Pakistan Vet. J., 2008, 28(3): 111-114.

REPLACEMENT OF FISH MEAL BY CANOLA MEAL IN DIETS FOR MAJOR CARPS IN FERTILIZED PONDS

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ABSTRACT

This study was conducted in three earthen ponds to evaluate the replacement of fish meal by low cost plant protein (canola meal) for major carps in semi-intensive culture system. Each pond was fertilized with cattle manure at the rate of 0.16g N/100g wet fish body weight daily. A control diet (30% CP), formulated by using fish meal, cotton seed meal, maize gluten and rice polish, was designated as T_1, while in T_2 and T_3, the fish meal was replaced with canola meal by 20 and 40%, respectively. Feeding was done at the rate of 4% of wet fish body weight daily for five months. The overall average weight gains in T_1, T_2 and T_3 for three fish species i.e. *Labeo rohita, Cirrhinus mrigala and Catla catla* were 356.6 ± 15.12, 332.6 ± 14.32 and 362.4 ± 12.12; 320.4 ± 14.03, 305.6 ± 14.03 and 337.1 ± 16.02; and 284.6 ± 13.07, 282.2 ± 15.13 and 305.1 ± 17.43g, respectively. Net fish yields (all the species together) were 1529.5 ± 13.93, 1327.0 ± 12.19 and 1122.5 ± 10.28 Kg/ha/year under T_1, T_2 and T_3, respectively. The gross fish production was calculated as 2338.5 ± 12.49, 2137.5 ± 11.65 and 1931.5 ± 13.01 Kg/ha/year in T_1, T_2 and T_3 pond, respectively. In all the treatments, *Catla catla* showed better growth performance, followed by *Labeo rohita* and *Cirrhinus mrigala.* The treated ponds caused a decrease in fish production when replacement of fish meal was done with canola meal.

Key words: Fish meal, plant protein, replacement, growth, major carps.

INTRODUCTION

Fish is highly nutritive and rich source of animal proteins. For the improvement of fisheries and to achieve maximum yields from resources of fresh water, it is necessary to provide artificial feed, by which fish grows rapidly and attains maximum weight in shortest possible time. As in other animals, fish requires a nutritious diet for proper growth and quality protein production. To date, nutritionists and feed manufacturers have concentrated their efforts on determining the feedstuff that may be used to produce a cost effective fish feed formulation.

Among commonly used feed ingredients, fish meal is considered to be the best ingredient due to its compatibility with the protein requirement of fish (Alam *et al.,* 1996). Replacement of fish meal with cheaper ingredients of either vegetable or animal origin in fish feed is necessary because of rising cost and uncertain availability of fish meal (Higgs *et al.*, 1995). Inclusion of feedstuffs with relatively high levels of carbohydrate in formulated fish feed is preferred in view of its protein-sparing action that may make the diet more cost effective (Hidalgo *et al.,* 1993). According to Rumsey (1993), increased use of plant protein supplements in fish feed can reduce the cost of fish meal. These days, the research has focused on utilizing less expensive and readily available resources to replace fish meal, without reducing the nutritional quality of feed (El-Sayed, 1999). In this study, an attempt was made to evaluate the replacement of fish meal by low cost plant protein (canola meal) ingredients for major carps in fertilized ponds.

MATERIALS AND METHODS

This study was conducted for 152 days in three earthen ponds, each measuring 25m x 8m x 1.5m, and located at Fisheries Research Farms, University of Agriculture, Faisalabad, Pakistan. Fertilization of all the ponds was done with cowdung at the rate of 0.16g N/100 g wet fish body weight daily. Each pond was stocked with 50 major carps viz., *Labeo rohita, Catla catla* and *Cirrhinus mrigala* in the ratio of 20:15:15 in each pond. A control diet was formulated with fish meal, cotton seed meal, maize gluten and rice polish and was designated as T_1. In T_2, fish meal was replaced by canola meal at 20% protein level, while in T_3 fish meal was replaced by canola meal at 40% level (Table 1).

In all the ponds, feeding was done at the rate of 4% of wet fish body weight daily. The amount of feed was increased fortnightly according to fresh fish body weight. Fish growth was measured in terms of increase in body weight by random capturing five fish sample of each species from all the ponds on fortnightly basis. After obtaining the data, the fish were released back into their respective ponds. The data on growth parameters was subjected to statistical analysis through microcomputer using MSTATC and MICROSTAT packages.

Table 1: Composition of standard diet and fish meal replacement diet with canola meal

Ingredients (g/100g)	Diets for the treatments		
	T_1	T_2	T_3
Fish meal	23.80	19.04	14.28
Cotton seed meal	23.80	23.80	23.80
Maize gluten	26.20	26.20	26.20
Rice polish	25.20	23.42	21.64
Canola seed meal	-	6.54	13.08
Vitamin pre-mix	1.00	1.00	1.00
Crude protein (%)	30.00	30.00	30.00

RESULTS AND DISCUSSION

After 152 days of rearing, all fish species were harvested from these three ponds. Survival rate for all the fish species was found to be 100% through out the experimental period. The initial average body weights of *Labeo rohita* in T_1, T_2 and T_3 were 123.0 ± 8.09, 122.7 ± 10.02 and 122.5 ± 10.25g, while the final weights were 356.6 ± 15.12, 320.4 ± 14.03 and 284.6 ± 13.07g, respectively (Table 2). There were net gains of 233.6 ± 10.69, 197.7 ± 11.76 and 162.1 ± 11.84g. The gross fish production was found to be 950.0, 853.5 and 758.0 Kg/ha/year, while the net production was 622.5, 526.5 and 432.0 Kg/ha/year in T_1, T_2 and T_3 pond, respectively (Table 2).

The *Cirrhinus mrigala* had average weights of 118.0 ± 7.05, 118.7 ± 8.03 and 118.1 ± 10.02g, when stocked, while average final weights were 332.6 ± 14.32, 305.6 ± 14.03 and 282.2 ± 15.13g in T_1, T_2 and T_3, respectively (Table 2). The net gains in average body weights were 214.6 ± 12.02, 186.9 ± 10.58 and 164.1 ± 10.94g. There were gross fish productions of 664.5, 610.5 and 564.0 Kg/ha/year, while the net productions were 428.5, 373.5 and 328.0 Kg/ha/year in T_1, T_2 and T_3, respectively (Table 2).

For *Catla catla* the initial average body weights were 123.0 ± 9.03, 123.5 ± 10.02 and 123.7 ± 9.05g, while the final average weights were 362.4 ± 12.12, 337.1 ± 16.02 and 305.1 ± 17.43g in T_1, T_2 and T_3 pond, respectively (Table 2). The respective values for net gains were 239.4 ± 14.31, 213.6 ± 10.33, and 181.4 ± 11.79g. The gross fish productions were calculated to be 724.0, 673.5 and 609.5 Kg/ha/year, while the net productions were 478.5, 427.0 and 362.5 Kg/ha/year, in T_1, T_2 and T_3, respectively (Table 2).

The gross fish productions for all the fish species together were calculated to be 2338.5 ± 13.93, 2137.5 ± 12.19 and 1931.5 ± 10.28 Kg/ha/year in T_1, T_2 and T_3, respectively. However, the net fish production for the three species was calculated to be 1529.5 ± 12.49, 1327.0 ± 11.65 and 1122.5 ± 13.01 Kg/ha/year for the three treatments, respectively (Table 2).

Analysis of varianc showed that there was a highly significant ($P<0.05$) difference in the increase in body weight of fish among the fortnights, treatments and species. The interactions between fortnights and the treatment (F x T), fortnights and the species (F x S), and species and treatment (S x T) were found to be non significant (Table 3a). Comparison of means of increase in average body weight for species, ponds and fortnights are shown in Table 3b.

In this experiment, all the fish species of control pond showed higher fish production than that in the ponds treated with replacement diets and there was a decrease in average fish weight with increase in the percentage of canola meal in the replacement diets. The replacement of fish meal with plant proteins in the diet of different fish species resulted in a significant decrease in fish production (Fontainhas *et al*., 1999; Abbas *et al.*, 2005). Alam *et al*. (1996) also reported that of all the available and commonly used feed ingredients, fish meal is considered to be the best ingredient for the fish growth due to its compatibility with the protein requirement of fish. However, Khan *et al*. (2003) replaced fish meal with soybean meal in the diet of *Labeo rohita* fingerlings on iso-nitrogenous basis (35% CP) and observed no significant variation in the growth performance of fish under different treatments. They suggested that fish meal could be replaced with soybean meal when supplemented with methionine and fortified with minerals. For broiler chicken, the inclusion canola meal upto 25% in the diet reduced the relative cost per unit weight gain (Naseem *et al*., 2006).

This study revealed that *Catla catla* showed the best growth performance in all the treatments, followed by *Labeo rohita* and *Cirrhinus mrigala*. However, Javed *et al*. (1993) observed maximum weight gain for artificial feed for *Cirrhinus mrigala*, followed by *Labeo rohita* and *Catla catla*.

In the present study, higher weight gain in all the treated ponds was noted in the months of September and October which might have been due to optimum temperature. Lower growth in the months of June and July might be due to high temperature during these months. Earlier studies have also shown that maximum growth of different fish species occur at optimum temperature (Villaluz and Unggui, 1983; Goolish and Adelman, 1984; Abbas *et al*., 2004).

Table 2: Total fish production of major carps in three treatments

Parameters	T_1			T_2			T_3		
	Labeo rohita	***Cirrhinus mrigala***	***Catla catla***	***Labeo rohita***	***Cirrhinus mrigala***	***Catla catla***	***Labeo rohita***	***Cirrhinus mrigala***	***Catla catla***
No. of fish stocked	20	15	15	20	15	15	20	15	15
Survival rate	100	100	100	100	100	100	100	100	100
Initial average weight (g)	123.0 ± 8.09	118.0 ± 7.05	123.0 ± 9.03	122.7 ± 10.02	118.7 ± 8.03	123.5 ± 10.02	122.5 ± 10.25	118.1 ± 10.02	123.7 ± 9.05
Final average weight (g)	356.6 ± 15.12	332.6 ± 14.32	362.4 ± 12.12	320.4 ± 14.03	305.6 ± 14.03	337.1 ± 16.02	284.6 ± 13.07	282.2 ± 15.13	305.1 ± 17.43
Gain in average weight (g)	233.6 ± 10.69	214.6 ± 12.02	239.4 ± 14.31	197.7 ± 11.76	186.9 ± 10.58	213.6 ± 10.33	162.1 ± 11.84	164.1 ± 10.94	181.4 ± 11.79
Gross fish production/pond/6 months (g)	7132.0	4989.0	5436.0	6408.0	4548.0	5057.0	5692.0	4233.0	4577.0
Gross fish production/pond/year (kg)	19.0	13.3	14.5	17.1	12.2	13.5	15.2	11.3	12.2
Gross fish production/acre/year (kg)	384.6	269.0	293.1	345.5	247.1	272.6	306.8	228.3	246.7
Gross fish production/hectare/year (kg)	950.0	664.5	724.0	853.5	610.5	673.5	758.0	564.0	609.5
Net fish production/pond/6 months (g)	4672.0	3215.0	3591.0	3954.0	2804.0	3204.0	3242.0	2462.0	2721.0
Net fish production/pond/year (kg)	12.45	8.57	9.57	10.53	7.47	8.54	8.64	6.56	7.25
Net fish production/acre/year (kg)	252.0	173.5	193.7	213.2	151.2	172.9	174.9	132.8	146.8
Net fish production/hectare/year (kg)	622.5	428.5	478.5	526.5	373.5	427.0	432.0	328.0	362.5
Gross fish production/ha/year (kg) (All three fish species)	2338.5 ± 13.93			2137.5 ± 12.19			1931.5 ± 10.28		
Net fish production/ha/year (kg) (All three fish species)	1529.5 ± 12.49			1327.0 ± 11.65			1122.5 ± 13.01		

Table 3a: Analysis of variance for increase in body weight (g) of major carps in the ponds

S.O.V.	D.F.	S.S.	M.S.	F. Value	Probability
Fortnight (F)	8	2240.14	280.017	208.94**	0.0000
Species (S)	2	91.05	45.527	32.19**	0.0000
F x S	16	37.00	2.312	1.52^{NS}	0.1505
Treatments (T)	2	614.86	307.428	221.19**	0.0000
F x T	16	30.17	1.886	1.45^{NS}	0.1777
S x T	4	12.49	3.123	2.60^{NS}	0.0547
Error	32	42.89	1.340		
Total	80	3068.6			

* = Significant (P<0.05); **= Highly significant (P<0.01); NS = Non-significant.

Table 3b: Comparison of mean values of increase in body weight of major carps

Parameters	Body weight
Species	
Labeo rohita	21.95 ± 1.344b
Cirrhinus mrigala	20.87 ± 1.028c
Catla catla	23.46 ± 1.178a
Treatments	
T_1	25.44 ± 1.052a
T_2	22.16 ± 1.103b
T_3	18.80 ± 1.095c
Fortnights	
16-06-2003	13.19 ± 1.473h
02-07-2003	15.70 ± 2.325g
06-07-2003	17.97 ± 3.421f
02-08-2003	20.43 ± 4.507e
16-08-2003	22.60 ± 5.524d
02-09-2003	26.21 ± 6.861c
16-09-2003	26.90 ± 7.964bc
02-10-2003	28.46 ± 7.634a
16-10-2003	27.40 ± 9.643ab

Values with different superscripts for each parameter differ significantly from each other (P<0.01).

Based on the present investigation, it was concluded that the highest fish production of major carps was observed with the control diet (fish meal, cotton seed meal, maize gluten and rice polish) compared to other diets in which fish meal was replaced with canola meal at 20 and 40%.

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