Comparative study of plant based isoproteiniousdiets onthe growth performance of *Labeorohita*and*Catlacatla*fingerlings

Abstract

The present study was carried out to compare the effect different plant based protein on the growth performance of *Labeorohita*and *Catlacatla*fingerlings. The experiment was designed as two experimental diets and one control group. Control groups contains (Mustard oil cake + Rice bran) whereas,experimental diets T1 (Soybean meal + Corn flour) and T2 (Groundnut meal + Wheat flour), both formulated by using the Pearson square method to maintain protein content of 35%. According to the results, the best survival and growth performances including SGR, FCR and PER was found in treatment T1(Soybean meal + Corn flour) as compare to other treatments. The findings suggest that the inclusion of Soya bean meal along with Corn flour in the diet led to superior fish growth and overall fish production compared to other plant-based feed ingredients investigated in this study. These results contribute valuable insights into optimizing plant-based diets for enhancing the growth and production efficiency of *L.rohita* and *C.catla* fingerlings during aquaculture operations.

Key words: SGR (Specific Growth Rate), FCR (Food Conversion Ratio), PER (Protein Conversion Ratio), EC (Electrical conductivity).

1. Introduction:

Aquaculture is the farming of aquatic animals in controlled aquatic environments. It is a rapidly growing industry, showing average increase of 6.7% per year in global aquaculture production since 1990 to 2020.Aquaculture is an important source of food, providing 49% of the world's fish supply. The Indian aquaculture sector is one of the fastest growing sectors in the world(FAO, 2022). In 2021-22, the sector produced 16.24 million tonnes of fish, of which 12.12 million tonnes came from inland sector which is predominantly propelled by aquaculture sector.This represents a growth of 400% since 2000-01, when inland production was just 2.82 million tonnes (PIB, 2023).

Feed is the most important input in aquaculture, accounting for up to 60% of total production costs(Govindharajet.al.2021). The quality and quantity of feed has a major impact on the growth, health, and reproduction of fish.Traditionally, fishmeal and fish oil have been the

primary ingredients in commercial fish feeds, but these resources are becoming increasingly scarce and unsustainable due to overfishing and competition from the human food market. In this case, plant-based feeds offer a sustainable and alternative to fishmeal and fish oil (Naylor et al. 2009).Plant-based feed ingredients encompass a diverse array of sources, including soybeans, sunflower, and other legumes and oilseeds. These ingredients are rich source of protein, essential amino acids, and other nutrients crucial for the growth and health of farmed fish (Daniel, 2018). The utilization of plant proteins in aquafeeds not only addresses concerns related to the overexploitation of marine resources but also mitigates the environmental impact associated with the production of fishmeal. Furthermore, the cultivation of plant-based ingredients for aquafeeds often demands less environmental resources, such as water and land, contributing to a more sustainable and efficient aquaculture system (Naylor et al.2009). Beyond their nutritional benefits, plant-based feeds play a pivotal role in reducing the overall carbon footprint of aquaculture operations, promoting a shift towards eco-friendly practices (Salineto, 2022)

Certain plant protein sources offer high-quality protein content, yet they are accompanied by anti-nutritional factors like phytic acid, gossypol, and tannins, which can potentially impede growth performance and protein utilization in animals. Groundnut cake (GNC) is renowned for its excellent palatability and superior binding properties for pelleting compared to soybean meal (Lovell, 1989).

Currently, the most commonly used plant protein supplement in an aquaculture operation is soybean meal, due to its high nutritional value, cost effectiveness and availability of essential amino acids in balanced form (O'Keefe, 2003). However, the success of soybean meal substitution has exhibited variability. Numerous studies have proposed the partial replacement of fish meal with soybean meal, reaching substitution rates of up to 60%, or alternatively incorporating its by-products (Elangovan & Shim. 2000). The viability of such substantial substitutions is attributed to the favorable protein and amino acid contents of soybean meal, coupled with its commendable digestibility and palatability characteristics. These factors collectively contribute to its widespread application in aquaculture as a key component in formulating nutritionally balanced and sustainable feeds (Bureau, 2008; Hassan, 2001)**.**

The choice of plant protein sources in aquafeeds is a multifaceted decision, influenced by factors such as nutritional composition, availability, cost-effectiveness, and the specific dietary preferences of the target species. *L.rohita* and *C.catla*, being prominent freshwater carp species

in aquaculture, present an intriguing comparative context for investigating the influence of diverse plant proteins on their growth performance. By examining the physiological responses of these two species to different plant-derived ingredients, this research aims to provide valuable insights into optimizing feed formulations for enhanced growth and overall productivity.

2. MATERIAL METHOD

i. Experimental design:

45 days experimental study was carried out in wet laboratory of College of fisheries, CCSHAU, Hisar, the primary objective of current study was to evaluate the effect of three different feeding treatments on growth and survival of *L. rohita* and *C. catla* fingerlings. The experimental setup involved the use of nine glass aquarium tanks, each measuring 1.5×0.6×0.6 m^3. The experiment was designed as a Completely Randomized Design (CRD), ensuring a randomized and unbiased allocation of treatments to the tanks. During the experimentationdissolve oxygen was maintained in each glass aquarium by using aerators. Any kind of organic and inorganic fertilizers was not applied to any treatment tanks during the experimental period.

ii. Experimental setup:

Fingerlings of*L. rohita* and *C. catla* were procured from a local fish hatchery and fish farm. The collected fingerlings underwent a one-week acclimatization period before being stocked in aquariums. The stocking density employed was 10 fish per aquarium, maintaining a balanced ratio of 50% *L. rohita*and 50% *C. catla*, creating a 1:1 proportion. Throughout the experimental period, the fishes were subjected to a feeding regimen equivalent to 5% of their body weight. The feeding routine was divided into three parts, with 40% of the total daily feed distributed in the morning between 7 am and 8 am, followed by 20% in the afternoon between 1 pm and 2 pm, and the remaining 40% in the evening between 6 pm and 7 pm.

iii. Experimental diets:

In current study, three isoproteinious diets were meticulously formulated to investigate their impact on fish growth and survival. The dietary compositions for each treatment were as follows: Control group, comprised conventional fish feed ingredients such as Mustard oil cake along with Rice bran, with a percentage proportion of (79.70 + 20.3). Treatment T1 consisted of a blend of Soybean flour and Corn flour with a percentage proportion of (66.5 + 33.4) and

Treatment T2 featured Groundnut meal and Wheat flour with a percentage proportion of (69.4 + 30.80). To prepare the pellet feed, all the ingredients were finely powdered, thoroughly mixed, and then sieved to ensure a homogenous and consistent composition. Proximate compositions of the ingredients used in the formulated diets are presented in Table 2.

Table1:Ingredients compositionoftheexperimentalfeed

Treatment	Ingredient	Percentage
Control	Mustardoilcake+ Ricebran	79.70 +20.3
T1	Soybeanmeal+ Cornflour	66.5+33.4
T2	Groundnut meal +Wheatflour	69.4+30.80

Table2:ProximatecompositionoffeedIngredients

Feedingredient	Protein(%)	Lipid(%)	Ash(%)	Fiber(%)
Mustardoilcake	28.86	6.64	15.13	8.23
Ricebran	10.85	2.74	11.87	9.87
Soybeanmeal	48.8	1.37	6.42	5.67
Groundnutmeal	43.8	9.4	5.25	6.6
Wheatflour	15.04	5.23	2.72	6.81
Cornflour	7.04	5.01	1.1	1.0

iv. Proximate composition analysis:

The proximate composition of feed ingredients was analyzed before and after formulating the feed. Samples of whole fish were analyzed after the end of the experiment. Following methods were used to analyze the proximate composition.

a. Moisture content: By drying the sample (about 5 gm for feed and whole fish carcass) in an oven at 90-105ºC for 24 hours (AOAC, 2000).
b. Crude Protein: Kjeldahl method. Nitrogen content was multiplied by factor 6.25.
c. Crude Lipid: Lipid of about 2 gm samples was extracted by petroleum ether (Boiling point 60 to 80ºC) in a soxtech system for 1:30hrs.
d. Crude fibre: Determination by acid and alkali digestion in Fibertech system (AOAC, 2000).
e. Ash content: 550ºC in Muffle furnace for 6 hours (AOAC, 2000)

v. Growth parameters:

The various growth parameters viz. DWG, ADG, FCR, SGR, PER, feed acceptability and survival rate etc. and percentage length measurement, percentage weight measurement, total weight gain, initial minimum length, initial minimum weight, initial maximum length, initial maximum weight, final maximum weight, final maximum length, final mean body weight and final mean body length were recorded and evaluated from the given formulae.

a) Average daily weight gain (ADWG) = $\frac{\text{Mean final weight (g)} - \text{Mean initial weight (g)}}{\text{Culture days}}$

b) Feed conversion ratio (FCR)= $\frac{\text{Total dry feed intake (g)}}{\text{Total live weight (g)}}$

c) Protein Efficiency Ratio (PER) = $\frac{\text{Total weight gain (g)}}{\text{Total protein intake (g)}}$

d) Specific growth rate (SGR)= $\frac{\ln(\text{final weight})\text{g} \times \ln(\text{Initial weight})\text{g}}{\text{No. of days}} \text{X}100$

e) Survival rate (%) = $\frac{\text{Final number of fishes}}{\text{Initial number of fishes}} \text{X}100$

vi. Water quality parameters:

Water temperature, dissolved oxygen, pH, and conductivity were measured on a daily basis, whereas total alkalinity, chloride content, total hardness, and calcium hardness were measured weekly. Water temperature was measured using comet Borosilicate glass mercury thermometer. While, pH and electrical conductivity were determined using pH strip and a portable TDS conductivity meter (Microprocessor COND - TDS - SAL Meter LT – 51) respectively. Dissolved oxygen was measured by Winkler's method with azide modification. Total alkalinity, total hardness, salinity, nitrite and nitrate were measured by phenolphthalein indicator, titration, Microprocessor COND-TDS-SAL meter (LT-51- LABTRONICS MAKE) and colorimetric method respectively.

vii. Statistical analysis:

All statistical analysis was performed using Statistical analysis OPSTAT. Bar diagram and graphs were made in Micro-soft Excel 2007. Statistical analysis will be carried out by using one way, frequencies, percentages, averages and chi-square and ANOVA analysis of variance. Probability levels of 0.05 were used to find out the significance in all cases.

3. Result:

A. Growth parameters:

1. Survival rate:

Survival rate of fishes was 100 percent in control and T1treatment for*L. rohita* and *C. catla* where as in treatment T2, 93.33% survival rate was observed as shown in table no. 3 and 4.

Table:3Survivalrate (%)of*L.rohita*indifferenttreatments

Treatment	Initial	8th day	15th day	22th Day	29th Day	36th day	45th day	Survival Rate(%)
C	5	5	5	5	5	5	5	100
T_1	5	5	5	5	5	5	5	100
T2	5	5	5	5	5	5	4	80

Table:4Survivalrate (%) of*C.catla*indifferenttreatments

Treatment	Initial	8th Day	15th Day	22th Day	29th Day	36th Day	45th Day	Survival Rate(%)
C	5	5	5	5	5	5	5	100
T_1	5	5	5	5	5	5	5	100
T_2	5	5	5	5	5	5	5	100

2. Daily average weight gain:

As shown in table no. 5 and 6 highest average daily weight gain in *C. catla*(0.18±0.005 g) and *L. rohita* (0.12±0.005 g) was found in treatment T1 and lowest (0.11±0.006 g) for *C.catla* and (0.09±0.008 g) for *L. rohita*in the control treatment at the end of experiment.

Table:5Averagedailyweightgain(g)of*C.catla*indifferenttreatments

Treatment	Numberofdays					
	8th	15th	22nd	29th	36th	45th
Control	0.07±0.02	0.08 ±0.003	0.09 ±0.004	0.10 ±0.004	0.11 ±0.003	0.11 ±0.006
Soybean meal (T_1)	0.11±0.02	0.12 ±0.009	0.14 ±0.007	0.15 ±0.007	0.17 ±0.005	0.18 ±0.005
Groundnut oil cake (T_2)	0.08±0.03	0.10±0.02	0.11±0.01	0.12±0.01	0.13±0.01	0.14 ±0.005

CD(P=0.05)	N/S	N/S	0.027	0.034	0.036	0.018

Table:6Averagedailyweightgain(g)of*L.rohita*indifferenttreatments

Treatment	**Numberofdays**					
	8th	**15th**	**22nd**	**29th**	**36th**	**45th**
Control	0.05 ±0.015	0.06 ±0.001	0.06 ±0.004	0.07 ±0.007	0.08 ±0.004	0.09 ±0.008
Soybean meal (T_1)	0.07 ±0.005	0.08 ±0.014	0.09 ±0.008	0.11±0.07	0.12 ±0.006	0.12 ±0.005
Groundnut oil cake (T_2)	0.06 ±0.009	0.07 ±0.007	0.08 ±0.013	0.09 ±0.007	0.10 ±0.005	0.10 ±0.006
CD(P=0.05)	N/S	N/S	N/S	0.112	0.083	0.117

N/S =Non significant, (Mean± S.E.)

3. Feed conversion ratio (FCR):

In this experiment as shown in table no. 7 recorded FCR value for *L. rohita*and*C. catla* during different days was found lowest (1.50±0.02) in treatment T1 and it was found gradually increased in treatment T2 whereas highest FCR value was recorded in control treatment.

Table:7Feed conversionratio duringdifferenttreatmentsindifferentfish

(Polyculture)	**Treatments**	**FCR**
L. rohita*and *C.catla	Control	1.973±0.14
	Soybean meal(T_2)	1.507±0.02
	Groundnut cake(T_3)	1.76±0.07

4. Specific growth rate

The highest value of SGR for *C. catla*was (2.81±0.13g) recorded in treatment T1 whereas lowest SGR value (2.16±0.14g) was found in control treatment. Similarly,in case of *L. rohita* it was found maximum (2.50±0.10g) in treatment T1 and minimum (2.02±0.11g) in control treatment as shown in table no. 8 and 9.

Table:8Specificgrowthrate(g) of *C.catla*indifferenttreatments

Treatment	**Numberofdays**					
	8th	**15th**	**22nd**	**29th**	**36th**	**45th**
Control	2.32±0.73	2.30±0.23	2.31±0.24	2.29±0.13	2.31±0.18	2.16±0.14
Soybean meal (T_1)	3.13±0.75	3.08±0.31	3.06±0.23	3.01±0.09	3.01±0.15	2.81±0.13

Groundnut oil cake (T_2)	2.39±0.84	2.57±0.58	2.57±0.23	2.56±0.23	2.58±0.27	2.41±0.09
CD(P=0.05)	N/S	N/S	N/S	N/S	N/S	0.44

Table:9Specificgrowthrates(g) of *L.rohita*indifferenttreatments

Treatment	**Numberofdays**					
	8th	**15th**	**22nd**	**29th**	**36th**	**45th**
Control	1.97±0.56	2.02±0.10	2.06±0.16	2.11±0.18	2.16±0.10	2.02±0.11
Soybean meal(T_1)	2.50±0.24	2.56±0.45	2.66±0.24	2.73±0.15	2.71±0.11	2.50±0.10
Groundnut oil cake(T_2)	2.24±0.25	2.33±0.15	2.35±0.25	2.38±0.12	2.41±0.06	2.24±0.09
CD(P=0.05)	N/S	N/S	N/S	N/S	0.339	0.369

N/S=Nonsignificant,(Mean±S.E.)

5. Protein Efficiency Ratio

The PER value for*C. catla* was founded highest (0.38±0.02) in treatment T1, followed by (0.33±0.09) in treatment T2, and lowest (0.29±0.05) in the control treatment similarly in case of *L. rohita*, it was recorded highest (0.31±0.02) in treatment T1, followed by (0.29±0.06) in treatment T2, and lowest (0.28±0.07) in the control treatment as shown in table no. 10 and 11.

Table:10Proteinefficiencyratioof*C.catla*indifferenttreatments

Treatment	**Numberofdays**					
	8th	**15th**	**22nd**	**29th**	**36th**	**45th**
Control	0.29±0.09	0.28±0.03	0.28±0.03	0.27±0.04	0.29±0.06	0.29±0.05
Soybean meal (T_1)	0.40±0.11	0.39±0.09	0.38±0.02	0.36±0.06	0.39±0.07	0.38±0.02
Groundnut oil cake(T_2)	0.30±0.11	0.35±0.08	0.32±0.07	0.31±0.05	0.34±0.4	0.33±0.09
CD(P=0.05)	N/S	N/S	N/S	N/S	N/S	N/S

N/S =Non significant, (Mean± S.E.)

Table:11Proteinefficiencyratioof*L.rohita*indifferenttreatments

Treatment	**Numberofdays**					
	8th	**15th**	**22th**	**29th**	**36th**	**45th**
Control	0.24±0.07	0.25±0.04	0.26±0.03	0.28±0.05	0.29±0.09	0.28±0.07
Soybean meal (T_1)	0.31±0.03	0.33±0.09	0.36±0.03	0.37±0.03	0.33±0.009	0.31±0.02
Groundnut oil cake (T_2)	0.27±0.034	0.30±0.02	0.30±0.08	0.31±0.06	0.31±0.02	0.29±0.06
CD(P=0.05)	N/S	N/S	N/S	N/S	N/S	N/S

N/S =Non significant, (Mean± S.E.)

6. Feed acceptance

The feed acceptance of different treatments was calculated and it was observed that Soybean meal i.e., T1 has highest feed acceptability whereas it was lowest for control as mentioned in table no. 12

Table:12Feedacceptances

Control(C)	Quantity(g)	Soybean meal(T1)	Quantity(g)	Groundnut oil cake(T2)	Quantity(g)
Totalfeedgiven	365.04	Totalfeedgiven	415.98	Totalfeedgiven	387.62
Feed residue	18	Feed residue	9	Feed residue	14
Feedacceptability	95.07	Feedacceptability	97.84	Feedacceptability	96.39

7. Proximate composition of different Treatments:

Three isocaloric and isonitrogenous diets were prepared with the help of Pearson square method. The proximate analysis of different feed i.e., control, T1 and T2 was done and it was recorded that the crude protein (CP) % of control, T1, T2 was 34.01%, 34.50% and 34.20% respectively. The moisture content of control, T1, T2 was 8.85%, 6.11 and 7.25% respectively as shown in table no 13. The fat content of control, T1, T2 was 6.7%, 6.5% and 6.3% respectively. The crude fibre content of control, T1, T2 was 10.0%, 7.90%, and 7.06 respectively. While the composition of ash for control, T1, T2 was 9.16%, 8.49% and 6.74 respectively.

Table:13Proximatecompositions ofthepelletedfeed

Experimentalfeed	**Protein(%)**	**Moisture(%)**	**Fat(%)**	**Fiber(%)**	**Ash(%)**
Control(C)	34.01	8.85	6.7	10.0	9.16
Soybeanmeal(T1)	34.50	6.11	6.5	7.90	8.49
Groundnut oil meal(T_2)	34.20	7.25	6.3	7.06	6.74

8. Physico-chemical parameters of water :

In the context of carp culture, the water quality parameters across various treatments consistently maintained optimal levels, as illustrated in Table No. 14. The temperature exhibited a range of 27 to 29°C, while dissolved oxygen levels fluctuated between 6.5 and 7.3

mg/l. The pH of the water ranged from 7.5 to 7.8, and alkalinity was observed within the range of 112.76 to 138.38 mg/l. Hardness values varied between 146.28 and 164.88 mg/l, and total dissolved solids (TDS) were recorded in the range of 126.88 to 140.52 mg/l. Ammonia concentrations remained within the narrow range of 0.03 to 0.07, and salinity levels were noted between 0.25 and 0.29 ppt.

9. Economics of feeding:

The cost of feed production (Rs kg-1) was calculated for Control, T1 and T2 treatments, the observed values were Rs. 39.30 kg-1 , Rs. 61.30 kg-1 and Rs. 54.10 kg-1 respectively. Which are depicted in table14, table 15 and 16.The FCR (table no. 9) of Control (1.97), T1 (1.5) and T2 (1.76) was observed in polyculture as well as cost of production for each kg of fish was Rs 77.42, 91.95 and 96.83 for Control, T1 and T2 respectively.

Table:14 Costoffeedproduction inControlfeed

CostoffeedproductioninControlfeed				
Ingredients	**(Cost)Rs./kg**	**%inclusion**	**g**	**(Cost)Rs./g.**
Mustardoilcake	**21**	**74.5**	**74.5**	**1.56**
Ricebran	**17**	**13.5**	**13.5**	**0.23**
CMC(Carboxymethyl cellulose)	65	2	2.0	0.13
Vegetableoil	120	8	8.0	0.96
Mineralmixture	50	1	1.0	0.05
Vitaminmixture	**1000**	**1**	**1.0**	**1.00**
Total(g)		**100%**	**100g**	**3.93**

Table:15 Cost of feedproductionin Soybeanmeal

Costoffeedproductionin Soybeanmeal				
Ingredients	**(Cost)Rs/kg.**	**%Inclusion**	**g**	**(Cost)Rs./g**
Soybeanmeal	**120**	**55**	**55**	**3.0**
Maizeflour	**28**	**33**	**33**	**0.92**
CMC(Carboxymethyl cellulose)	65	2	2	0.13
Vegetableoil	120	8	8	0.96
Mineral mixture	50	1	1	0.05
Vitaminmixture	**1000**	**1**	**1**	**1.00**
		100%	**100g**	**6.13**

Table:16 Cost of feedproduction in groundnut oil cake

Costoffeedproductioningroundnut oil cake				
Ingredients	**(Cost)Rs./kg**	**%Inclusion**	**g**	**(Cost)Rs./g**
Groundnutmeal	**45**	**65**	**65**	**2.75**
Wheatflour	**27**	**23.5**	**23.5**	**0.54**
CMC(Carbon-methyl cellulose)	65	2	2	0.13
Vegetableoil	120	8	8	0.96
Mineralmixture	50	1	1	0.05
Vitaminmixture	**1000**	**1**	**1**	**1.00**
Total		**100%**	**100g**	**5.41**

Discussion

A healthy and thriving fish population is the main goal of aquaculture operations, and it depends on the proper nutrition which is given to animals being cultivated.The most important source of nutrition for fish raised in intensive and semi-intensive cultures is exogenous feed that contains minerals, vitamins, and other necessary nutrients. The raw material which is used in fish feed formulations should be easily digested, palatable, and highly nutritious. Because of its high nutritional value and palatability, fishmeal has long been used as a major source of protein in feeds for semi-intensive and intensive fish farming. Nevertheless, fishmeal is costly and not easily available in many countries which necessitated its substitution with easily available plant protein resources. In current years, plant proteins are being mostly used in fish and prawn feeds, mainly to replace the fishmeal component, in order to reduce the feed cost (Priyadarshini et al., 2011). The extent of plant protein used in fish diet depends on the species, availability, cost and acceptability by fish, presence of nutrient and antinutritional factors (Lim and Dominy, 1990).For carp, Singh et al. (2005) opined that optimum protein requirements diverge with the protein sources and feed ingredients that are locally available and cheap protein sources should be used to develop a suitable feed.The most favourable replacements of fishmeal in carp diets are oilseed meal i.e. mustard oil cake, linseed meals and sesame meal (Hossain and Jauncey, 1989). Moreover, soybean meals is considered to be the most nutritive plant protein and are used as the major protein source in fish diets (El-Sayed, 1999).

Present study was on the growth of *L.rohita* and *C.catla* under the different plant based isoprotineious diets revealed high average weight gain, SGR, PER and lowest FCR in treatment T1 where fishes were fed with soybean meal and cornflour based diet as compare to other treatment and control groups. The present study shows that the specific growth rate and FCR in *C.catla* and *L.rohita* was influenced by the diet based on different plant protein sources especiallySoybean mealalong with cornflour based diet. The reason behind this is could be feed acceptancebecause in treatment T1 residue of feed was 9 gm, whereas in treatment T2 and control residue it was 14gm. and 18gm. respectively. Zahan et al 2013 also observed the increase in final weight, average live weight gain, specific growth rate (SGR), lower food conversion ratio (FCR), protein efficacy ratio (PER), apparent net protein utilization (ANPU%) and survival of fingerlings fed on diet D3, a soybean meal based diet. This study clearly indicate that soybean flour contain crude protein that make the feed easily digestible and more sustainable than conventional feed diet of mustard oil cake and rice brain (Zlaugotne, 2022) which gives maximum growth performance in case of *C.catla* as well as *L.rohita*.

Latif et al. (2008) also reported that mustard oil cake, soybean meal, seasame meal, linseed meal (25:25:25:25) fed to*L. rohita* showed poor growth performance in comparison with the diet consisted of soybean meal, seasame meal, linseed meal (40:30:30). Singh and Dhawan (1996) obtained almost similar result in *C. carpio*.There were no statistical difference ($P>0.05$) between the treatment in respect of survival rate.

In the present study a decreasing trend of FCR value was observed in control, treatment T2 and least in treatment T1. As a result indicate combination of soybean meal along with cornflour based diet giver better FCR and PER in case of both *C.catla* and *L.rohita*. While Hossain and Jauncey (1989) attributed poor growth response of *C. carpio* fed on diets containing mustard oil cake. Moreover, Devi et al. (1999) observed higher feed protein efficacy in the diet of rohu having soybean meal and also obtained higher protein level in the tissues of rohu.

Conclusions

The result of the present study indicates that conventional diets such as mustard oil cakealong with rice brain and groundnut along with wheat flour gave lower growth and poorer food conversion ratio compared to soybean based diets. The use of soybean meal along with cornflour (66.5+ 33.4) might be advantageous for rearing of carp fingerlings.

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