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Study, to assess the influence of supplementary feeding methods in different combinations on growth performance of *Catla catla* (F. Hamilton, 1822) and *Labeo rohita* (F. Hamilton, 1822).

Ganesan. R., Dr.D.Manivelu and Dr. C. Chennakrishnan
P.G & Research Department of Zoology, Government Arts College for Men,
Krishnagiri, Tamilnadu, South India.
Corresponding mail: prof.dmani@gmail.com

ABSTRACT: Overall, two species of fish *Catla catla, Labeo rohita* attained the maximum average body weight in T1 which was treated with artificial feed. Among the two species *Catla catla* showed the maximum average body weight, followed by *Labeo rohita* in T1. *Catla catla, Labeo rohita* showed the percentage of weight gain with the highest rate in all the treatments., The highest specific growth rate of *Catla catla, Labeo rohita* showed as 0.3 and 0.49 in T1. The overall range of food conversion ratio (FCR) varied from 0.89 to 3.11 in all the treatments. The maximum values were recorded in T3 (3.11) followed by 2.31 (T1). Among these two species, *Catla catla* and *Labeo rohita* showed the survival percentage of 90-96.66%, under the all treatments. Biomass production of all treatment slightly modified (0.74 - 16.80) in *Catla catla* and *Labeo rohita.* Fish production highest in artificial feed in other feed are treated with *Catla catla and Labeo rohita.* Among these two species were growth response was high in their feeds. Artificial feed is high quantity crude protein and cost low and growth is high. The present investigation is aimed to study in the Growth status in the Indian major carps such as *Catla catla* and *Labeo rohita* are the most important commercial fishes with a maximum market demand under the laboratory condition.

Key words: *catla catla, Labeo rohita*, Treatments, FCR, and Artificial feed, Rice bran, Oil cake.

INTRODUCTION

Aquaculture is a fast developing industry in India. Development of aquaculture is mainly depended on availability of compatible and suitable diets. The contamination of aquatic environments with a wide range of pollutants has become a matter of great concern over the last few decades. Fish play an important role in human nutrition in India,

particularly to the peoples of coastal areas. Fish meal has been an important source of protein in fish diets because of its high protein quality and palatability. However, fish meal is very expensive and can substantially increase feed costs.

The nutrients derived from fish include vitamins, calcium, phosphorus and unsaturated fat. These nutrients when provided naturally or artificially in aquaculture enable the fish to grow adequately for the enhancement of health in humans (Ayanda, 2003). Various fishes may not be free from cultural and religious taboos, but could be acceptable by people of all nations, tribes and religious affiliations (Ayodele and Fregene, 2003). The inadequate supply of fish protein in the country has no doubt increased malnutrition especially among low income earners. These persons can hardly afford the high cost of meat products. The demand for fish has therefore been on the increase because the high cost of protein from livestock, and the general increase in human population, has resulted in increased demand for food, including fish. Fish like other animals require essential nutrients to grow adequately at all times. Such nutrients could be supplied from plankton, (Adigun, 2005) insect's larvae, worms/maggot, etc. (Ovie, 1996). When fishes are cultured in artificial environment, additional nutrients need to be supplied in form of supplementary diet (Eyo, 1996).

The Indian major carps *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala* are the most important common commercial fishes in India with a maximum market demand and acceptability as food by the consumers due to their taste and flesh. They contribute about 67% of total freshwater fish production (ICLARM, 2001). Feeding management plays a critical role in the success of fish culture. The current trend in fish culture is towards increased intensification whereby, provision of feeds becomes necessary and success depends significantly on the availability of well-balanced nutritionally complete and cost effective compounded feeds. In India, the aquaculture practices mainly revolve around a few species of finfish and shellfish, among which the Indian Major Carp's viz. *Catla catla* and *Cirrhinus mrigala* contribute substantially to the inland production. Although carp culture is widely practiced, the non- availability of appropriate compounded feed to meet the demands of the species still remains as a major constraint. 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).

Fingerlings of *Labeo rohita* are reported to give best growth performance with diet consisting of fish meal and mixed animal protein (fish meal, bone and meat meal). Nile tilapia showed the maximum increment in average body weight, feed intake and SGR with the fish meal diets (Goda *et al.*, 2007). However, maximum conversion ratio is observed with mixed plant based diet (mustard oil cake, soyabean meal ,sesame oil cake and rice bran) and vitamin premixes @ 2 times feeding day-1 (Choudhury *et al.*, 2002; Akhteruzzaman and Kiaya, 2003). Plant protein mixture is also utilized for high growth performance of fish species (El-Saidy and Gaber, 2003). Protein of plant origin is preferred as compared to animal origin protein in the culture of carps (Singh *et al.*, 2004). The supplementary feed with 40% crude protein of plant origin along with the manuring plays a key role in enhancing productivity and performance in terms of weight gain and specific growth rate in carp culture system (Kalla *et al.*, 2004; Samantaray and Mohanty, 1997).

The present investigation is aimed to study in the Growth status in the Indian major carps such as *Catla catla* (F. Hamilton, 1822), *Labeo rohita* (F. Hamilton, 1822) are the most important commercial fishes with a maximum market demand under the laboratory condition.

MATERIALS AND METHODS

Animal collection and maintenance

Freshwater Indian major carps (*Catla catla and Labeo rohita*) fingerlings (Plate 2, 3) were collected from the Government Fish culture farm in K.R.P Dam in Krishnagiri, Tamilnadu, South India. They were brought to the laboratory in the polythene bags filled with aerated water. They were maintained in a rectangular cement tank washed with Potassium permanganate to make the walls free from fungal attack, if any chlorine free groundwater was used in the tank with aerators fixed of entire tank. The water had PH is 7.4 - 7.8. Fishes were acclimated for a 25 days in the laboratory conditions at room temperature ($28\pm1^{o}C$) before subjecting them for tests significant sign of stress or unusual behavioural criteria were not observed in the control of fishes throughout the acclimation and test period .The fishes

were regularly fed with commercial feed. The water in the tank was changed into three times in a week, after consumptions of food supplied.

The healthy fishes are the uniform size and weight (5 ± 1g) was selected for the experimental purpose. Twenty healthy fishes were selected in each variety of *Catla catla and Labeo rohita* in different feed conditions, it was transferred from the stock to small cement tank and were divided into three groups. It consisted of the fishes in tap water which served as control.

The chlorine free Groundwater was used in the growth studies of experiments. The condition of the experimental water was maintained with constant characteristics throughout the experiment period.

Diet preparation

The formulation of the experimental diet presented in Table 1 was felt to be representative of commercial diets. The artificial feed components were oil cakes, rice bran, soya beans, corn powder, tapioca powder, chicken wastes, and vitamin B Complex. Their feed components mixed with the water. The artificial diet was steam pelletized using a laboratory scale; Pellets were sifted to remove any fine particles, cooled to room temperature in a fan ventilated chamber, and stored in a 28ºC freezer until required for feeding.

Formulation of experimental diet

Table 1. Composition of Experimental feeds.

Control	Treatment - 1 (Artificial feed)	Treatment -2	Treatment -3
Rice Bran	Rice bran-120 gm	Oil cake	Commercial feed (Gold mahur foods and feeds Pvt Ltd, Mumbai-79)
	Oil cake – 800 gm		
	Soya beans-200 gm		
	Corn powder-200 gm		
	Tapioca powder-80 gm		
	Chicken waste -600 gm		
	Vit. B Complex-15		

Prepared (Artificial) Diets

Prepared or artificial diets may be either complete or supplemental diets. Complete diets supply all the ingredients (protein, carbohydrates, fats, vitamins, and minerals) necessary for the optimal growth and health of the fish. Most fish farmers use complete diets, those containing all the required protein (18-50%), lipid (10-25%), carbohydrate (15-20%), ash (< 8.5%), phosphorus (< 1.5%), water (< 10%) and trace amounts of vitamins, and minerals (Table 1).

Evaluation of Production Diets

For most practical applications, evaluation of production diets (diets for fingerling and adult production) can be adequately done in feeding trials. Since diets are available that have a well-defined composition, growth performance of fish can be readily determined after modifications of a control diet are made. Typically, the total feed utilization by fish, expressed as food conversion ratio (FCR), or the protein utilization, expressed as protein efficiency ratio (PER), are calculated. The highest quality production diets will have relatively low FCRs and high PER's.

One of the simplest means for an aquaculture producer to assess feed performance is to determine a food conversion ratio (FCR). The FCR is the weight of food supplied divided by the weight gain of the fish during the feeding period. FCR can be expressed by the equation:

$$FCR = \frac{\text{Total weight of Feed Fed}}{\text{Total amount of Fish weight gain}}$$

and is the weight of food supplied to fish during the study period, is the live weight of fish at the beginning of the study period, is the live weight of fish at the end of the study period 1A very important factor to remember when FCRs are compared is that they are based on the wet weight of the feed. Different feeds may have very different moisture levels. For example, a dry catfish production diet may have a moisture content of around 10 percent, whereas a semi- moist diet for sea bass may have a moisture content of over 60 percent. Moisture does not contribute to the growth of fish, but does add a bias to the FCR values. Thus, if comparisons are made between two or more diets, it is often useful to calculate the FCR on a dry weight basis. To make this easier, it is important to know the percent of moisture and dry weight in both your feeds and fish. High protein ingredients are frequently the most

expensive components of artificial diets. Consequently, feeding a diet too high in crude protein will not only be wasteful in terms of cost, but excess excretory nitrogen resulting from the breakdown of protein for energy metabolism may be a stressor to the fish. One means for determining the optimum level of protein in a selected feed is to compare the protein efficiency ratio (PER) of different feeds fed to fish. PER is the weight gain of fish divided by the dry weight of protein in the feed.

Growth Parameters:

The growth parameters of the *Catla catla* and *Labeo rohita* fingerlings were assessed by taking their body weight at weekly interval.

The results were recorded in terms of percentage of weight gain (PWG), specific growth (SGR), survival percentage (SP), feed conversion ratio/efficiency (FCR) and biomass. There was recorded at the end of the week.

RESULTS AND DISCUSSION

Growth Performance of Fish

The growth performance of two cultured fish species under three different treatments was studied on the following morphometric parameters

Increase in average Fish body weight

I. *Catla catla*

The initial average body weights of fingerlings of *Catla catla* were recorded as 45.1, 52.8, 44.4, and 53.2gm whereas the final average weight were 77.1, 87.8, 76.9 and 77.9 gm in Control T1, T2, and T3 respectively (Table - 2). The minimum weight gain of *Catla catla* was 3.8, 3.8, 5.5, and 2.1gm in the second week in Control T1, T2 and T3. *Catla catla* showed the maximum average body weight gain of 9.4g in T1 which was noted in fourth week. In control the maximum body weight increase of 7.6 gm was observed during sixth week, while in T2, and T3 the maximum increase in the average body weight was noted as

8.6 and 8.3gm in first week. Overall, the maximum increment of 9.4 gm was noted in T1, under the influence of artificial feed with the final average body weight of 77.1gm.

Table –2: Weekly wise increase in average body weight (gm) of *Catla catla* under different treatments (N=20)

Weeks	Control		Treatment -1		Treatment -2		Treatment -3	
	Avg. Body Wt.	Inc. in Body Wt.	Avg. Body Wt.	Inc. in Body Wt.	Avg. Body Wt.	Inc. in Body Wt.	Avg. Body Wt.	Inc. in Body Wt.
Initial	45.1	-	52.8	-	44.4	-	53.2	-
1st	52.4	7.3	57.7	4.9	53.0	8.6	61.4	8.2
2nd	56.2	3.8	61.5	3.8	58.5	5.5	63.5	2.1
3rd	61.0	4.8	68.7	7.2	60.6	2.1	65.8	2.3
4th	64.7	3.7	78.1	9.4	66.4	5.8	68.4	2.6
5th	69.5	4.8	80.5	2.4	69.2	2.8	71.8	3.4
6th	77.1	7.6	87.8	7.3	76.9	7.7	77.9	6.1

II. *Labeo rohita:*

The initial average body weights of fingerlings *Labeo rohita* were recorded as 16.5, 17,4, 16.5 and 16.0gm whereas the final average weight were 68.3, 71.8, 70.1 and 71.0gm in Control T1, T2, and T3 respectively (Table -3). The minimum weight gain of *Labeo rohita* 4.9, 7.1 gm was observed in Control and T1 was first week and 5.4 and 7.9gm in the second week in T2 and T3. *Labeo rohita* showed the maximum average body weight gain of 14.6gm in T1 which was noted in second week. In control the maximum body weight increase of 11.4gm was observed during fifth week, while in T2, and T3 the maximum increase in the average body weight was noted as 13.9, 13.3gm in third and first week. Among the different treatments, maximum increment of the body weight was recorded in T1, as 14.6gm which was treated with artificial feed.

Table – 3: Weekly wise increase in average body weight (gm) of *Labeo rohita* under different treatments (N=20)

Weeks	Control		Treatment -1		Treatment -2		Treatment -3	
	Avg. Body Wt.	Inc. in Body Wt.	Avg. Body Wt.	Inc. in Body Wt.	Avg. Body Wt.	Inc. in Body Wt.	Avg. Body Wt.	Inc. in Body Wt.
Initial	16.5	-	17.4	-	16.5	-	16.0	-

1st	21.4	4.9	24.5	7.1	28.6	12.1	29.3	13.3
2nd	28.6	7.2	39.1	14.6	34.0	5.4	37.2	7.9
3rd	36.5	7.2	49.2	10.1	47.9	13.9	42.2	5.0
4th	46.0	9.5	58.0	8.8	53.5	5.6	51.9	9.7
5th	57.4	11.4	65.2	7.2	60.1	6.6	60.8	8.9
6th	68.3	10.9	72.8	8.6	70.1	10.0	71.0	10.2

Percentage of Weight Gain (PWG)

The percentage of weight gains of *Catla catla* and *Labeo rohita* under the influence of supplementary feeds in various combinations under three different treatments. (Table -4). *Catla catla* showed the minimum value of percentage of weight gain as 4.6, 6.6 and 7.0 in T3, T1 and Control in which Commercial feed, Artificial feed and Rice bran was applied. Maximum value of 7.3 of was percentage of weight gains noted in T2 which treated with Oil cake.

The percentage of weight gain of *Labeo rohita* in Control, T1, T2 and T3 were noted as 31.3, 31.2, 32.8 and 34.3. The minimum value was 31.2 in T1 treated with artificial feed. This species attained the best value of percentage weight gain 34.3 in T3, which was treated with Commercial feed.

The highest percentage of weight gain was observed for the *Catla catla*7.3 in T2 (Oil cake) as compared to the *Labeo rohita* 34.3 in T3 (Commercial feed). The lowest value PWG was recorded for the *Catla catla* 4.6 in T3 (Commercial feed) as compared to the *Labeo rohita* 31.2% in T1 (Artificial feed). The overall range of percentage of weight gain was increased in Commercial feed (T3) respectively.

Table 4: Mean growth performance and feed utilization of *Catla catla* fingerlings feed with experimental Diets (N=20)

Growth parameters	Control	Treatment-1	Treatment-2	Treatment-3
Mean weight gain(gm)	32.0	35.0	32.5	24.7
Mean average weight (gm)	426	487.1	429	462
PWG	7.0	6.6	7.3	4.6
SGR	0.29	0.3	0.29	0.22
FCR	2.2	2.31	2.2	3.11
SP	93.33	93.33	90.0	90.0
Biomass ($\times 10^2$)	0.96	10.5	0.97	0.74

PWG= percentage of weight gain, FCR = feed conversion ratio, SGR= specific growth rate, SP =survival percentage.

Specific Growth Rate (SGR)

The specific growth rate of *Catla catla* and *Labeo rohita* under the influence of supplementary feeds in various combinations fewer than three different treatments (Table – 4 &5). *Catla catla* showed the minimum value of specific growth rate as 0.22 and 0.29% in T3, T2 and Control in which Commercial feed, Oil cake and Rice bran was applied. Maximum value of 0.3% of specific growth rate was noted in T1 which treated was Artificial feed. For the *Catla catla* the overall range of specific growth rate was increased in artificial feed (T1) respectively.

The specific growth rate of *Labeo rohita* in Control, T1, T2 and T3 were noted as 0.47, 0.49, 0.48 and 0.50%. The minimum value was 0.47 in Control treated with Rice bran. This species attained the best value of specific growth rate (0.5%) in T3, which was treated with Commercial feed.

The highest specific growth rate was observed for the *Catla catla* 0.3% in T1 as compared to the *Labeo rohita* 0.50% in T3. The lowest value SGR was recorded for the *Catla catla* 0.22% in T3 as compared to the *Labeo rohita* 0.47% in Control. The overall range of specific growth rate was increased in artificial feed (T1) respectively.

Table -5: Mean growth performance and feed utilization of *Labeo rohita* fingerlings feed with experimental Diets (N=20)

Growth parameters	Control	Treatment-1	Treatment-2	Treatment-3
Mean weight gain(gm)	51.8	54.4	53.6	55.0
Mean average weight (gm)	274.7	324.2	310.7	308.4
PWG	31.3	31.2	32.8	34.3
SGR	0.47	0.49	0.48	0.5
FCR	0.89	0.99	0.96	0.93
SP	96.66	90.0	93.33	90.0
Biomass ($\times 10^2$)	15.54	16.32	16.08	16.80

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PWG= percentage of weight gain, FCR = feed conversion ratio, SGR= specific growth rate, SP =survival percentage.

Food Conversion Ratio (FCR)

The food conversion ratio of two cultured fish species viz., *Catla catla* and *Labeo rohita* under the influence of supplementary feeds in various combinations designated as Control, T1, T2 and T3 respectively. For the *Catla catla* the values of food conversion ratio showed 2.2, 2.31, 2.2 and 3.11 in Control, T1, T2 and T3 respectively. The lowest value of food conversion ratio was noted as 2.2 for Control and T2. The highest value of food conversion ratio was found to be 3.1 (T3). (Table - 4 & 5). The minimum value of food conversion ratio for the *Labeo rohita* was observed as 0.89 and 0.93 in Control and T3 respectively. The maximum values were recorded as 0.99 and 0.96 for T1 and T3 respectively.

The overall lowest food conversion ratio was observed for the *Catla catla* 2.2 in Control and T2 (Oil cake) as compared to the *Labeo rohita* 0.89 in Control. The highest value food conversion ratio was recorded for the *Catla catla* 3.11 in T3 (Commercial feed) as compared to the *Labeo rohita* 0.99 in T1 (Artificial feed).

Survival Percentage (SP)

The survival percentage of *Catla catla and Labeo rohita* under the influence of supplementary feeds in various combinations fewer than three different treatments. (Table- 4 & 5).

Catla catla showed the minimum value of survival percentage as 90% in T2 and T3 in which Oil cake and Commercial feed was applied. Maximum value of 93.33% of was survival percentage noted in Control and T1 which treated Rice bran and Artificial feed. The survival percentage of *Labeo rohita* in Control, T1, T2 and T3 were noted as 96.66, 90, 93.33 and 90%. The minimum value was 90% in T1 and T3 treated with artificial feed and Commercial feed. This species attained the best value of survival percentage 96.66% in Control, which was treated with Rice bran.

The highest survival percentage was observed for the *Catla catla* 93.33% in Control (Rice bran) and T2 (Oil cake) as compared to the *Labeo rohita* 96.66% in T3 (Commercial feed).The lowest value SP was recorded for the *Catla catla* 93.33% in Control (Rice Bran) andT1 (Artificial feed) as compared to the *Labeo rohita* 96.66% in Control (Rice bran). The overall range of survival percentage was increased in Commercial feed (T3) respectively.

Biomass

The biomass of three cultured fish species under three different treatments was studied. (Table – 4 & 5). For the *Catla catla* the values of biomass showed 46.26, 52.68, 46.14 and46.74 in Control, T1, T2 and T3 respectively. The lowest values biomass was noted as 46.14 for T2. The highest value of biomass was found to be 52.68 in T1. The minimum value of biomass for the *Labeo rohita* was observed as 40.98 in Control respectively. The maximum values were recorded as 43.68 for T1, respectively. The overall lowest biomass was observed for the *Catla catla* 46.14 in T2 (Oil cake) as compared to the *Labeo rohita* 40.98 in Control (Rice bran). The highest value biomass was recorded for the *Catla catla* 52.68 in T1 (Artificial feed) as compared to the *Labeo rohita* 43.68 in T1 (Artificial feed)

The fish culture practices improved in recent days and the production is also high because of the application of supplementary feeds. The results suggest that supplementary feeds in all concentrations promoted the growth of *Catla catla and Labeo rohita* fingerlings. These results showed that the supplementary feeds of all treatment enhances nutrient utilization, which is reflected in improved Percentage of weight gain, Mean weight gain, FCR, SP and SGR. In cement tank, the frequent application of supplementary feed and stocking species ratio make the maintenance of production, population of natural food organism and the maximal utilization of productivity. The quantity and quality of supplementary feed have a pronounced effect on growth rate, feed conversion efficiency and proximate composition of fish.

CONCLUSION

In conclusion, the result of present study showed that supplementary feeds improved growth performance of fingerlings Indian common carp (*Catla catl* and *Labeo rohita*) that this can associate with improve health statues and physiological response. The manipulation of Common carp along with the major carps and the provision of supplementary feed enhanced the growth rate as well as production in semi intensive culture system. The growth performance indices (SGR, PWG, and FCR) were higher in artificial feed fish at all dietary inclusion levels Furthermore it increased the effectiveness of liming application and the availability of nutrients of their feed for the fish species in Polyculture system, which is helpful in the reduction of input costs.

The average weight gained per day is fluctuating due to non-feeding of supplementary feeds in the initial days of experiment. The dietary protein should be just enough for growth and repair as it is more expensive than carbohydrates and fats. Moreover, any excess amount of protein can be utilized for energy production. Factors affecting protein requirements of fish Protein requirements of fish varies according to temperature, protein quality, age, genetic differences and dietary energy. The rise in temperature accelerates fish growth, leading to the increase in protein requirement. Contrarily, low water temperature depresses growth rates and thus results in lower protein.

Although floating feeds are more expensive, usually, it is advantageous to feed floating feed, because fish can consume it from the surface or column of water and the farmer can directly observe the feeding requirements of fish and adjust feeding rates accordingly. Determining whether feeding rates are too low or too high is important in maximizing fish growth and feed use efficiency. The present level of fish production can be increased by formulation and commercial production of fish feed (artificial feed) that meet nutritive requirements of the fish.

SUMMARY

Overall, these two species of fish attained the maximum average body weight in T1 which was treated with artificial feed. Among the two species *Catla catla* showed the maximum average body weight, followed by *Labeo rohita* in T1. *Catla catla, Labeo rohita* showed the percentage of weight gain with the highest rate in all the treatments. The highest specific growth rate of *Catla catla, Labeo rohita* showed as 0.3 and 0.49 in T1. The overall range of food conversion ratio (FCR) varied from 0.89 to 3.11 in all the treatments. The maximum values were recorded in T3 (3.11) followed by 2.31 (T1).

Among these two species, *Catla catla* and *Labeo rohita* showed the survival percentage of 90-96.66%, under the all treatments. Biomass production of all treatment slightly modified (0.74 - 16.80) in *Catla catla* and *Labeo rohita.* Fish production highest in artificial feed in other feed are treated with *Catla catla and Labeo rohita.* Among these two species were growth response was high in their feeds. Artificial feed is high quantity crude protein and cost low and growth is high. The use of water and feed in agricultural fields should be

controlled to prevent in cultural system in contamination by leaching into the aquatic environments. In this way water and feed could be protected from these kinds of purpose.

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