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Growth Response of Indian Major Carps *Catla catla* and *Labeo rohita* to Formulated Diets Containing Leaf Powders as Protein Source

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Search for alternative sources of protein for partial or complete replacement of fishmeal is an ongoing process, since fishmeal, which is used as the major source of protein in pelleted feed, is becoming very expensive and scarce. In the present study fishmeal was partly replaced with locally available plant leaf powders, *Eichhornia crassipes* (pellet E), *Colocasia esculenta* (pellet C) and *Gliricidia maculata* (pellet G) and the pelleted feeds prepared separately were fed to the Indian major carps *Catla catla* and *Labeo rohita* and the growth performance was compared with fishmeal based control diet (pellet FM) for a period of 112 days. The best growth of catla was recorded in pellet FM followed by pellet C, E and G treatments, respectively. However, rohu registered maximum growth in pellet C followed by pellet G, E and FM treatments during the experimental period.

The common fish feed used in India is a mixture of ricebran and oilcake. Varghese *et al.* (1976) developed a nutritionally balanced pelleted feed which gave much higher growth in common carp *Cyprinus carpio*. Of late, fishmeal is being used as the major source of protein in pelleted feeds the world over. However fishmeal is becoming expensive and scarce. Therefore, there is an urgent need to develop low cost nutritionally balanced diets for aquaculture. Fish nutritionists have been trying to replace fishmeal partially or completely with plant protein sources to bring down the cost of feeds. The magnitude of fishmeal replacement varied in different studies and most of the studies indicated poor performance when fishmeal was replaced (Debrowski & Kozak, 1979; Jackson *et al.*, 1982). The reason for growth depression have been discussed by Higgs *et al.* (1988). Alternate sources of protein for partial or complete replacement of fishmeal have been investigated by Abel *et al.* (1984) and Hossain & Jauncey (1989). In the present study, attempts were made to reduce the cost of feed by partly replacing fishmeal with locally available plant proteins in diets for Indian major carps.

Materials and Methods

The feeding experiment was carried out in 12 out door cement cisterns of 5x5x1 m size each. The cisterns were cleaned thoroughly and dried for a week. They were filled with water up to a depth of 65±5 cm and this depth was maintained throughout the experimental period. Half of the water in all the 12 cisterns was changed with freshwater from a perennial well every fortnight after sampling. Two species of Indian major carps, *Catla catla* (Hamilton) and *Labeo rohita* (Hamilton) were used in the experiment. Each cistern was stocked with 10 fingerlings each of catla (size 2.6 g) and rohu (size 2.01 g) of almost uniform size at a total stocking density of 8000 per hectare.

Four isonitrogenous pelleted feeds were formulated using different ingredients such as ricebran, groundnut oilcake,

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fishmeal, tapioca flour, vitamin-mineral mixture (*Supplevite-M*, Sarabhai Chemicals), leaf powders of *Eichhornia crassipes*, *Colocasia esculenta* and *Gliricidia maculata* in different proportions (Table 1). The control diet (pellet FM) was prepared as described by Varghese *et al.* (1976) and it contained fishmeal as the major source of protein. The proportion of fishmeal was kept constant at 10% level in the three test diets pellet E, pellet C and pellet G in which low cost leaf powder of *Eichhornia*, *Colocasia* and *Gliricidia*, respectively were incorporated at 30% level.

Each pelleted diet was tested in triplicate. Fishes were fed once daily at the rate of 5% body weight. At fortnightly intervals a minimum of 50% of fishes were sampled to record the growth.

Feed ingredients and the experimental diets were analysed for proximate composition such as moisture, crude protein, crude fat, crude fibre, total ash, nitrogen free extract and calorific content (Table 2). Moisture content was determined by drying the sample in an oven till constant weight was obtained following the method of Boyd

Table 1. *Percentage of different ingredients used in formulated pelleted diets*

Ingredient	Pellet FM	Pellet E	Pellet C	Pellet G
Ricebran	40 (14.20)	10 (3.60)	14 (4.95)	15 (5.32)
Groundnut oilcake	24 (35.38)	40 (58.72)	36 (51.86)	35 (50.62)
Fishmeal	25 (48.86)	10 (19.46)	10 (19.10)	10 (19.17)
Tapioca flour	10 (1.86)	9 (1.67)	9 (1.63)	9 (1.64)
Vitamin-mineral mixture	1	1	1	1
Eichhornia leaf powder	-	30 (16.84)	-	-
Colocasia leaf powder	-	-	30 (22.03)	-
Gliricidia leaf powder	-	-	-	30 (22.48)

(Figures in parenthesis indicate proportion of protein contributed by the ingredient)

Table 2. *Proximate composition of pelleted diets*

Feed pellets	Moisture, %	Crude protein, %	Crude fat, %	Crude fibre, %	Ash %	Nitrogen free extract, %	Calorific content, kcal g^{-1}
Pellet FM	6.84 ±0.35	30.34 ±0.36	5.94 ±0.42	9.64 ±0.18	18.71 ±0.41	28.53	3.19
Pellet E	6.87 ±0.40	30.47 ±0.41	6.16 ±0.21	8.28 ±0.31	13.08 ±0.18	35.14	3.48
Pellet C	5.47 ±0.25	31.05 ±0.21	7.26 ±0.21	7.37 ±0.19	15.57 ±0.32	33.28	3.54
Pellet G	6.93 ±0.45	30.93 ±0.20	6.40 ±0.14	10.39 ±0.35	11.59 ±0.31	33.76	3.47

Table 3. *Growth performance of catla and rohu with different experimental diets*

	Pellet FM		Pellet E		Pellet C		Pellet G	
	Catla	Rohu	Catla	Rohu	Catla	Rohu	Catla	Rohu
Initial average length, cm	5.57	4.97	5.50	4.93	5.53	4.89	5.28	4.94
Final average length, cm	17.32	17.21	16.82	17.71	16.93	18.37	16.76	18.12
Initial average weight, g	2.6	2.0	2.6	2.0	2.6	2.0	2.6	2.0
Final average weight, g	71.03	71.16	67.54	76.33	70.29	83.77	65.86	80.67
Specific growth rate, % per day	2.95	3.19	2.91	3.25	2.94	3.33	2.89	3.30
Survival, %	87.00	87.00	83.00	87.00	83.00	90.00	80.00	90.00
Relative food conversion ratio*	1.99	2.09	2.16	1.86	2.21	2.21	2.22	2.24

* Relative food conversion ratio = Dry weight of feed given/Increase in wet weight of fish due to both natural and supplementary feeding

(1969). Total nitrogen was estimated by microkjeldahl method (AOAC, 1975) and the crude protein was calculated by multiplying nitrogen content of sample with the factor 6.25. The crude fat content was estimated by extraction with petroleum ether (B.P. 40 to 60°C) for 6-7 hours in the soxhlet apparatus. Crude fibre was estimated employing the modified method of de Silva (1985). Ash content was determined by burning the sample at 550±20°C for 6 h in a muffle furnace. The nitrogen free extract was found out by the difference method (Hastings, 1976). The energy value of each food ingredient was found out by multiplying percentage nutrient with energy factors of 4 for carbohydrate, 9 for fat (Hastings, 1976) and 5 for protein (Smith, 1975; Viola, 1977). Water samples were collected at fortnightly intervals in the morning hours (07:00 to 08:00) and were analysed for various physicochemical parameters such as temperature, pH, dissolved oxygen, free carbondioxide and total alkalinity following standard methods.

The mean growth of catla and rohu in response to different formulated feeds was analysed statistically by using ANOVA technique (Snedecor & Cochran, 1968). The pair of treatments differing significantly were treated by the method of least significant difference based on *t* test.

Results and Discussion

The water quality parameters in the experimental cisterns were within the optimum range for growth of carps. The temperature of air and water ranged from 23.5 to 26.5°C and from 25.5 to 30°C, respectively. The pH of water was in the alkaline range (7.4 to 8.6). The dissolved oxygen concentration ranged from 6.4 to 11.2 ppm and the total alkalinity 38 to 70 ppm in the different cisterns. Since there was no significant difference in final average weight of fishes among the replicates ($P < 0.05$) the average growth was calculated pooling the three values.

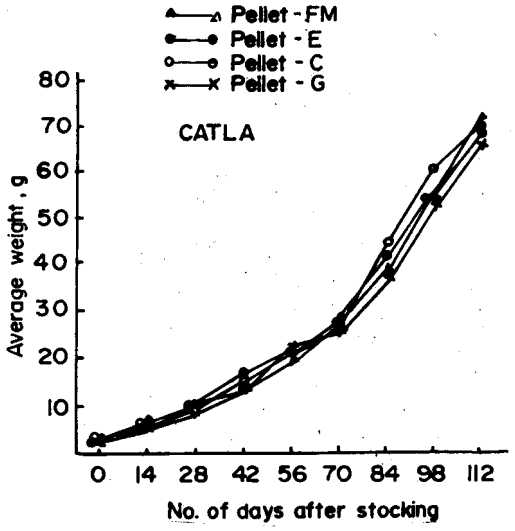

Fig. 1a. Average weight of catla recorded in different treatments

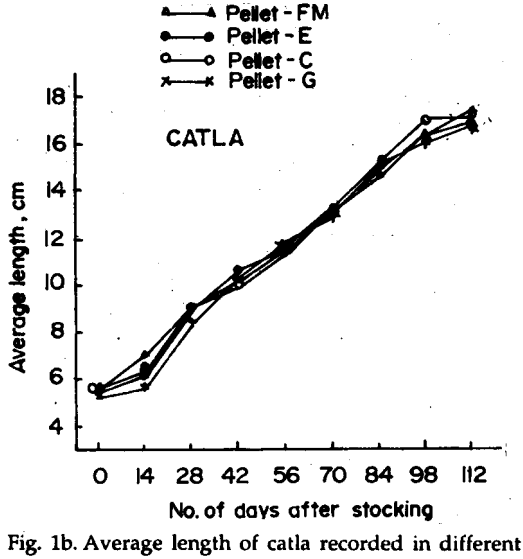

Fig. 1b. Average length of catla recorded in different treatments

The growth rate, percentage survival, specific growth rate and relative food conversion ratio are given in Table 3. The lowest survival percentage recorded for catla was 80.0 and that of rohu, 87.0. This low survival was due to accidental escape of fishes from the tanks. The best growth of catla was recorded in pellet FM followed by pellets C, E and G, respectively. Rohu registered maximum growth in pellet C followed by pellets G, E and FM, respectively during the period of experiment. The growth response of catla in terms of weight and length are depicted in Figs. 1a and b and that of rohu in Figs. 2a and b, respectively.

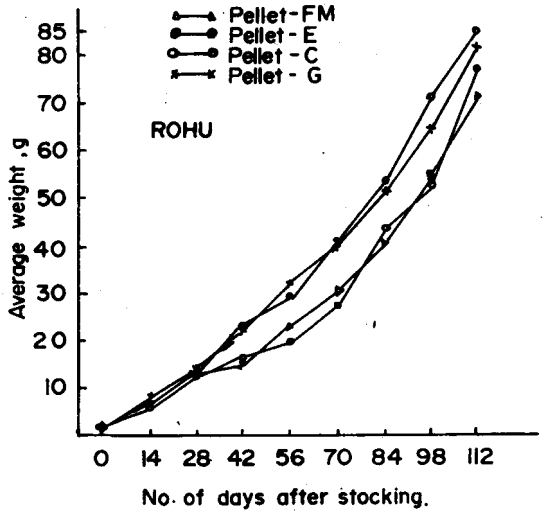

Fig. 2a. Average weight of rohu recorded in different treatments

The best growth of catla recorded in pellet FM may be due to its zooplankton feeding habit. According to Mc Coy II (1990), fishmeal contains 19 amino acids, several minerals and the vitamin choline, all of which are very useful for fish or shrimp growth. Since fishmeal contains all the dietary essentials, it would have satisfied the nutritional requirements of catla leading to better growth. Superiority of fishmeal as a major protein source in fish feeds has been reported by several workers (Viola, 1977; Sitasit & Sitasit, 1977). The growth of catla was significantly higher ($p < 0.05$) in control diet in comparison to test diets, pellet E and pellet G. The relatively poor growth of catla on plant protein based diets could be due to the inefficiency of this species to utilise plant sources of protein. Hossain & Jauncey (1989) observed better growth rate, food conversion ratio and protein efficiency ratio in common carp fed

on fishmeal based diet than on mustard, linseed and sesame incorporated diets.

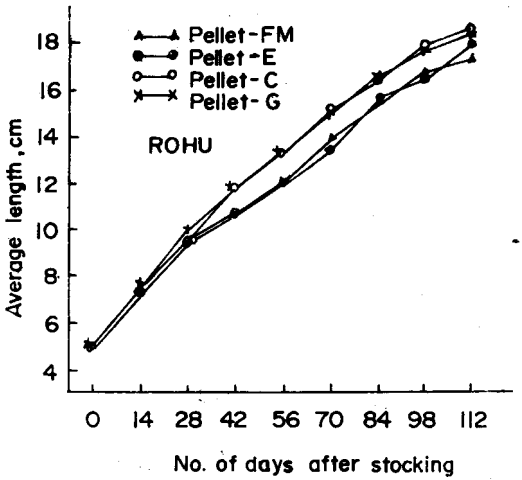

Fig. 2b. Average length of rohu recorded in different treatments

There was no significant difference ($p < 0.05$) between the final average weight of catla on control diet and pellet C, which may be due to the relatively higher crude protein, crude fat and caloric content in pellet C. Watanabe *et al.* (1987) found better growth of common carp with pelleted diet having 32 to 37% protein and 3.4 kcal g^{-1} of energy. However, catla recorded better growth in pellet E treatment till 70th day among all the feeds tried. This indicates the ability of catla to utilise Eichhornia leaf powder based diet at least during the early stages of growth, which was similar to the observation made by Anil (1981). The lowest growth of catla in pellet G treatment may have been due to its faster disintegration, adversely affecting the availability of feed. The higher fibre content of pellet G might have also affected its utilisation by catla. Leary & Lovell (1975) noticed growth depression in catfish, fed with diets having 8% or more cellulose. National Research Council (1977) reported that larger amount of fibre could impair pellet quality.

Rohu showed significantly ($p < 0.05$) better growth in all the three leaf powder incorporated diets compared to control. This is mainly due to its feeding habits. Meske & Pruss (1977) reported that fishmeal is not essential in carp diet. Haniffa *et al.* (1987) found better feeding rate of rohu when fed on diet containing a mixture of plant and animal proteins than only on either of them. Pellet C had relatively higher nutrients and caloric value which favoured growth of rohu in this treatment. Growth of rohu in pellet G was almost similar to that in pellet C inspite of high crude fibre content and low stability the former. The relatively low survival of catla recorded in G series cisterns might have also resulted in availability of more food to rohu resulting in its faster growth. Growth of rohu was also higher in pellet E than fishmeal based control diet. Boyd (1969) reported that dehydrated samples of Eichhornia leaves contain satisfactory levels of essential amino acids. The dried powder of Eichhornia also contains essential vitamins capable of promoting growth in fish when included at low levels in vitamin free diets (Liang & Lovell, 1971). The poor growth of rohu recorded in pellet FM can be attributed to feed's low crude fat, calorific value and the herbivorous nature of fish.

From the present study, it can be concluded that catla grows well with the pelleted feed containing fishmeal as major source of protein, but rohu grows well with diet containing both fishmeal and leaf powders as sources of protein.

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