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Studies on the evaluation of supplementary feed on the growth and body mass in commercially important fish species

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Abstract
A study was conducted to determine the efficacy of supplementary feed on the growth rate of three Indian major carps *Catla catla*, *Labeo rohita* and *Cyprinus carpio.* The study was conducted for a period of six months from July to December. The fish fingerlings were used to evaluate the growth and weight against the formulated food. The evaluation of efficiency of the fish feed used in the present study was naturally and easily available and low cost food products and ultimately its objective is to evaluate the cost effective feed in order to minimize the expenditure in fish culture practices. The results revealed that the *Catla catla* have grown up to 6.060±0.05 cms.in length and 8.560±0.05gms in weight. It is observed that the FCR was 8.624±0.05 and SGR was 0.988±0.00 and the statistical analysis showed that the results are significant (P<0.05) in *Catla catla* when it is fed with experimental feed containing cotton seed, Azolla and Bengal Gram. The fingerlings of *Labeo rohita* fed with same feed have also shown an increase of 6.040±0.05cms in length and 8.540±0.08gms in weight, FCR was 8.624±0.06 and SGR was 0.990±0.00. The statistical analysis showed that this results are significant (P<0.05). Next to *Catla catla* and *Labeo rohita* the another fish, *Cyprinus carpio has gained* 6.040±0.05cms. length and 8.520±0.10gms weight, the FCR and SGR was 8.610±0.08 and 0.992±0.00 respectively. The Statistical analysis showed that it is significant (P<0.05). Therefore by using experimental feed body length, weight and all the changes were satisfactory and found to be statistically significant over the control values. The result of present study revealed that there is a considerable increase in the growth in both length and weight of all the three species of fishes, when they were fed with experimental feed. Thus the experimental feed was proved to be highly effective and economical.

Keywords: supplementary feed, azolla, cotton seed, Bengal gram, FCR, SGR, VSI, HSI

Introduction
The Indian major carps, *Catla catla, Labeo rohita* and *Cyprinus carpio* are the most important commercial fishes in India with a maximum market demand and acceptability as food by the consumers due to its taste. These fishes contribute about 67% of total fresh water fish production (ICLARM, 2001) [24]. Fish require adequate nutrition in order to grow fast and survive in nature and offers a great diversity. Artificial feed plays an important role in semi intensive fish culture where it is required to maintain a high density of fish than in natural water (Jhingran, 1991) [27, 28]. The quantity and quality of feed consumed by the fish have tremendous impact on fish production because the feed of fish effects growth rate, efficiency of feed conversion and chemical composition of fish (Hassan *et al.*, 1996; Jena *et al.*, 1998; Erfanullah and Jafri, 1998) [26, 18]. Supplementary feed is to meet the nutritional requirements of stocked fish. Supplementary feed is the artificial source of dietary nutrients like protein, fats and carbohydrates. It was observed in the past sthat the feed comprises of 30-35% protein, 4% fat and 35% carbohydrate was proved to observe the influence on growth rate of *Catla catla*,which has a positive impact (Seenappa and Devaraj, 1995) [38], it was noticed.

In fish culture practices, feed is the major input and upto 60% of the total expenditure in fish culture practices has to incur only on feed (De Silva, 1988) [13]. The use of cost effective diets which have been formulated, on the basis of nutritional requirement so the fish species and it is the key to get success in aqua culture practices (Halver,1976; Lovell,1989) [22, 33]. For supplementary diet, we need to depend on traditional feed ingredients such as Rice Bran cakes, Ground Nut cake etc. The prices of fishmeal have been increasing due to the increase of rates of these components, which in turn determine the profitability in aquaculture enterprises (Kumar, 2000) [30].

The significance of qualitative and quantitative feeds is well organized in the level of dietary protein and is of fundamental importance, because it significantly influences growth, survival and yield of fish. Provision of artificial feed increased the fish growth and production in the fertilized ponds than those of supplementary feed (Diana *et al*., 1994) [16] and obtained higher growth rate in rohu when fed on combined feeding than those with solitary applications of fertilizers (Azim *et al*., 2002) [7]. Hence there is a need to find good quality, cheaper, and readily available alternative resources so as to substitute the costly ingredients in the traditional supplementary diets (Kaur and Saxena, 2003) [29]. A variety of ingredients of plants and animal origin has been screened for incorporation in supplementary feed for carps and used either singly or in combination (Lakshmanan *et al*., 1967) [32]. Degani *et al*., (1989) [14] established the direct relationship between growth rate and protein content of diet. He reported that higher growth was recorded in high protein (34 and 38%) diets than the lower (31%) protein diets. Swami and Mohanty *et al*.,(1988) [36] while testing different protein levels (30 –

45%) with fish meal and groundnut oil cake as the major source of protein has observed that the fish feds on 40% protein exhibited the maximum average with a weight gain and SGR. Whereas, Mohanty *et al*., (1990) [35] reported that inclusion of fish meal in the diet reduced the protein requirement level from 45 – 40% in fry and fingerling of rohu and mrigala. De silva *et al*., (1992) [12] also reported that dietary proteins influence somatic growth of both the sexes but not the gonadal maturation. Fish utilize fishmeal-free all-plant protein diet less efficiently than diets containing different plant protein ingredients in combination with fishmeal (Webster *et al*., 1992) [40].

Cotton seed is one of the best sources of most essential aminoacids, phosphatides like lecithin, lipase, phytase, (Olcott and Fountains, 1941) [37] and protein (Alma Shouley and Khan, 1990) [5]. Azollapinnta is an aquatic fern highly productive plant it doubles it's biomass in 3-10 days. FAO study describes Azolla has also been suggested as food stuff for human consumption. It contains 25-30 protein, rich in EAA, Vitamins (Vitamin A, Vitamin B_{12} and Beta-Carotene). The chemical score index of Azolla meal showed that it is a potential source of protein, leucine, lysine, Arginine, and valine were predominant essential amino acidswhich are present in it. (Fasuyi and Aletor, 2005) [19].

The present study has taken up to investigate the effect of selected supplementary feed consists of Azolla, Cotton Seed and Bengal Gram for enhancing the growth parameters. The aim of the present study is to develop nutritionally balanced, compatible, cost effective feed and also to estimate the weight gain, length gain, Feed Conversion Ratio (FCR), Specific Growth Ratio (SGR), Visero Somatic Index (VSI) and Hepato Somatic Index (HSI) of the three selected fish species.

Material and Methods

The early fingerlings of Indian major carps *Catla catla, Labeo rohita* and *Cyprinus carpio* were procured from private nursery located at Warangal. Each species were kept separately in oxygenated poly ethylene bags and brought to the laboratory for acclimatization, care was taken to maintain adequate amount of water with oxygen during the transportation of fish fingerlings. All the three fish *sps* were transferred separately into acclimatization tanks maintaining separate tank for each species. The size of the three different acclimatization tanks measuring 5'x4'x4' feet. In these the first tank was with *Catla catla* species, the second tank was for Labeo rohita and the third tank was for *Cyprinus carpio*. The experiment was started in the month of July by the procurement of fish fingerlings. The water quality parameters such as temperature, dissolved oxygen and pH of water in each tank wasmonitored with regular intervals. Continuous air was supplied by using the aerators. The temperature of each tank was maintained at 25±1°C during the total study period the pH was between 7.1±0.01during the period of acclimatization. These water quality parameters were taken care of, because the water quality parameters influence a lot on the growth of the fish as it was observed earlier (Adigun, 2005) [1].

The fishes were given twice daily feed during the acclimatization period, i.e., morning and evening time in two equal meals. After acclimatization the three species of fishes were sorted out in to six different rearing tanks. Therefore, the total experiment was set with one control group and one experimental group of each species and as such a total of 6 tanks were maintained. However, the control group of fishes were fed only with control feed consisting of Rice Bran (60%) and Groundnut cake (40%). The experimental groups were fed with the experimental feed consisting of Rice Bran (20%), Ground Nut cake (20%), Azolla (15%), Bengal Gram (20%) and Cotton Seed meal (25%). Feeding was given at a rate of 5% of the body weight in a feeding interval of twotimes a day and experiment was continued for a period of four months. The water in the cement tanks was changed every day to remove the remains of the feed and faecal matter. The growth parameters such as Length gain, Weight gain. Feed Conversion Ratio (FCR) and Specific Growth Rate (SGR) were observed and the Viscero Somatic Index (VSI) and Hepato Somatic Index (HSI) were also calculated in order to observe the impact of formulated supplementary diet on the three fish species.

Feed Preparation

The Control feed (CF) was made of Rice Bran and Ground Nut Oil Cake in the ration of 60:40 respectively. For the preparation of Experimental feed, harvested Azolla was washed thoroughly in clean water and sundried for 2 to 3 days. Thus it becomes crispy while green colour still retained with in the dried Azolla. This was collected packed in air tight bags and stored in aluminum boxes until further use. In this manner the Bengal gram was also sundried and made to fine powder by using domestic grinder and stored in air tight container. Raw cotton seeds after separating fibres were collected and are thoroughly delinted and are sundried and made to fine powder with the help of domestic grinder along with Hull and Kernal of delinted seeds. The control feedwas substituted with 20% of Rice Bran, 20% groundnut, 25% cotton seed meal, 20% Bengal Gram, and 15% of Azolla. However, low cost food items such as Azolla leaf meal, Bengal gram cereal meal and cotton seed meal have been selected for the study.

The growth parameters such as Mean Body Weight (MBW), Body Length (BL), Feed Conversion Ratio (FCR), Specific Growth Rate (SGR), and the Somatic indices like Viscero Somatic Indices(VSI) and Hepato Somatic Indices(HSI) of the fish fingerlings were calculated every month. The growth parameters and the Somatic Indices were calculated by adopting the following formulae.

$$\text{Percentage Weight Gain} = \frac{\text{Final weight--Intial Weight}}{\text{Initial Weight}} \text{X100}$$

$$\text{Specific Growth Rate (SGR)} = \frac{\ln(\text{Final Weight})g - \ln(\text{Initial Weight})g}{\text{Experimental Periods in days}} X100$$

$$\text{Food Conversion Ratio (FCR)} = \frac{\text{Feed given (Dry weight)}g}{\text{Body weight gain (Wet weight)}g}$$

$$\text{Viscero Somatic Indices: VSI} = \frac{\text{Weight of the Viscera}}{\text{Weight of the fish}} x\ 100$$

$$\text{Hepato Somatic Indices: HSI} = \frac{\text{Weight of the Liver}}{\text{Weight of the fish}} x\ 100$$

The viscera and liver of a batch of each ten fishes were weighed which was divided by the total weight of theeach fish to known the respective somatic indices of that group of fishes and expressed in percentage.

Results and Discussion

The work carried out in closed circuit systems has the advantage of providing identical environmental conditions in all tanks, and in contrast to experimental work in ponds, allows exact appraisal and complete control of the various factors involved. (Meske, 1985) [34].

The results obtained on the growth parameters and Somatic indices of the three species of fish fingerlings after fed with formulated supplementary feed is presented in table 1 to 4. Growth of organism isa change in length or weight or both which proportionally increases with it's age. The growth generally increases in size of the organism which due to converts the chemical constituents of the food matter into the building matter with in the body. The results obtained during the present study on the growth parameters of three fish species after feed with formulated supplementary feed shows that the weight and size of the fingerlings have increased a maximum maximum increased with experimental feed, over control feed. (Table-2 and Fig.1). It was noticed that *Catla catla* has shown a maximum increase (8.560±0.05grms) in weight with experimental feed and with the control feed it was only 7.280±0.07grms after four months. This was a change of 17.58% over controls and the statistical analysis showed that it is significant (P<0.0001). *Catla* has gained 6.060±0.05cms length with the experimental feed, and with the control feed and it was 4.120±0.12cms which is a change of 47.087% over controls. Statistical analysis showed that it is significant (P<0.0001). Table.3 Fig.4 reveals that the *Labeo rohita* has gained weight (8.540±0.08gms) with the experimental feed. But with control feed it was only 7.280±0.007grms and this was a change of 17.35% over controls and the statistical analysis showed that it was also significant (P<0.0001).

Labeo showed an increase 6.040±0.052cms in length with experimental fed but with control feed it was 4.100±0.01cms with a change of 47.31% over controls. Statistical analysis showed that it was also significant (P<0.0001).Table-4 and Fig.3 shows that in the case of *Cyprinus carpio* with experimental feed the weight gained was 8.520±0.10grms. But with control feed it was only 7.260±0.10grms with a change of 17.30% over controls. Statistical analysis showed that it was significant (P<0.0001). Length gain with experimental feed it was 6.040±0.05cms and with control feed it was 4.100±0.11cms, which is a change of 47.31% over controls. Statistical analysis showed that it is significant (P<0.0001) the comparative analysis of the body weight and body length among the fish species with experimental feed it was observed that *Catla catla* has attained maximum weight and length with in four months this may be attributed that the individual efficiency of converting food to their body mass. Generally *Catla* is a fast feeder when compared to other species. Next to *Catla*, *Labeo* and then *Cyprinus* attained maximum weight and length gain respectively this higher growth rate may be due to their individual growth and food habits of major carps which was well documented (Alikunhi 1957) [4]. In the present study all the food components in the feed have good amount of proteins. In the earlier studies (Seenappa and Devraj, 1995) [28]. That fingerlings of *Catla Catla* grow better with 35% protein diet and 4% of fat and 35% of carbohydrate content respectively. However according to (Srivastava, 1999) [39] on an average the nutritional requirements of carps at fingerling stage require 45% proteins, 6% of fats and 26% of carbohydrates. Because proteinsare the major source which will directly convert into the body mass and in the present study, the experimental food has good amounts of proteins. The Azolla consists of 26.62 crude protein. This value of crude protein content in Azolla was similar to Basalk *et al.*, (2002) [9] this protein content was also higher than the values obtained by Balaji *et al*., (2009) [8] and the proteins present in Bengal gram was higher when compared to others (Gopalan *et al.,* (2004) [20]. With the protein rich feed all the three fish species have attained a maximum growth when compared to control feed. It was observed (Balaji *et al.,* 2009) [8] that the Azolla promoted growth in chicks thus it was included in the diet of laying hens, (Alalade *et. al.,* 2007) [3] and it was a protein source for growing fattening pigs (Bacerra *et al.,* 1990) [10]. The ability of Azolla as a growth promoter is mainly due to it's crude protein content because it contains all most all essential amino acids. The essential amino acids were markedly effects the nutritional status of the diet especially the protein and amino acids levels (Yamanto *et. al.,* 2005).

Food is one of the important factors promoting growth and the feed conversion ratio (FCR) is an appropriate way to judge the acceptability and suitability of artificial feed for fish. Feed Conversion Ratio also termed as food quotient (or) food coefficient. In the present study it was stated (Table-2, Fig.3) that in case of *Catla catla* during the first one month the FCR with Experimental feedwas 1.684±0.07 but with control feed it was 1.748±0.01. Generally the good feed have less feed conversion ratios. The FCR value of cotton seed meal was studied by Jabeen *et al.,* (2004) [25]. Feed Conversion Ratios of 1.5 – 2.0 are considered as a good feed nutrient and such feed can be prescribe in aquaculture practices. During the second month with Experimental feed FCR was 4.068±0.18, however with Control feed it was 4.244±0.26. However during the third month with Experimental feed the feed conversion ratio was 6.638±0.10 with control feed it was 6.906±0.21 and in the fourth month the FCR of *Catla catla* with experimental feedit was 8.624±0.05 with control feed it was 9.578±0.18 and this was a change of -9.906% over controls which was significant (P<0.0001). The FCR of *Labeo rohita* during first month with experimental feed it was 1.688±0.06 and with control feed it was 1.754±0.008 (Table-3 and fig.2) and during 2nd month with experimental feed it was 4.072 and with control feed it was 4.258±0.261. But it was not significant. During 3rd month the FCR was 6.640±0.087 experimental feed and with control feed it was 6.908±0.198, which is significant (P<0.0001). During the 4th month the FCR of *Labeo rohita* was 8.624±0.062and with experimental feed and with control feed it was 9.54±0.184. Which is a change of -9.734% over control, which is significant (P<0.0001). It was observed in the present study that the FCR of *Cyprinus carpio* was1.694±0.054 with the experimental feed during first month and with control feed it was 1.754± 0.008 which is significant (P<0.001), and during 2nd month the FCR with experimental feed it was 4.072±0.137 and with control feed it was 4.258±0.261 which is not

significant (P>0.05).FCR during 3rd month in the case of *Cyprinus carpio* 6.628±0.098 with experimental feedand with control feed it was 6.900±0.196, which is significant (P<0.001).During the 4th month the FCR of *Cyprinus carpio* was 8.610±0.088 with experimental feed and with control feed it was 9.574±0.205,which is significant (P<0.0001). Which is a change of -10.068% over controls. The FCR is an indicator which is commonly used as a good indicator which indicates how efficient a feed or feeding strategy can be. It is the mathematical relationship between the input of the feed and the weight gained by the fish. Devi and Vishwanath (1992) [15] reported that in a fish, *Osteobrama Belangeri* Azolla with 10% in the feed resulted in better feed conversion levels than fish meal based control diets.

When Azolla was include in the diet upto 30% to 94% negative correlation of carcass protein was also observed in Nile tilapia (El – Sayed, 1992) [17] and in *Oreochromis aureus*(Yousif *et al.,* 1994) [42] keeping this in view in the present study we have included 15% Azolla in experimental diet.

During all the four months of study the period the FCR values with experimental feed was less over control but in the second month the FCR for *Catla*, *Labeo* and *Cyprinus carpio* were not significant over control. But during the 3rd month they were significant and even in the 4th month they were extremely significant this gives an impression that the experimental feed is a good feed with good feed conversion ratio.

Specific Growth Rate (SGR) is the rate of growth per unit time and it was mainly based on final and initial weight and the time required for the growth. It is observed in the present study (Table-2 and Fig.1) that the specific growth rate (SGR) with experimental feed in the fish, *Catla catla* has attained 3.406 ±0.09 gms during the first month and with control feed it was 3.322 ±0.023 gms. During the 2nd month specific growth rate was 1.844 ± 0.065 gms with experimental feed and with control feed it was 1.77 ±0.07. In the 3rd month with experimental feedit was 1.23±0.01, but with control feed it was 1.197 ±0.03.

During the 4th month specific growth rate (SGR) with experimental feed was 0.988±0.007 and with control feed it was 0.904 ±0.015.This is a change (9.7%) over control. All the observations were however reveals that they were significant (P<0.001). It was observed (Table-3, Fig.3) that the SGR of *Labeo rohita during* the 1st month with experiment feed was 3.314 ±0.012 and with control feed it was 3.400 ±0.084. During the 2nd month with experimental feed it was 1.836 ±0.052, but with control feed it was 1.774 ±0.077. In the 3rd month with experimental feed it was 1.236 ±0.028 and with control feed it was 1.196 ±0.028. Finally in the 4th month *Labeo* with experimental feed the specific growth rate was 0.990 ±0.006. With control feed it was 0.906 ±0.015, with a change of 9.27% over controls. Statistical analysis revealed that it is significant (P<0.0001). (Table-4, Fig.5). In the case of *Cyprinus carpio* the specific growth rate during the 1st month with experimental feed was 3.394±0.07 and with Control feed it was 3.322 ±0.01. In the 2nd month with experimental feed it was 1.834 ±0.04 and with control feed it was 1.770 ±0.07 and during the 3rd month with experimental feed it was 1.238 ±0.015, and with control feed it was 1.212 ±0.03. During the 4th month the SGR of *Cyprinus carpio* with experimental feed it was 0.992±0.007 and with control feed it was 0.904±0.01. Which is a change of 9.73% over controls and the statistical analysis revealed that it was significant (P<0.001). It was observed that in every month the SGR was high with experimental feed over control feed in all the three fishes however when the relative comparison among the species it was observed that it is higher in the *Cyprinus carpio* at the 4th month and almost similar in *Catla catla* and *Labeo rohita*.

The Viscero Somatic Index (VSI) reveals that (Table-2, Fig.3) in *Catla catla* during the 1st month with experimental diet it was 3.880±0.04 and during the 2nd month the Viscero Somatic Index (VSI) with experimental feed was 4.220±0.04 and with control feed it was 3.640±0.05 and in the 3rd month with the experimental feedit was 4.880±0.04 and with control feed was 3.860±0.052. During the 4th month the Viscero Somatic Index with experimental feedit was 5.740±0.052 and with control feed it was 4.640±0.084. Which is a change of 23.70% over controls andthe statistical analysis was revealed that it was significant (P<0.0001).

Table-3and Fig.4 reveals that in the case of *Labeo rohita* the Viscero Somatic Index with experimental feed. During the 1st month it was 3.840±0.052 and with control feed it was 3.180±0.042. During the 2nd month the Viscero Somatic Index with experimental feedit was 4.200±0.067 and with control feed it was 3.620±0.042. During the 3rd month with experimental feed it was 4.860±0.052 andwith control feed it was 3.840±0.084. During the 4th month the Viscero Somatic Index with experimental feed it was 5.720±0.042. With control feed it was 4.620±0.042. Which is a change of 23.809% over control and thestatistical analysis revealed that it was significant (P<0.0001).

Table-4, Fig.5 reveals the Viscero Somatic Index of *Cyprinus carpio* during the 1st month with Experimental feed it was 3.840±0.052 and with control feed it was 3.160±0.052. During the 2nd month with experimental feed it was 4.200±0.067. With control feed it was 3.600±0.067. During the 3rd month with experimental feed it was 4.840±0.84. With control feed it was 3.820±0.079. During the 4th month the Viscero Somatic Index with experimental feedit was 5.720±0.000 andwith control feed it was 4.620±0.079 and thestatistical analysis shows that it was significant (P<0.0001). The results of all the three fishes with experimental feedreveals that the Viscero Somatic Index slowly increased over control feed in all the four months.

Table-2, Fig.3 shows that the Hepato Somatic Index in the case of *Catla Catla*during the 1st month with experimental feedit was 1.340±0.196andwithcontrol feedit was 0.880±0.042. During the 2nd month with 2.160±0.084 experimental feed and with Control feed it was 1.060±0.052. For the 2nd month the Hepato Somatic Index with Experimental feedit was 2.160±0.084 andwith control feedit was 2.160±0.084. With Control feedit was1.060±0.052. During the 3rd month the Hepato Somatic Index with Experimental feedit was 3.160±0.084. With Control feedit was 1.900±0.000. During the 4th month the Hepato Somatic Index with Experimental feed was 4.160±0.084 and with control feedit was 2.240±0.103. Which is a change of 85.714% over control and statistical analysis showed that it

was significant (P<0.0001). Table-3, Fig.4 reveals that in the case of *Labeo rohita*. The Hepato Somatic Index during the 1st month with Experimental feedit was 1.320±0.192 and with control feed it was 0.860±0.052. During the 2nd month the Hepato Somatic Index of *Labeo* with Experimental feed was 2.140±0.052 and with control feedit was 1.040±0.052. During the 3rd month with experimental feed the Hepato Somatic Index was 3.140±0.052 andwith control feedit was 1.880±0.042. During the 4th month the Hepato Somatic Index with experimental feedkit was 4.120±0.079 and with control feed it was 2.440±0.042. Every month the Hepato Somatic Index was increased gradually with Experimental feed when it was compared with Control feed. Table-4 and Fig.3 reveals about the Hepato Somatic Index of *Cyprinus* carpio. During the 1st month with experimental feedit was 1.320±0.193. With control feed it was 0.840±0.052. During the 2nd month with experimental feed the Hepato Somatic Index it was 2.120±0.042. With control feed it was 1.060±0.050. During the 3rd month the Hepato Somatic Index with experimental feed it was 3.120±0.042. With control feed it was 1.860±0.052. During the 4th month the Hepato Somatic Index with experimental feed it was 4.120±0.079 and with Control feed it was 2.420±0.079. Which is a change of 70.247% over control.

Statistical analysis revealed that it was significant (P<0.0001). The Viscero Somatic Index and Hepato Somatic Index are important indicators of fish condition status. Measurement and analysis of these indices are very important in assessing food value. According to Ahmad *et al.,* (2012) [2] reported that the Viscero Somatic Indices and Hepato Somatic Indices increased with the increase in dietary carbohydrate level these observations are also correlated with identifications of Gumus. E, and Ikiz .R, (2012) [21]. Amoah *et al.,* (2008) [6] reported that liver size increased with increase carbohydrates, the excess carbohydrates gets deposited in the liver as fat. Hepato Somatic Indices (HIS) increased with higher carbohydrate content but no effect on Viscero Somatic Index. The Viscero Somatic Indices and Hepato Somatic Indices are important indicators of fish condition status with Experimental feed over Control feed. In this study all the three fishes had good and healthy condition of liver with significant values over control values. The Experimental feed is also having required amount of carbohydrate. All the growth parameters in three fishes i.e. *Catla catla, Labeo rohita* and *Cyprinus carpio* were shown a significant enhancement over control values.

Table 1: Proximate contents in Control and Experimental Feed

Content (%)	Control feed	Experimental Feed
Crude Proteins	26.59	32.48
Crude Fats	6.62	9.76
Available Carbohydrates	46.72	43.60
Moisture	7.58	8.35

Table 2: Growth Parameters of *Catla catla* (Monthly Variations)

Month		Weight(gms)		Length(cms)		FCR		SGR		VSI		HSI	
		CF	EF	CF	EF	CF	EF	CF	EF	CF	EF	CF	EF
1st Month	Mean	6.02	6.240*	3.260	4.450***	1.748	1.684*	3.322	3.406*	3.180	3.880***	0.880	1.340***
	SD	± 0.079	± 0.295	±0.126	±0.071	± 0.016	± 0.075	± 0.023	± 0.097	± 0.042	± 0.042	± 0.042	± 0.196
	PC	3.65%		36.50%		-3.66%		2.528%		22.01%		52.27%	
2nd Month	Mean	6.718	7.180**	3.720	5.540***	4.244	4.068NS	1.776	1.844*	3.640	4.220***	1.060	2.160***
	SD	± 0.383	± 0.122	±0.079	±0.052	± 0.268	± 0.185	± 0.077	± 0.065	± 0.052	± 0.042	± 0.052	± 0.084
	PC	6.877%		48.92%		-4.15%		3.828%		15.934%		103.77%	
3rd Month	Mean	7.040	7.660***	4.020	5.920***	6.906	6.638*	1.197	1.238**	3.860	4.880***	1.900	3.160***
	SD	± 0.052	± 0.052	±0.103	±0.079	± 0.211	± 0.105	± 0.032	± 0.016	± 0.052	± 0.042	± 0.00	± 0.084
	PC	8.806%		47.263%		-3.880%		3.425%		26.424%		66.315%	
4th Month	Mean	7.280	8.560***	4.120	6.060***	9.578	8.624***	0.904	0.988***	4.640	5.740***	2.240	4.160***
	SD	± 0.079	± 0.052	±0.123	±0.052	± 0.188	± 0.058	± 0.015	± 0.007	± 0.084	± 0.052	± 0.103	± 0.084
	PC	17.58%		47.087%		-9.960%		9.777%		23.70%		85.714%	

P < 0.0001(Highly Significant),P 0.001 to 0.01 (Very Significant), P 0.01 to 0.05 (Significant),> 0.05 (Not significant)
Feed Conversion Ratio (FCR), Specific Growth Rate (SGR),Viscero Somatic Index (VSI), Hepato Somatic Index (HIS)

Table 3: Growth Parameters of *Labeo rohitha* (Monthly Variations)

Month		Weight(gms)		Length(cms)		FCR		SGR		VSI		HSI	
		CF	EF	CF	EF	CF	EF	CF	EF	CF	EF	CF	EF
1st Month	Mean	5.980	6.220**	3.240	4.420***	1.754	1.688**	3.314	3.400*	3.180	3.840***	0.860	1.320***
	SD	± 0.042	±0.253	±0.107	±0.079	± 0.008	± 0.067	±0.012	± 0.084	± 0.042	± 0.052	± 0.052	± 0.192
	PC	4.01%		36.419%		-3.762%		2.595%		20.75%		53.488%	
2nd Month	Mean	6.696	7.160**	3.700	5.540***	4.258	4.072NS	1.774	1.836*	3.620	4.200***	1.040	2.140***
	SD	± 0.373	±0.107	±0.067	±0.094	± 0.261	± 0.161	±0.0.077	± 0.052	± 0.042	± 0.067	± 0.052	± 0.052
	PC	6.929%		48.648%		-4.369%		3.494%		16.022%		105.769%	
3rd Month	Mean	7.020	7.640***	4.000	5.880***	6.908	6.640*	1.196	1.236**	3.840	4.860***	1.880	3.140***
	SD	± 0.042	±0.052	±0.133	±0.123	± 0.198	± 0.087	±0.028	± 0.015	± 0.084	± 0.052	± 0.042	± 0.052
	PC	8.839%		47.00%		-3.879%		3.344%		26.562%		67.021%	
4th Month	Mean	7.280	8.540***	4.100	6.040***	9.554	8.624***	0.906	0.990***	4.620	5.720***	2.440	4.120***
	SD	± 0.0079	±0.084	±0.015	±0.052	± 0.184	± 0.062	±0.015	± 0.006	± 0.079	±0.042	± 0.084	± 0.079
	PC	17.307%		47.317%		-9.734%		9.271%		23.809%		68.852%	

P < 0.0001(Highly Significant),P 0.001 to 0.01 (Very Significant), P 0.01 to 0.05 (Significant),> 0.05 (Not significant
Feed Conversion Ratio (FCR), Specific Growth Rate (SGR),Viscero Somatic Index (VSI), Hepato Somatic Index (HIS)

Table 4: Growth Parameters of *Cyprinuous carpio* (Monthly Variations)

Month		Weight(gms)		Length(cms)		FCR		SGR		VSI		HSI	
		CF	EF	CF	EF	CF	EF	CF	EF	CF	EF	CF	EF
1st Month	Mean	5.980	6.200**	3.220	4.420***	1.754	1.694**	3.322	3.394*	3.160	3.840***	0.840	1.320***
	SD	±0.042	±0.211	±0.103	±0.103	± 0.008	± 0.054	±0.016	± 0.071	± 0.052	± 0.052	± 0.052	± 0.193
	PC	3.678%		37.267%		-3.420%		2.167%		21.518%		57.14%	
2nd Month	Mean	6.676	7.140**	3.680	5.460***	4.258	4.072NS	1.770	1.834*	3.600	4.200***	1.060	2.120***
	SD	±0.369	±0.107	±0.079	±0.158	± 0.261	± 0.137	±0.076	± 0.047	± 0.067	± 0.067	± 0.052	± 0.042
	PC	6.950%		48.369%		-4.369%		3.615%		16.666%		100.00%	
3rd Month	Mean	7.020	7.620***	3.980	5.860***	6.900	6.628*	1.212	1.238**	3.820	4.840**	1.860	3.120***
	SD	±0.042	±0.079	±0.123	±0.126	± 0.196	± 0.098	±0.032	±0.015	± 0.079	± 0.84	± 0.052	±0.042
	PC	8.547%		47.236%		-3.942%		4.591%		26.701%		67.741%	
4th Month	Mean	7.260	8.520***	4.100	6.040***	9.574	8.610***	0.904	0.992***	4.620	5.720***	2.420	4.120***
	SD	±0.107	±0.103	±0.115	±0.052	± 0.205	± 0.088	±0.018	± 0.007	± 0.079	± 0.000	± 0.079	± 0.079
	PC	17.355%		47.317%		-10.068%		9.734%		23.809%		70.247%	

P < 0.0001(Highly Significant),P 0.001 to 0.01 (Very Significant), P 0.01 to 0.05 (Significant),> 0.05 (Not significant)
Feed Conversion Ratio (FCR), Specific Growth Rate (SGR),Viscero Somatic Index (VSI), Hepato Somatic Index (HIS)

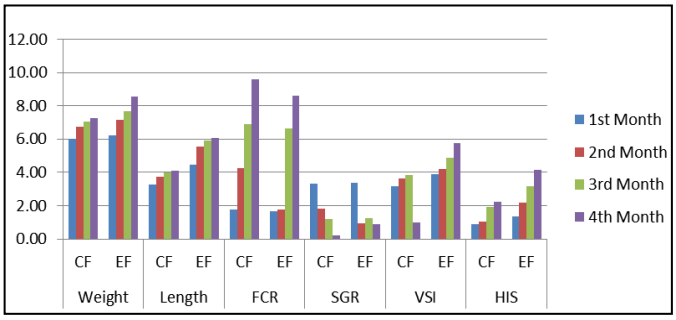

Fig 1: Growth Parameters of *Catla catla*

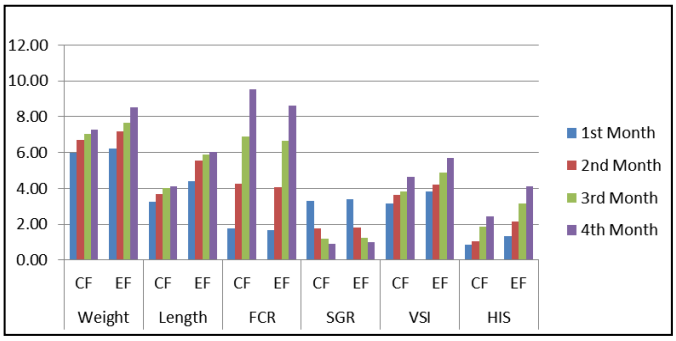

Fig 2: Growth Parameters of *Labeo rohitha*

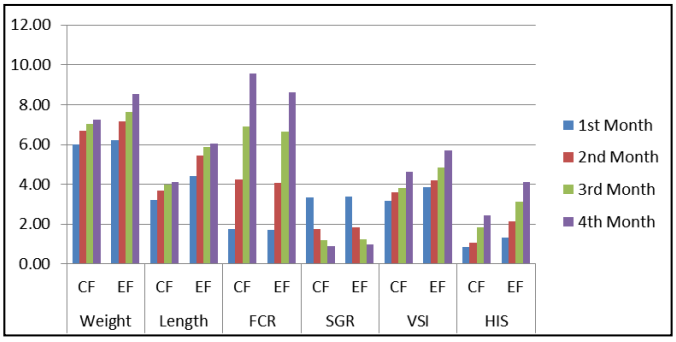

Fig 3: Growth Parameters of *Cyprinus carpio*

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