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Study of effect of dietary protein, lipids and carbohydrate present in the feed formulated on growth pattern and feed efficiency of common carp *Cyprinus carpio* fingerlings.

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ABSTRACT:

The aim of present study was to observe the effect of dietary protein, lipid and carbohydrate present in different ingredients of the feed formulated here. The diet was fed to the common carp in the laboratory at the rate of 5% of the body weight, twice daily for 60 days. The common carp used for experiments had initial weight 1.56 to 1.74 g and length 6.18 cm to 6.35cm. They were fed four different formulated feed, and the control had different contents. The feed had ground nut oil cake, mustard oil cake, rice bran, maize flour, fish meal and soybean meal in different ratio. All the four feed were fed them separately. Above feed provided balanced need of protein, lipids and carbohydrates. It was observed that the composition of feed had significant effect on the different parameters considered here. In the present study, out of the four formulation of the feed, the number II was the best one as here the gain in length was 5.40cm and in weight it was 13.41 g respectively. The percentage of weight gain was 798.21% and daily percentage growth was 0.224%. All these were higher than the data obtained in feed I III and IV. Secondly, the feed II had les moisture 5.28%, highest amount of crude protein 64.86%, and lowest carbohydrate 20.79%. The conversion ratio of feed was lower which indicated maximum utilization by the common carps. Next values for the length, growth was observed in the formulation feed I. Here the gain in length was 4.40, in weight 10.10g, the percentage of weight gain 623.43; feed conversion rate was next to feed II. Percentage of daily growth was 0.168. All the above parameters were the lowest observed in feed formulation III. Therefore, formulation of diet II was the best for aquaculture. Physico-chemical analysis revealed that the pH ranged between 7.2-7.6, Temperature 28^0-30^0C,

Dissolved Oxygen 6.2-6.8 mg/l, the Alkalinity 74.3 to 80.0 mg/l, Hardness 62.78 mg/l respectively.

KEYWORDS:

Aquaculture, *Cyprinus carpio*, Dietary protein and lipid, Formulated feed, Growth performance.

INTRODUCTION:

The dietary protein to energy ratio, in fish diets, is of great importance. Levels of dietary protein and energy not only influence the growth and body composition, but also digestive enzyme activities and plasma metabolites in different fishes, (Gangadhara *et al*; 1997; Yamamoto *et al*; 2000). If adequate energy is provided through dietary lipids, it can minimize the use of costly protein as an energy source (Vander Meer *et al*; 1997). To reduce feeding cost in aquaculture, approaches to reducing dietary protein levels or utilization have been studied extensively. Most studies concentrate on increasing dietary levels or lowering the protein in fish diets and have been confirmed mainly to studies of growth performance in catfish, rainbow trout. Indian major carp and snake head etc. (Reis *et al*; 1989; Hassan and Jafri, 1996, Samant Ray and Mohanty, 1997).

Dietary lipid was also reported to bring protein sparing effect, so that protein be utilized for the synthesis of muscle tissue and not for metabolic energy (Williams *et al*; 2003). Excessive lipid in the diet not only suppresses fatty acid synthesis, but also reduces ability of fish to digest and assimilate lipids (Sargent *et al*; 1999). Therefore, proper level of lipid in the diet of fish is necessary to achieve high growth rate and feed conversion efficiency. (Gangadhar *et al*; 2025).

Effects of dietary protein, lipids, fatty acids, vitamins on growth and development of different fishes have been reported by different workers such as, Sargent *et al*; (1999); Thomas *et al*; (1999); Manimuthu and Sukumaran (2001); Jha *et al*; (2007); Vijayagopal *et al*; (2008); Glencross (2009); Kaushik and Seiliez (2010); Daris *et al*; (2011); N. Jayaraj *et al*; (2012); Vijayagopal *et al*; (2015); Kurban and Maqbool (2017); Sagada *et al*; (2017); Abdel Rahman *et al*; (2018); Wang *et al*; (2020); Huyben *et al*; (2021); Hamed *et al*; (2022); Wang *et al*; (2023); Dey *et al*; (2024); Jiang *et al*; (2025) respectively.

The aim of the present study was to perform orderly growth and development research with common carp. For this diets were prepared using different dietary protein, lipd and carbohydrate contents. This will help in the production of common carp economically without using costly proteins and lipids.

MATERIALS AND METHODS:

The material was *Cyprinus carpio* communis fingerlings obtained from the Central Institute of Fisheries Education ICAR, Mumbai, at Motipur of Muzaffarpur District Bihar, India.

Preparation of diets containing different amounts of proteins and lipids.

In the present study four different feeds were prepared separately such as I, II, III, and IV. In addition the control feed was also prepared.

Table -1

Ingredients	Control	Feed-I	Feed-II	Feed-III	Feed-IV
Ground nut oil cake	Nil	16.0	19	9	16.66
Mustard oil cake	50	16.0	59	11	16.66
Rice bran	50	9.0	3	42	16.66
Maize flour	Nil	9.0	7	28	16.66
Fish meal	Nil	25.0	4	6	16.66
Soybean meal	Nil	25.0	8	4	16.66
Sodium alginate (g)	5	5	5	5	5
Vitamin mineral mixture (g)	Nil	2	2	2	2
Vegetable oil (ml)	Nil	1.5	1.5	1.5	1.5
Cod lever oil (ml)	Nil	1.5	1.5	1.5	1.5
Oxytetra cycline (mg)	500	500	500	500	500

(% in dry weight basis). Chemicals were obtained from the supplier at Muzaffarpur, Bihar.

In this way, feeds (feed I, II, III, IV) were prepared using the amounts of ingredients like ground nut oil cake, mustard oil cake, rice bran, maize flour, fish meal, and soybean meal. The amounts of above ingredients were taken as mentioned in the table-1. First the ingredients were weighed and the moisture content was determined. In the formulated feed there were different amounts of protein, lipids and carbohydrate. The control feed had only 50% mustard oil cake and 50% rice bran. Feed I was containing, 16.0% ground nut cake, 16.0% mustard oil cake, 9.0% rice bran, 9.0% maize flour, 25.0% fish meal, 25.0% soybean meal. In this composition it was aimed to supply maximum protein component than energy. Feed II had 19.0% ground nut oil cake, 59.0% mustard oil cake, 3.0% rice bran, 7.0% maize flour, 4.0 % fish meal, 8.0% soybean mean. Here, mustard oil cake was maximum source of protein. Feed III, had 9.0% ground nut oil cake, 11.0% mustard oil cake, 42.0% rice bran, 28.0% maize flour, 6.0% fresh meal and 4.0% soybean meal respectively. This feed was carbohydrate rich feed. Feed IV had equal amount of feed II the ingredients that were 16.66. Each feed was supplemented with 1.5 ml of vegetable oil and 1.5 ml of cod liver oil for 100g of feed contents. This was added to supply adequate quantity of fatty acids.

Vitamin-Mineral mixture (2.0 g per 100 g of feed) was also supplemented in each feed for maintaining the health of the fish. Sodium alginate (5.0g/100 of feed) was added as binder and oxytetracycline (500mg/100 of feed) as antibiotic to control any bacterial infection in the feed (Table-1).

First the mixtures were separately homogenized in grinder for 30 minutes. Then it was blended with oil for 15 minutes. 25% water was added to make a pelletable mixture. With help of manual pelleting machine pellets were prepared, having 1.0-3.0 mm size. Pellets were dried in oven and stored in a moisture free container. Pellets were fed to the fishes 5.0% of the body weight, two times a day, at 8:00 AM and 4:00 PM every day.

Cyprinus carpio communis fingerlings were obtained from the fishery research centre, having weight 1.70g and length 6.18 to 6.35 cm, were used in this experiment. Before the feeding trial, the fishes were acclimatized for 7 days. During this period, traditional mixture of mustard oil cake and rice bran (1:1) was feed only. Each formulated feed and control feed was fed to triplicate group of fingerlings for 60 days.

Fish weight and length were taken at the time of beginning of the experiment. Then the increase in weight and length were noted on fortnightly basis.

All the fish were fed at 5.0% of their body weight, twice a day. Common carp fingerlings having average weight 1.56g to 1.74g and average length 6.18cm to 6.35cm were used. They were divided in five groups. Four groups of them were fed the experimental diets and fifth were fed the tradition food used as control. About 30% of water from the tank was replaced with fresh water to adjust water quality. The pH, temperature, dissolved oxygen were monitored on daily basis, to observe any unusual changes. The tanks were aerated throughout the experiments with aquarium air pumps.

Observations:

i. **Net weight gain (NWG)**
Net weight gain (g) = Mean of final weight – Mean of initial weights

ii. **Average daily growth (ADG)**
ADG = Net weight gain / Number of days

iii. **Body length gain (cm)**
Final average length gain – Initial average length gain

iv. **Average daily growth in length**
Net length gain/ Number of days

v. **Feed conversion ratio (FCR, g)**
Feed given (g dry weight) / Body weight gain (g weight gain)

vi. **Specific growth rate (SRG%)**
In. Final weight – Initial weight / No. of days.

vii. Average Temperature range
Average pH range
Average dissolved oxygen
Alkalinity and Hardness

Here, Temperature was taken at 8.30 to 9.0 AM. pH was measured with digital pH meter. (Systronics). Dissolved Oxygen, Alkalinity, and Hardness were calculated following the Standard methodology of APHA (2005).

RESULTS AND DISCUSSION:

Five groups of fingerlings were fed with different formulated feed. One group was fed with traditional fish feed, while four groups were fed four different formulated diet separately. Formulated diets were fed twice daily at the rate of 5.0% of the body weight. After sixty days the final length, weight, the gain in length and weight and percentage weight gain specific growth rate, food conversion and % daily growth etc. were calculated. Experiments were done in triplicate and means of data were tabulated in table-3. From the data, it may be noted that after 60 days, the maximum growth length were recorded in the fingerlings in fed on feed II. Here gain in length was 5.40 cm, gain in weight was 13.41 g, the % weight gain was 718.21, specific growth rate was 3.66, food conversion ratio was 0.93, and % daily growth was 0.224, respectively. The highest growth rate obtained in feed II having higher amount of total crude protein, 46.53%, crude lipids 9.60% and carbohydrate 20.779%. Above findings are in accordance with the findings of Ahmad *et al*; (2012). They also used the highest

dietary crude protein that was 40% in culture of common carp, *Cyprinus carpio* communis fingerlings, which attained 12.78 g, the effect of dietary protein and lipids have also been reported by Reis *et al*; (1989); Gangadhara *et al*; (1997); Samant Ray and Mohanty (1997); Thomas *et al*; (1997); Yamamoto *et al*; (2000); Khan and Maqbool (2017); Wang *et al*; (2023); Basim *et al*; (2024); Dey *et al*; (2024); Zhigang *et al*; (2024); Xiaona *et al*; (2025); Findings of all these workers also observed the effect of dietary protein and lipid, carbohydrate on growth and gain in weight. Present findings thus corroborate with the findings of the above workers. Agbedi *et al*; (2009) replaced fish meal (crude protein 60.0%) with blood meal (crude protein = 80.0%) in pelleted feed given to *Clarias gariepinus* and reported that increase in crude protein resulted in efficient average final weight, daily weight gain, specific growth rate, protein efficiency ratio, survival and total production of fish. The dietary protein used in crude from different ingredients of the feed also increased all the parameters as mentioned above.

In the present study minimum gain in length was 4.07g from the initial weight after 60 days, the weight gain was only 4.03% percentage of growth was 258, and daily growth rate was 0.67% when the above fingerlings were fed the feed formulated in III. This poor growth in feed III was perhaps due to presence of dietary protein only 23.14g. Similarly, the dietary lipid was only 5.85g. Above findings clearly indicates the role of protein level in the feed of the fishes in aqua culture. Above findings are supported with the findings of Baba Bola and Adebayo (2006). Agbedi *et al*; (2009); Sotolu (2010). They also observed that fish fed continuously on low crude protein (25-30%) resulted in poor growth rate and feed utilization in culture conditions.

The better growth observed in the fingerlings, fed on feed II may be due to presence of dietary protein, which were utilized for growth. Here perhaps the dietary lipids spared the proteins in the fingerlings fed on feed II formulation. Here dietary lipids provided maximum energy that minimized the use of the dietary proteins for energy production (Lee *et al*; 2002; Zen *et al*; 2009). The poor growth observed in fingerlings fed on feed formulation III, may be due to the fact that here proteins were utilized for the energy source (Hassan *et al*; 1995; Yamamoto *et al*; 2000; and Krogdahi *et al*; 2005).

It may be concluded that in the formulated diet containing 43.66% protein 10.02% lipids and 20.79% carbohydrate as in formulation II here is most suitable feed for the better growth of the fingerlings in aquaculture. Where, as diet having 23.14% crude proteins, 7.68% lipids and 24.46% carbohydrates as in the feed formulation III is the poor diet for the aqua cultured fingerlings.

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Table-2

Analysis of the feed ingredients used for the formulation of fed.

S.N.	Ingredients	Dry Matter %	Moisture %	Crude Protein %	Crude Lipid %	Carbohydrate %	Ash %
1	Ground nut oil cake	95.12	4.88	46.0	10.50	22.0	4.70
2	Mustard oil cake	95.40	4..60	40.0	11.15	16.0	5.0
3	Rice bran	91.58	8.42	14..5	4.0	42.0	13.0
4	Maize	90.16	9.166	10.4	4.5	65.0	1.5
5	Fish meal	93.84	6.16	60.0	8.0	4.0	18.0
6	Soybean meal	93.66	6.34	50.0	8.5	15.0	7.5

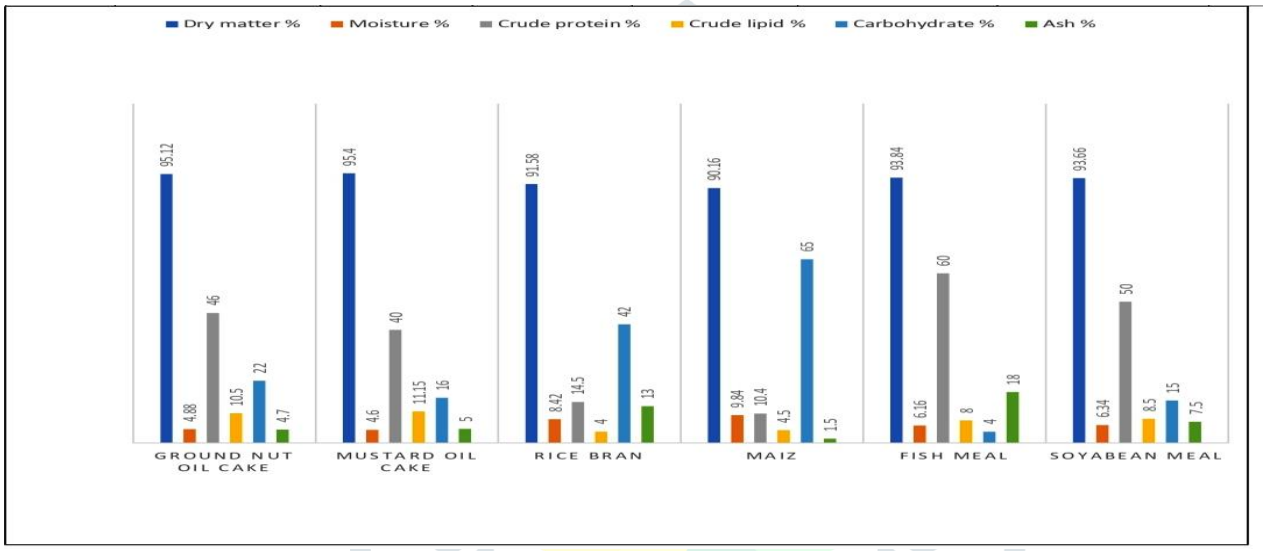
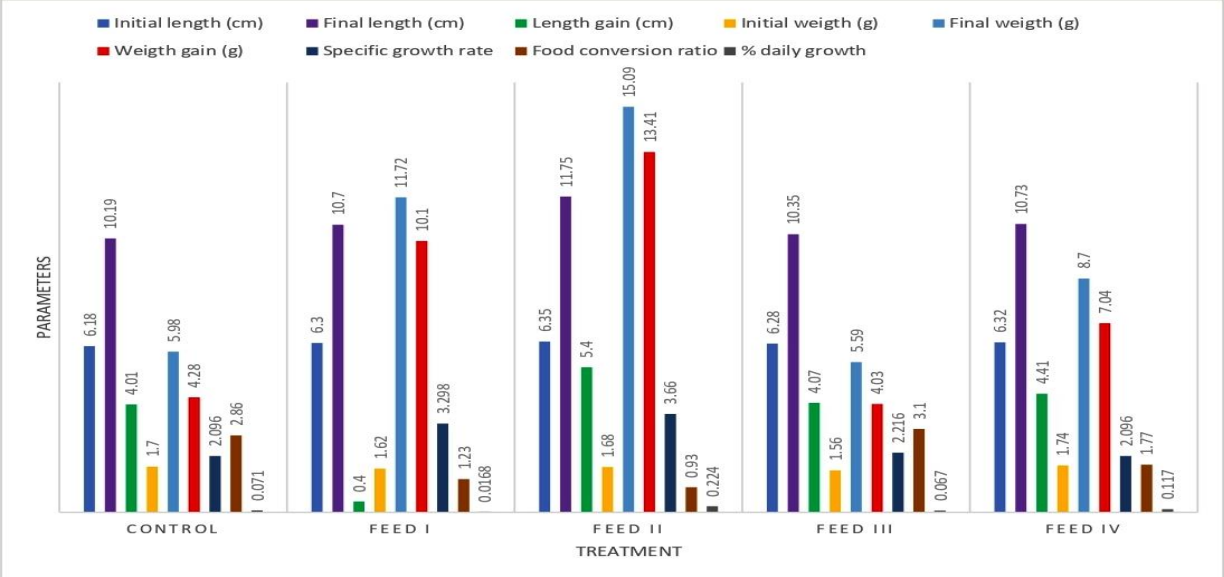


Table-3

Growth of common carp noted during experiment

Parameters / Treatment	Initial length cm	Final length cm	Length gain cm	Initial weight (g)	Final weight (g)	Weight gain (g)	% weight gain (g)	Specific growth rate	Food conversion ratio	% daily growth
Control	6.18	10.19	4.01	1.7	5.98	4.28	251.76	2.096	2.86	0.071
Feed I	6.30	10.70	4.40	1.62	11.72	10.10	623.43	3.298	1.23	0.168
Feed II	6.35	11.75	5.40	1.68	15.09	13.41	798.21	3.66	0.93	0.224
Feed III	6.28	10.35	4.07	1.56	5.59	4.03	258.33	2.126	3.10	0.067
Feed IV	6.32	10.73	4.41	1.74	8.7	7.04	404.59	2.096	1.77	0.117



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