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IMPACT OF PLANT-BASED DIETARY FAT LEVELS ON GROWTH, FEED UTILIZATION, BODY COMPOSITION, AND SERUM METABOLITES IN *LABEO ROHITA*

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ABSTRACT

Fish is the preferred and the cheapest source of high-quality animal protein for humans. The study aimed to assess the influence of varying levels of plant dietary fats on the growth, feed utilization, body composition, and serum metabolites of *Labeo rohita*, a significant carp species known for its rapid growth and palatable flesh. Seventeen fingerlings were acclimatized and subjected to six different dietary treatments, including mono- and polyunsaturated fat supplements at 3%, 6%, and 9%. Serum metabolites were analyzed using the Biuret assay for total serum proteins, glucose peroxidase method for total serum glucose, cholesterol oxidase-phenol amino phenazone method for total serum cholesterol, and GPO/PAP method for serum triglycerides. Physiochemical parameters were meticulously maintained throughout the trial period. The results revealed that fish fed with 6% polyunsaturated and 9% monounsaturated fat exhibited significantly higher feed utilization and maximum growth performance, particularly in treatments 3 and 5. Furthermore, significant alterations in body composition and serum metabolites, such as proteins, triglycerides, and cholesterol, were observed in these treatments. The study concluded that 6% polyunsaturated fats (soybean + sunflower oil) and 9% monounsaturated fats (canola + olive oil) could effectively enhance the growth of *Labeo rohita*. Statistical analysis was executed using analysis of variance (ANOVA) and under central registration depositary (CRD). These findings offer valuable insights into optimizing the dietary requirements for the growth and health of *Labeo rohita*.

Keywords: Dietary Fat, Growth, Feed Utilization, Body Composition, and *Labeo Rohita*

INTRODUCTION: The fishery sector plays an essential role to the socioeconomic, medical, aesthetic, and dietary stability of emerging nations. In fish meat, animal proteins minimum quantity of cholesterol and greater unsaturated fatty acid contents are present (Fawole et al., 2007). Notably, the demand of fish meat is enhanced in market due to its proteins quality and nutritious values (Yildrim et al., 2008). In aquaculture Indian major carps such as *Cirrhinus mrigala*, *Labeo rohita*, and *Catla catla* are widely cultured because the demand of these species is very high. It

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plays significant role in the economy of various countries (Mokolensang et al., 2003). *Labeo rohita* commonly known as rohu. Rohu is conventionally cultured due to high protein quality, fast growth, disease resistance properties and also have maximum market demand. For better production of *Labeo rohita* it is required to understand the requirement of dietary amino acid to prepare the balanced diet (Abidi et al., 2004). The balanced diet provides all the ingredients proteins, carbohydrates, fats, vitamins and minerals. A great diversity of food for fish is provided by nature including plants and animals (Glencrosis et al., 2007). The key elements of the diet that provide energy and necessary fatty acids are lipids. The majority of fish species readily digest them (Martino et al., 2002). Dietary lipids have a major effect on fish physiology through improving growth rate, feed conversion ratio, reproduction, vision, behaviour, osmoregularity, membrane fluidity (thermal adaptability), and immune response (Kim et al., 2005). There are two kinds of lipids: unsaturated and saturated. At room temperature, saturated lipids are solid and come from animal sources such as dairy, beef, and chicken fat. Plant sources of unsaturated lipids include nuts, seeds and vegetable oils (Pandey, 2013). Fish oil is considered as a significant lipid source in the aquaculture feed industry because of its high concentration of essential fatty acids. Long chain polyunsaturated fatty acids (PUFA), primarily docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), are abundant in fish oil and play a significant role in lowering the risk of metabolic syndromes and cardiac diseases (Regost et al., 2003).

Plant fats are present in the form of oil in the market that can rapidly digest. Each gram of fat contains 2.5 times more energy than that of carbohydrates and proteins (Breslow, 2006). Dietary fats are essential for fish because they can store energy for longer periods, provide insulation to the body, helps in the absorption of nutrients, protect the vital organs of fish and also help in lowering the cholesterol level of animals (Abbass, 2007). Fish muscle uses fatty acids, which are produced from triglycerides, or fats and oils, as its primary aerobic fuel source for energy metabolism. A significant decrease of essential fatty acids can result in skin lesions, poor fish growth, less effective fish feed, and higher fish mortality (Yang et al., 2011). A food source of the fatty acids linoleic and alpha linolenic acid is a requirement for freshwater fish. Alpha linolenic and linoleic acids can be found in abundance in soybean, corn, and sunflower oils. They play an integral role in cardiovascular complications, brain function and immunity of fish. These fatty acids can reduce the inflammation, which can cause chronic conditions such as heart diseases, cancer and diabetes. Linoleic acid and alpha linolenic acid both are 18carbon fatty acids. The minimum requirement of EPA and DHA for freshwater fish is around 0.9% (Prabu et al., 2017). Mono-unsaturated and poly-unsaturated are the two types of plants fats. Avocados, peanuts, canola, and olive oil are rich sources of monounsaturated fats, which are liquid at room temperature and have single unsaturated carbon bond in their molecular structure. Polyunsaturated fats are liquid at room temperature and include several unsaturated carbon bonds in their structure, Omega-6 fats, sunflower, soybean and corn are rich sources of poly-unsaturated fats (Barma et al., 2013). The ratio of fats, proteins, moisture, and ash that aquatic species contain is determined by their body composition. It is an important aspect of measuring the physiological and functional condition of fish (Pedro et al., 2005).

The body's crude fat content rises as dietary fats are consumed, yet the body's protein and ash concentrations may fall as lipid consumption increased. Omega-3 along with omega-6 fatty acid supplements enhance the body composition of the rohu (Chatzifotis et al., 2010). Aquatic organisms' feed conversion ratio rises when they consume dietary fats. They aid in the body's ability to absorb vital nutrients from diet. Fish can have their nutritional requirements fulfilled through well-balanced pelleted feed that has been adjusted to their specific species and age. Fish growth rate, feed conversion efficiency, and chemical composition are all significantly affected by the amount and quality of feed they consume (Girginov, 2007). Growth rate is highly important as it controls the economic effectiveness of cultured fish species, which are effected by feed stuffs and many environmental parameters like pH of water, temperature and dissolve oxygen in water. Effective feed utilization and fast growth of fish is maintained by formulating a fat-rich ingredients in fish diet. (Ashfauq et al., 2016). Excess of dietary lipids lowers the feed conversion ratio, retards the rate of growth and proximate composition of fish.

So, it is requirement of fish (Tayyaba et al., 2004).

2Material and Methods:

Labeo Rohita is one of the tastiest fish and because of its fast growth, high-quality animal proteins and disease-resistance properties, it is widely cultured. This research aimed to examine how varying levels of plant dietary fats influence different aspects of *Labeo rohita*, including growth performance, feed utilization, body composition, and serum metabolites.

2.1) Site of experiment:

The research was done at fish Research farms of the Department of Zoology, Wildlife and Fisheries, University of Agriculture, Faisalabad.

2.2) Experimental conditions:

Labeo Rohita fingerlings were procured from the Fish Hatchery, Satyana road Faisalabad. In each tank, Seventeen fingerlings were added and they were kept for at least one week for acclimatization. Fish fingerlings were fed with basal diet, during the acclimatization period. Throughout the trials, physio-chemical parameters including temperature, pH, and DO were continuously examined. A capillary system was used to ensure continuous aeration for all the tanks. The tanks were siphoned daily to remove un-eaten feed and feces. The tank was refilled with fresh water after cleaning.

2.3) Experimental diet preparation:

Fish diet was prepared in the laboratory according to given diet tables by purchasing feed ingredients from the local market. The ingredients were chemically analyzed, mixed and ground by pestle and mortar to specific particle size for making pellets from them. They were supplemented with mono-unsaturated and poly-unsaturated fats at varying levels of 0%, 3%, 6% and 9%. Diet was prepared according to the rules of AOAC (1995).

Table 1: Composition of diet in trail / 100G with three levels of plant mono-unsaturated dietary fats for *Labeo rohita*.

Ingredients	Control	% of monounsaturated fat in diet		
		3%	6%	9%
Meal of fish	45.0 g	45.0 g	45.0 g	45.0 g
Canola oil	0.0 g	1.6 g	3.0 g	4.5 g
Olive oil	0.0 g	1.4 g	3.0 g	4.5 g
Wheat bran	29.0 g	26.0 g	23.0 g	20.0 g
Rice bran	24.0 g	24.0 g	24.0 g	24.0 g
Vitamins &mineral premix	1 g	1 g	1 g	1 g
Ascorbic Acid(Antioxidant)	1g	1g	1g	1g
Grand sum	100g	100g	100g	100g

Table 2: Composition of experimental diet/ 100G with three level of plant poly-unsaturated dietary fats for *Labeo rohita*.

Ingredients	Control	% of polyunsaturated fat in diet		
		3%	6%	9%
Fish diet	45.0g	45.0g	45.0g	45.0g
Sunflower oil	0 g	1.5g	3.0g	4.5g
Oil of Soybean	0 g	1.5g	3.0g	4.5g
Wheat bran	29.0g	26.0g	23.0g	20.0g
Rice bran	24.0g	24.0g	24.0g	24.0g
Vitamins &mineral premix	1.0g	1.0g	1.0g	1.0g
Ascorbic Acid(Antioxidant)	1g	1g	1g	1g
Grand total	100g	100g	100g	100g

2.4) Feeding procedure:

Fingerlings were feed every day according to their body weight. Six groups of fish were given the test food, while group T0 received the basal diet. Monounsaturated based diet, 3%, 6% and 9% was fed to Treatment (T1, T2 and T3). A polyunsaturated fat-based diet was given to treatment (T4, T5 and T6) at varying levels of 3%, 6% and 9%. Uneaten feed was taken out of the tanks to measure feed utilization.

Measurements of SGR, FCR, and survival ra te were used to assess growth performance a nd feed utilization. Tanks were washed, dried in sunlight to avoid fungus contamination and refilled with fresh water. An unconsumed diet will be removed from tank.

2.5) Growth performance and Feed utilization:

Total body length, weight gain and fork length were calculated fortnightly from each treatment to determine growth performance. Feed utilization was determined by collecting uneaten feed from the tanks. Growth performance and feed utilization were determined by measuring SGR,

FCR and survival rate (TEKİNAY & DAVIES, 2001)

2.6) Weight gain (%): (Wg)

Weight gain was determined by the following formula:

Weight gain %

$$= \frac{\text{Final weight of fish} - \text{Initial weight of fish}}{\text{Initial weightof fish}} \times 100$$

2.7) Specific growth rate (SGR):

SGR of fish was calculated as:

SGR=

$$\frac{\text{In}[\text{Initial weight of fish (g)} - \text{Final weight of fish (g)}]}{\text{Experimental duration in days}} \times 100$$

2.8) Survival rate (%):

The survival rate of fish was determined as:

Percentage of survival rate =

$$\frac{\text{Final no.of fish}}{\text{Initial weight of fish}} \times 100$$

2.9) Feed conversion ratio (FCR):

Feed utilization was determined by calculating Feed conversion ratio.

$$FCR = \frac{\text{Total intake of feed(g)}}{\text{Total Wet weight gain (g)}}$$

2.10) Proximate composition analysis:

Muscles of *Labeo rohita* were minced for proximate composition analysis. Homogenized mixture of muscle sample was prepared after mincing. This mixture was collected in plastic bags and frozen at -18 degree for the calculation of proximate body composition. Following parameters were calculated for body composition analysis (Inayat & Salim, 2005). For the determination of moisture content Muscle samples were dehydrated, for twelve hours at 105°c. Micro-kjeldhal method was used for crude proteins estimation.

The soxhlet method of extracting petroleum ether was employed to determine the crude f at content, while samples free of fat were bu rned to determine the crude fibre content by weight loss.

2.11) Moisture:

Gram samples of fish muscle were placed in a petri dish and baked at 105°C for twelve h ours in order to analyse the moisture content
.

After being dried, the sample was placed in a desiccator for five minutes, and its weight was once more measured. Once more, this sample was placed in the ov en for one to two hours, or until its weight re mained constant (W2). Moisture was identified as the cause of the weight differential.

Using the following formula, the dry matter % was determined

$$\text{Moisture (\%)} = \frac{W1-W2}{\text{Weight of sample}}$$

WI = Sample before drying + Weight of petri dish

W2 = Sample after drying + Weight of petri dish

Percentage of dry matter = moisture %-100

2.12) Kjeldahl's method for Crude Protein Determination:

Check the crude protein content in a fish muscle sample micro-kjeldahl method was employed. In a Kjeldahl flask, a dried fish muscle sample was combined with 30ml of concentrated H2SO4 and 5g of a digestion mixture containing K_2SO_4, $CuSO_4$, and $FeSO_4$ in a 90:7:3 ratio. The mixture was boiled, initially at low temperature and then at high temperature, until the solution's green color clarified. With distilled water after cooling and filtering, the volume was adjusted to 250ml. Further, 10ml of NaOH was added to 10ml of the diluted, digested sample and distilled with steam to

release ammonia. 10ml of boric acid solution and an indicator (methyl red) was collected in a beaker evolved ammonia containing. The collection was stopped when the boric acid color changed from pink to golden yellow within 2 minutes. The collected ammonia was then titrated against 0.1N H_2SO_4, and the quantity of H_2SO_4 used was recorded. The percentage of nitrogen was determined using a specific formula.

Nitrogen(%)=

Vol.of sulphuric scid used x Normality of sulphuric acid x 0.014x 250

Weight of sample x 100

Where: 0.014 = Standard volume of 0.1 Normality H_2SO_4 used to neutralize 1ml of NH3.

250 = Dilution of digested sample.

100 = N_2 %

Crude protein in sample was calculated with the help of following formula.

Crude protein% = % of nitrogen x 6.25

Where by, 6.25 = conversion factor (Cf)

2.13) Crude Fat:

The determination of crude fat was conducted through the Soxhlet system using petroleum ether. A weighed, dried muscle sample was placed in de-fatted paper, which was then inserted into a thimble connected to an adapter. The thimble, attached to a condenser, was joined to an extraction cup. The extraction cup was weighed, and 5070ml of petroleum ether was added. The cup was heated on a hot plate for about 20 minutes while cold tap water circulated. The thimble absorbed the solvent during the process. After 30 minutes, the extraction mode was switched to 'rinsing.' The thimble was suspended above the solvent, and the condenser valve was partially closed. Following rinsing, the extraction cup was released, allowing ether collection with open condenser valves. Subsequently, water and electricity to the hot plate were discontinued.

Fat (%) = $\frac{W2-W1}{\text{Weight of sample}}$ X100

Where,

WI = Weight of empty extraction cup

W2 = Weight of extraction cup having fat after evaporation of ether

2.14) Crude Ash:

For ash content determination, 2 grams of the dried sample were placed in crucibles and weighed. Subsequently, the sample underwent ignition in a muffle furnace at 550-600°C for 4-5 hours. After cooling in a desiccator, the crucibles with the ash were reweighed.

$$\text{Total Ash} = \frac{\text{Weight of ash}}{\text{Weight of original sample}} \times 100$$

2.15) Serum analysis:

Proteins coagulated from blood plasma were isolated through centrifugation at 3000 rpm for fifteen minutes. Serum collection was done using a Pasteur pipette and transferred to a plain plastic test tube, followed by storage at 20°C until analysis.

Biochemical analysis of serum parameters:

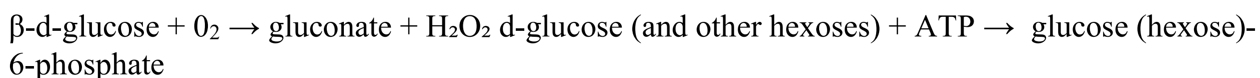
Serum metabolites which were analyzed are total serum proteins by Biuret assay method, Total serum glucose was estimated by glucose peroxidase method, total serum cholesterol by cholesterol oxidase-phenol amino phenazone method and serum triglycerides by GPO/PAP method (Tanuja et al., 2017) .

Total Serum Proteins (TP):

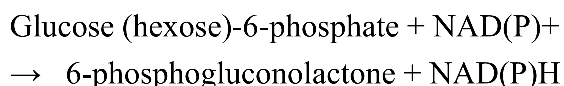
The serum metabolites subjected to analysis included total serum proteins using the Biuret assay method, total serum glucose estimated through the glucose peroxidase method, total serum cholesterol determined via the cholesterol oxidase-phenol amino phenazone method, and serum triglycerides.

Determination of Serum Glucose:

The estimation of glucose utilized the Glucose oxidase peroxidase method, an assay technique. Substrate β-D-glucose oxidase catalyzed the formation of gluconic acid and hydrogen peroxide. The released hydrogen peroxide oxidized phenolic compounds, resulting in the formation of a red quinoneimine dye. The color intensity, directly correlated with glucose concentration, was measured at 505nm using a spectrophotometer.



β-d-glucose + 0_2 → gluconate + H_2O_2 d-glucose (and other hexoses) + ATP → glucose (hexose)-6-phosphate



Glucose (hexose)-6-phosphate + NAD(P)+ → 6-phosphogluconolactone + NAD(P)H

2.16) Total Cholesterol:

The enzymatic measurement of cholesterol employs the CHOD-PAP (cholesterol oxidase-phenol amino phenazone) method. Cholesterol esterase (CE) facilitates the hydrolysis of cholesterol esters, converting them into free cholesterol and fatty acids.

The reaction sequence is as follows:

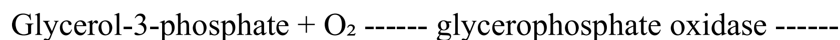
Cholesteryl ester+ H_2O ------- cholesterol esterase ------ cholesterol + fatty acid

2.17) Total Triglycerides:

Triglycerides (TG) were determined using the (GPO-PAP) assay employing the endpoint method. Lipoprotein lipase catalyzed the breakdown of triglycerides into free fatty acids and glycerol. Glycerol kinase, in the presence of ATP, converted glycerol into glycerol 3-phosphate. The oxidation of glycerol 3-phosphate produced dihydroxyacetone phosphate and H_2O_2. Hydrogen peroxide, reacting with 4-amino antipyrine and 4-chlorophenol in the presence of peroxidase, led to the formation of a red dye. The absorbance of the colored dye was measured at 425nm, and its intensity was proportional to the amount of triglycerides in the serum. (Kulkarni, 2015). The reaction sequence is as follows:

Triglycerides + $3H_2O$ ---- lipase ------ glycerol + fatty acids

Glycerol + ATP ------ glycerokinase ------ glycerol-3-phosphate + ADP



Glycerol-3-phosphate + O_2 ------ glycerophosphate oxidase ------

dihydroxyacetone phosphate + H_2O_2

H_2O_2 + 4-aminophenazone + 4-chlorophenol

------ peroxidase ------ 4-(pbenzoquinonemonoimino)-phenazone + $2H_2O$ + HCI

Statistical analysis:

Data was analyzed by comparing different dietary treatments by analysis of variance (ANOVA) and under CRD design.

3 RESULTS:

The effects of source of dietary fats levels in prepared diets on growth and serum metabolites are given in Table Growth performance of *Labeo rohita* fed with animal origin monounsaturated and polyunsaturated dietary fats were observed during the trial.

3.1) Growth performance:

Growth performance of fish was seen maximum in treatment 3 having 9% of monounsaturated fat supplementation and in treatment 5 that contains 6% of polyunsaturated ats. n growth performance weight gain, body length, fork length is included. In treatment 3 and 5 Maximum weight gain was observed. While minimum in T0 having no fat supplementations. The total body length of Rohu fingerlings was maximum in T3 and T5, while minimum body length was in T0. Maximum increase in fork length was in T3 and T5, minimum fork length was observed in T0 which was without any fat supplementations.

Table 3 : Comparison of growth performance of *Labeo rohita* between monounsaturated and polyunsaturated fats.

Growth performance	Control group	Monounsaturated fat			Polyunsaturated fat		
	Treatment 0	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Weight gain	30.5g	32.8g	36.1g	40.9g	32.6g	37.9g	35.2g
Body weight	7.4cm	7.5cm	7.9cm	8.2cm	7.6cm	8.0cm	7.5cm
Fork length	4.2cm	4.5cm	4.7cm	5.0cm	4.3cm	4.8cm	4.4cm

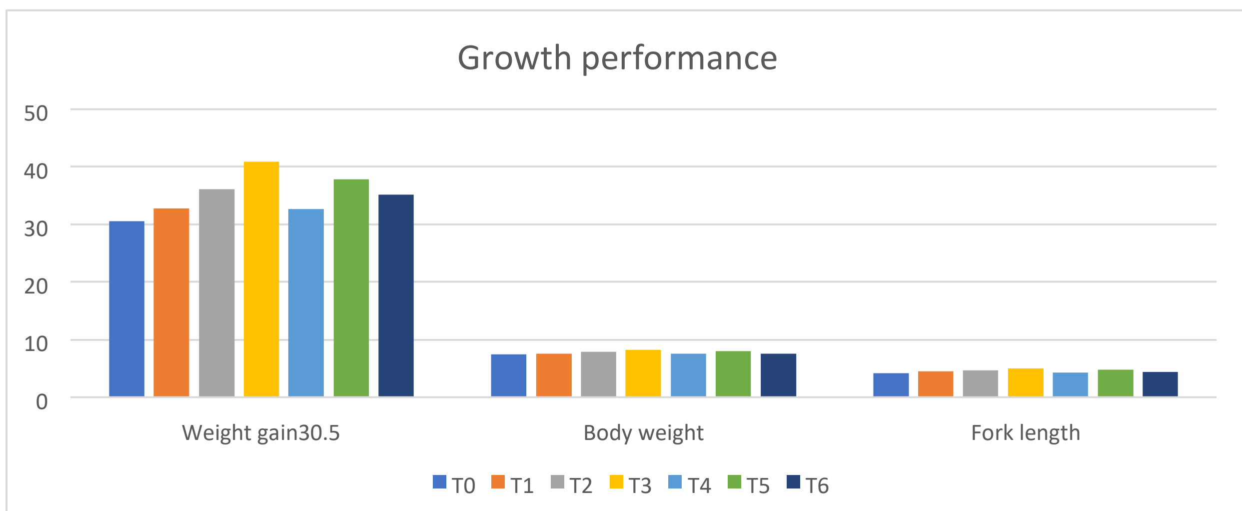


Fig 1. Graphical representation of comparison of growth performance of *Labeo rohita* between monounsaturated and polyunsaturated fats.

3.2) Body composition: exhibited the highest body composition levels (moisture, crude fat, crude protein, and The body composition was analyzed crude fiber), followed by T4, T6, T2, and T1, moisture, crude protein, crude fat and crude with the lowest levels observed in T0. ash. The study findings indicated that the content of body remains unaffected by fat addition of various plant-based dietary fats supplements has a notable effect on the body composition of *Labeo rohita* fingerlings. T3 and T5.

Table 4: Effects of monounsaturated and polyunsaturated fats on body composition of *Labeo rohita*.

Body composition	Control group	Monounsaturated fat			Polyunsaturated fat		
	T0	T1	T2	T3	T4	T5	T6
Moisture	74.05	72.21	71.26	70.15	71.29	70.09	72.14
Crude protein	14.40	15.52	15.55	16.64	15.57	16.52	15.59
Crude fat	4.51	5.19	5.22	5.28	5.24	5.26	5.00
Crude ash	2.60	2.48	2.31	1,70	2.56	1.59	1.65

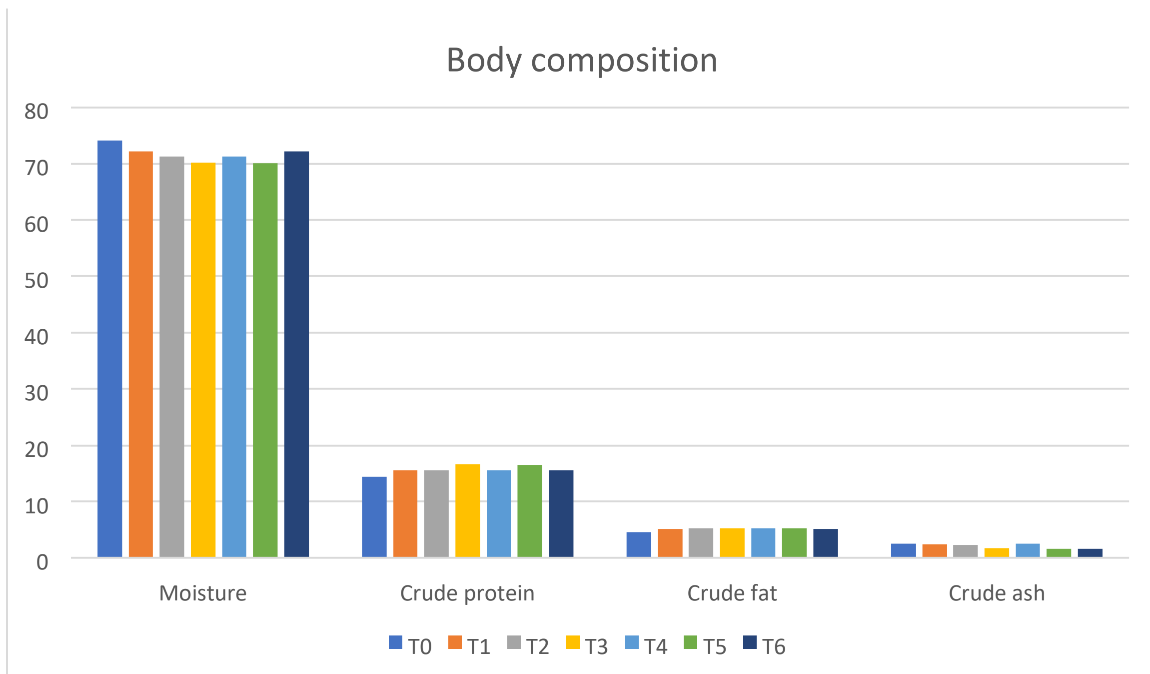


Fig 2. Graphical representation of effects of monounsaturated and polyunsaturated fats on body composition of *Labeo rohita*.

Glucose	75	73	70	68	71	60	74

3.3) Serum metabolites: minimum amounts were in TO. Total serum glucose remains unaffected by fats. Serum metabolites such as proteins supplementations in diet and serum and triglycerides, were maximum in T3 and cholesterol was maximum in T2.

Table 5: Effects of monounsaturated and polyunsaturated fats on serum metabolites of *Labeo rohita*.

Serum metabites	Control group	Monounsaturated fat			Polyunsaturated fat		
	T0	T1	T2	T3	T4	T5	T6
Total protein	3.28	3.30	3.76	3.80	3.79	3.70	3.50
Triglycerides	126	134	141	146	136	144	138
Cholesterol	131	134	136	132	133	130	135

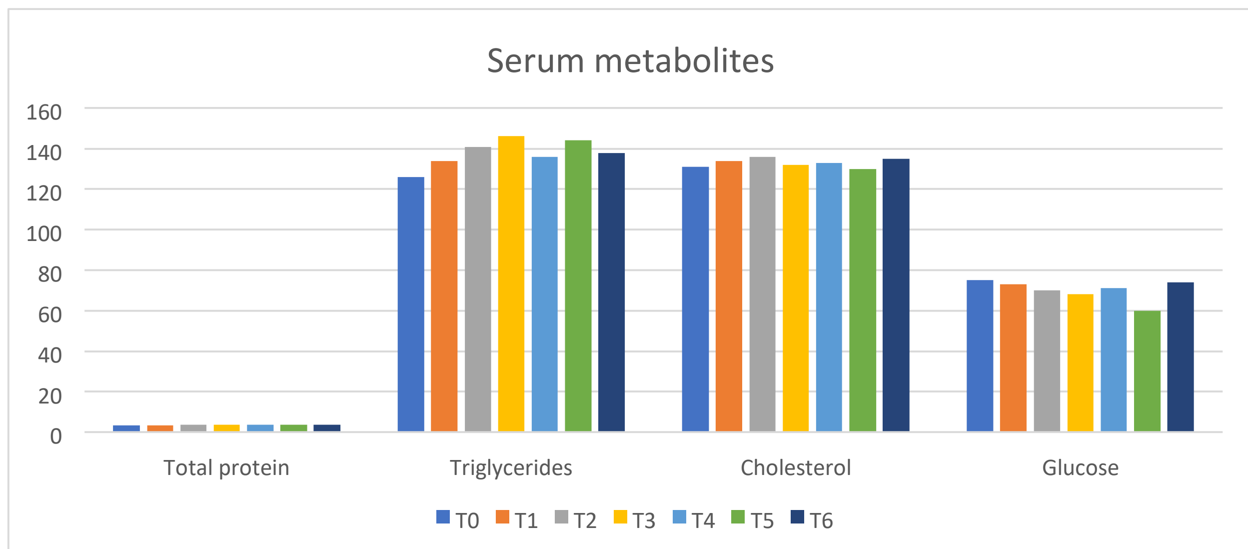


Fig 3. Graphical representation of effects of monounsaturated and polyunsaturated fats on serum metabolites of *Labeo rohita*.

3.4) Feed conversion ratio (FCR): fats compared to T0 with no fat supplementation. FCR was highest in groups with 9% monounsaturated and 6% polyunsaturated.

Table 6: Comparison of FCR of *Labeo rohita* in monounsaturated and polyunsaturated fats.

FCR	Control group	Mo ıounsaturated fats			Pol yunsaturated fats		
	T0	T1	T2	T3	T4	T5	T6
1st	0.27	0.21	0.22	0.17	0.23	0.20	0.208
2nd	0.24	0.23	0.23	0.18	0.20	0.18	0.20
3rd	0.26	0.21	0.20	0.18	0.22	0.19	0.21
4th	0.20	0.23	0.19	0.15	0.21	0.16	0.179
5th	0.24	0.20	0.17	0.162	0.24	0.21	0.22
6th	0.22	0.21	0.19	0.167	0.19	0.18	0.17
7th	0.20	0.19	0.18	0.165	0.26	0.19	0.22
8th	1.04	0.30	0.29	0.15	0.28	0.16	0.20
9th	1.06	0.33	0.27	0.12	0.25	0.14	0.24
10th	1.08	0.31	0.25	0.11	0.29	0.12	0.21
11th	1.05	0.35	0.24	0.13	0.24	0.15	0.22
12th	1.07	0.33	0.24	0.10	0.26	0.11	0.21

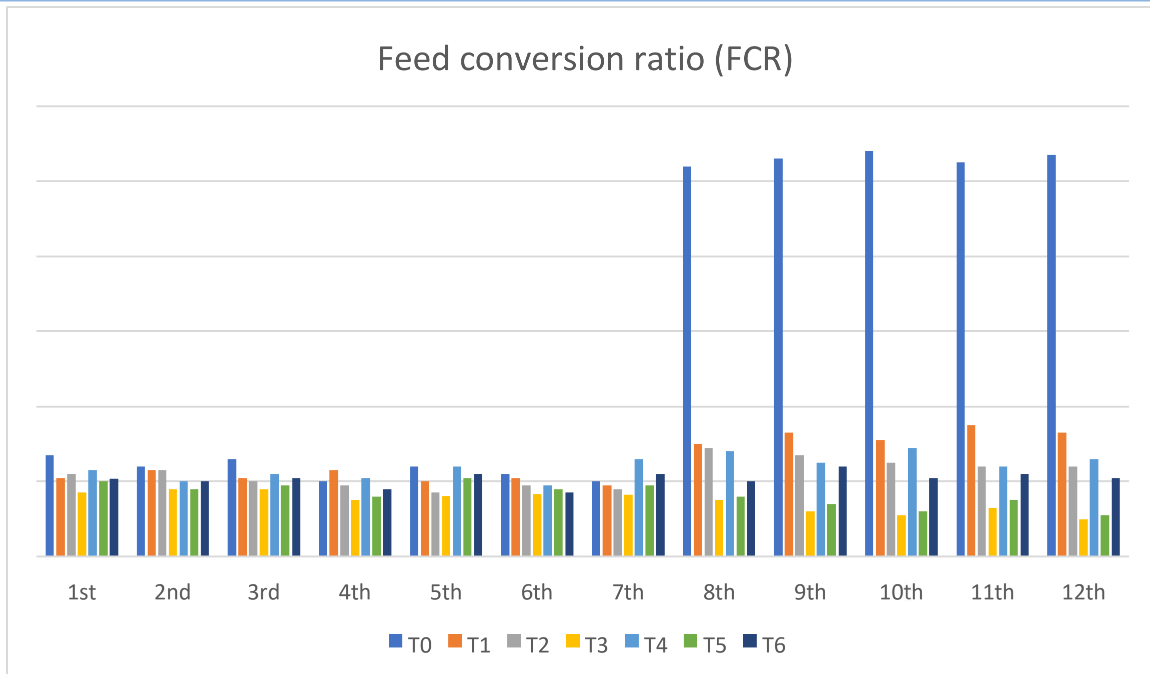


Fig 4. Graphical representation of Comparison of FCR of *Labeo rohita* in monounsaturat and polyunsaturated fats.

4) DISCUSSION:

The study aimed to analyze the influence of different levels of plant-based dietary fats on *Labeo rohita,* examining growth, body composition, feed utilization and serum metabolites. Trials involved seven groups (T1-T6 and control T0) over six months, with T1-T3 receiving monounsaturated fats (3%, 6%, and 9%) and T4T6 receiving poly-unsaturated fats (3%, 6%, and 9%). Physio-chemical parameters and growth were measured fortnightly, while body composition and serum metabolites were evaluated at the end of the experiment.

Plant fats play a crucial role in fish growth, providing necessary energy storage. Variations were seen in growth indicators such as specific growth rate, body weight, length, feed conversion ratio, and survival rate. T3, with 9% monounsaturated fat, showed maximum growth while T0 with 0% supplementation had the minimum.

Statistical analysis indicated significantly higher weight in the 9% fat group, aligning with findings (Erdogan et al., 2012) also stated that the optimum lipid content for weight increase in young African cichlids is 9%. Poly-unsaturated fats at 6% exhibited maximum growth, in contrast to 3% and 9%.

FCR was highest in groups with 9% monounsaturated and 6% polyunsaturated fats compared to T0 with no fat supplementation. Increasing dietary fat levels improved FCR, consistent with studies on sardine oil (Lim et al., 2001) and Studies on Ctenopharyngodon idella juveniles indicate that an increase in dietary fat levels has no detrimental effects on FCR (Koprucu,

2012). Specific growth rate was highest in T3 with 9% monounsaturated fat and T5 with 6% polyunsaturated fat. Body composition analysis revealed significant impacts on crude fat, moisture, and protein. Maximum values were in T3 (9% monounsaturated) and T5 (6% polyunsaturated), while T0 (no fat supplementation) had minimum values indicating increased carcass fat with higher dietary fat levels. Same results in the fingerlings of Gilthead Sea bream (Vergara et al., 2010). The body produces triglycerides from food utilizing carbohydrate calories for immediate energy. Triglycerides, which are formed when excess calories are utilised, are kept in fat cells for later use. Triglyceride levels were highest in T3 and T5, and lowest in T0. Muscle lipid is known to be positively influenced by dietary lipid levels, according to Guler et al. (2008).

A considerable increase in fat content in fish fed the experimental diet suggests increased lipid synthesis, which may be connected to the diet's fat content. According to Du et al. (2005), grass carp's body fat content raised as dietary fat levels arose, suggesting that fish may store fat in their muscles. Therefore, the rise in dietary lipid levels in many fish species needs to be carefully considered as it may cause fish to deposit more fat. Serum parameters were also observed in present study.

Serum metabolites which were observed during the present study are total proteins, total triglycerides, total cholesterol and total glucose. Cholesterol, a waxy steroid metabolite, is present in cell membranes and circulates in the blood plasma of all animals. It plays a vital role in cell membranes and works as a precursor for sexual hormone synthesis. Some fish species experience seasonal cholesterol variations, peaking during spawning. Total cholesterol, the sum of HDL and LDL was highest in T3 and T5 with T0 showing the lowest levels. Natural water is commonly bicarbonate content.

The pH levels were carefully maintained within optimal ranges during the experiment. pH is inversely related to hydrogen ion concentration and serves as an environmental indicator, varying with photosynthetic and respiratory activities. Animals have specific pH tolerances, and water in fish culture, while not chemically pure, may exhibit acidity or alkalinity due to various substances present. Dietary lipid levels positively influenced muscle lipid, with increased fat deposition observed. Serum metabolites analysis showed variations, with total proteins highest in T3 and T5, triglycerides highest in T3 and T5, and cholesterol highest in T3 and T5. Glucose levels remained unaffected by fat supplementation. Stress and ecological changes contributed to variations in serum biochemistry, emphasizing the need for careful evaluation in fish studies. Physiochemical parameters (pH, temperature, dissolved oxygen) were maintained at optimum levels. In conclusion, monounsaturated fats at 9% exhibited optimal growth, while polyunsaturated fats at 6% showed the best performance. Overall, 9% monounsaturated plant fats are recommended for maximum growth in *Labeo rohita.*

5) CONCLUSION:

The purpose of this research was to find out how varied amounts of plant-based dietary lipids affected *Labeo rohita* development, body composition, feed utilisation, and blood metabolites. For six months, the trial was carried out in glass tanks. Seventeen fingerlings were taken in each tank and acclimatized to lab conditions for one week. Plant based diets of both polyunsaturated and

monounsaturated fats were given to fingerlings present in seven treatments T0, T1, T2, T3, T4, T5 and T6 at different levels of 0%, 3%,6% and 9%. Mono-unsaturated diet was given to fingerlings present in T1, T2 and T3 while poly-unsaturated diet was given to fingerlings present in T4, T5 and T6. Fish were fed once a day according to its body weight. Temperature, DO, pH, and other physio-chemical parameters were maintained at their optimum levels during the experiment. Weight increase, total body length, fork length, SGR, FCR, and survival rate were used to gauge growth performance. Every fifteen days, measurements were taken of the body's weight, fork length, and overall length. At the end of the experiment, the following parameters were computed for body composition: moisture, crude protein, crude fiber, crude fat, and crude ash. At the final stage of the trial, blood samples were obtained from the caudal portion of the fish for the determination of serum metabolites.

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