84	28.75 ± 0.95	29.11± 1.16	28.61±0.96	29.48± 1.03	28.92± 1.12	29.20± 1.26
Cirrhina mrigala	16	36.82± 1.25	36.16± 1.32	37.50± 1.14	36.42±0.96	37.23± 1.06	36.78± 1.09	35.91± 1.36

Table III. Final average body weights of three fish species under seven treatments (T1-T7)

Fish Species	Standard diet	Treatments Levels of N replacement from fish meal with sun flower seed meal			Levels of N replacement from fish meal with canola seed meal			Mean
	T1	20%	40%	60%	20%	40%	60%	
		T2	T3	T4	T5	T6	T7	
Catla catla	1227.14 ± 8.32 a	1154.35± 7.74 b	1041.93±7.18 c	976.73± 6.43 d	996.29± 5.96 d	940.19± 6.35 e	864.09± 5.72 f	1028.67
Labeo rohita	1065.99± 7.66 a	963.73± 6.12 b	905.15± 7.42 c	857.53± 6.48 d	907.33± 7.34 c	855.22± 5.44 d	796.27± 4.67 e	907.32
Cirrhina mrigala	997.01± 7.62 ab	902.44± 6.76 c	849.04± 6.43 d	800.78± 7.74 e	1014.29±8.37 a	973.59± 7.24 b	917.08± 7.60 c	922.03
Mean	1096.71	1006.84	932.04	878.35	972.64	923.00	859.15	

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

Table IV. Specific growth rate (%) of three fish species under seven treatments (T1-T7)

Fish species	Standard Diet	Levels of N replacement from fish meal with sun flower seed meal			Levels of N replacement from fish meal with canola seed meal			Mean
		20%	40%	60%	20%	40%	60%	
	T1	T2	T3	T4	T5	T6	T7	
Catla catla	1.067	1.047	1.026	1.005	1.006	0.989	0.959	1.014 a
Labeo rohita	0.997	0.976	0.955	0.945	0.952	0.941	0.918	0.955 b
Cirrhina mrigala	0.916	0.894	0.867	0.858	0.918	0.910	0.900	0.895 c
Mean	0.993 a	0.972 ab	0.949 bc	0.936 bc	0.958 abc	0.947 bc	0.926 c	

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

body weight and those of Abbas *et al.* (2005) who reported the replacement of fish meal with sunflower meal (vegetable protein) in the diet of major carps. Khan *et al.* (2003a) reported that fish meal could not be replaced totally with plant products; however, partial replacement can be done using sunflower meal to reduce the cost without affecting growth rate of *C. carpio*.

Specific growth rate. The maximum value of specific growth rate for *C. catla* was recorded as 1.067 under T1 while the minimum value remained as 0.959 under T7. For *L. rohita* the overall range of specific growth rate varied from 0.918 (T7) to 0.997 (T1). *C. mrigala* showed maximum specific growth rate of 0.918 (T5) closely followed by 0.916 (T1), while the minimum rate remained as 0.900 under T7 (Table IV). Analysis of variance showed highly significant difference (P< 0.01) among the three fish species for the specific growth rates. The specific growth rate of *C. catla* remained the maximum, followed by *L. rohita* and *C. mrigala* (Table IV). The effect of different treatments towards specific growth rate of fishes remained

significant (P< 0.05). The overall maximum values of specific growth rate were recorded in T1 and T2 (receiving diet at 20% replacement of fish meal with sunflower seed meal) and T5 (receiving diet at 40% replacement of fish meal with canola seed meal). Similarly the response of treatments T2, T3, T4, T5 and T6 towards specific growth rate of fishes was statistically similar (Table IV). *C. catla* showed the overall maximum values of specific growth rate (as 1.014) followed by *L. rohita* (as 0.955) and *C. mrigala* (as 0.895). Khan *et al*. (2003b) recorded specific growth rate of 0.904 and 0.668%, respectively for *C. carpio* under the application of fish meal based and sunflower meal based diet. However, Dhawan and Kaur (2002) recorded specific growth rate of 0.90 and 1.23 for *C. catla* and *L. rohita*, respectively under application of pig dung as pond manure.

CONCLUSION

Sunflower and canola seed meal are not suitable as diet for *L. rohita* and *C. catla*. However canola seed meal can be incorporated in the diet of *C. mrigala* when it is replaced at 40% nitrogen level from fish meal based diet.

REFERENCES

Abbas, K., I. Ahmed and M. Hafeez-Ur-Rehman, 2005. Growth performance as influenced by partial replacement of fish meal with plant proteins in the diet of major carps. *Indus J. Biol. Sci*., 2: 219–26

Alam, M.K., O.E. Maughan and W.J. Matter, 1996. Growth response of indigenous and exotic carp species to different protein sources in pelleted feeds. *Aquacult. Res*., 27: 673–9

Devi, B.C., S. Vijayaraghavan and C. Srinivasulu, 1998. Soybean meal as protein source in the diet of fingerling *Labeo rohita*. *Indian J. Anim. Sci.*, 68: 281–3

Dhawan, A. and S. Kaur, 2002. Pig dung as pond manure: Effect on water quality, pond productivity and growth of carps in polyculture system. *The ICLARM Quarterly*, 25: 11–4

Fontainhas-Fernandes, A., E. Gomes, M.A. Reis-Henriques and J. Coimbra, 1999. Replacement of fish meal by plant proteins in the diet of Nile Tilapia: digestibility and growth performance. *Aquacult. Int.*, 7: 57–67

Javed, M. and M.B. Sial, 1991. Fish pond fertilization (III): Effect of layer manure fertilization on the growth performance of fish, viz. *Catla catla, Labeo rohita* and *Cirrhina mrigala*. *Pakistan J. Agric. Sci.*, 28: 115–20

Javed, M., M.B. Sial and S.A. Zafar, 1990. Fish pond fertilization (II): Influence of broiler manure fertilization on the growth performance of major carps. *Pakistan J. Agric. Sci*., 27: 212–5

Khan, M.A., A.K. Jafri, N.K. Chadha and N. Usmani, 2003a. Growth and body composition of rohu (*Labeo rohita*) fed diets containing oilseed meals: partial or total replacement of fish meal with soybean meal. *Aquacult. Nutr*., 9: 391–6

Khan, M.N., M. Perveen, A. Rab, M. Afzal, L.Sahar, M.R. Ali and S.M.H.M. Naqvi, 2003b. Effect of replacement of fish meal by soybean and sunflower meal in the diet of *Cyprinus carpio* fingerlings. *Pakistan J. Biol. Sci.*, 6: 601–4

McDonald, P., R.A. Edwards, J.F.D. Greenhalgh and C.A. Morgan, 1999. *Animal Nutrition*, 5th edition, pp: 546–64. Addison-Wesley Longman, Inc. California

Pillay, T.V.R., 1983. *Fish Feeds and Feeding in Developing Countries*, p: 97. FAO Fisheries Technical Report ADCP/REP/ 83/18

Rath, R.K., 2000. *Freshwater Aquaculture*, 2nd edition, p: 421. Scientific Publishers, Jodhpur, India

SPSS ,1999. *Software Program of Statistical Analysis, Version 8.0 Edition for Windows*. SPSS Inc., Chicago, IL, USA

Tacon, A.G.J., 1993. *Feed Ingredients for Warm Water Fish: Fish Meal and other Feed Stuff*, p: 64. FAO Fisheries Circular, No 856, Rome

Watanabe, T., V. Verakunpiriya, K. Watanabe, V. Kiron and S. Satoh, 1997. Feeding of rainbow trout with non-fish meal diets. *Fisheries Sci*., 63: 258–66

(Received 04 September 2007; Accepted 26 February 2008)