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Effect Vegetable Oils on Growth, Feed Utilization and Digestive Enzyme Activities of *Labeo rohita* (Hamilton 1822)

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Abstract: The present study was aimed to evaluate the effect of selected vegetable oils on growth, feed utilization and digestive enzyme activities of *Labeo rohita*. A 60-day trial was conducted using flour vegetable oils sunflower, mustard, sesame oil) and soybean oil along with control. Oils were supplemented at 10 % in the basal diet. One hundred fifty fingerlings were stocked in fifteen tanks and fed at the rate of 3 percent of body weight twice a day 1000 and 1700 hours) for 60 days.The weight gain (g), per cent weight gain and specific growth rate were significantly higher in soybean oil (60.08 and 0.78) followed by mustard oil sesame oil. Significantly the improved feed conversion ratio also showed similar trend. Similarly, gross conversion efficiency and protein efficiency ratio were also improved in the soybean oil. The amylase and protease activities did not show significant difference while lipase activity was significantly improved in control and treatments. From the present study use of the oils in basal diet promote growth, with the highest growth enhancement from soybean oil.

Keywords: Sunflower, Significantly, Efficiency, Lipase, Protease

Indian major carps *viz*. *Labeo rohita, Catla catla* and *Cirrhinus mrigala* are the prime species cultivated in the inland freshwater aquaculture systems of India. Among the three Indian Major carp species, Rohu is highly preferred by the farmers mainly due to its higher growth rate, market demands and consumer preference (Nair and Salin 2007, Mahapatra et al 2012). *Labeo rohita* is a fast-growing species and attains about 35-45 cm total length and 700-800 g weight in one year under normal conditions. Generally, in polyculture, its growth rate is higher than that of Mrigal but lower to that of catla (FAO 2009). In aquaculture, feed accounts for 60-70 percent of the entire production cost which is why cost-effective feed management is the key to farming success. For growth, reproduction and other body functions, a balanced amount of protein, fat, vitamins and minerals in fish feed is a necessity. Different types of feed ingredients are used in fish food formulation such as plant and animal-based ingredients, groundnut oil cake, rice bran, wheat flour and fish meal, etc.

Vegetable oils are used as an alternative to fish oil (Dalbir et al 2015). They are cheap and less harmful to the natural aquatic system. Further, the feed supplementation with vegetable oils will not alter the organoleptic properties of the fillets and will be highly digestible for fish. Dietary lipids play an important role as a good supplier of energy, essential fatty acids and soluble vitamins. The addition of lipids in fish feed contributes to protein sparing by increasing their digestible energy value (Ayisi et al 2019). Substitution of fish oil in aqua feeds has become inevitable due to the limited global supply of fish oil (Dalbir et al 2015). In fish diet, oils are essential compounds as they play an important key role in enhancing growth. Oils are the principal source of omega-3 and omega-6 fatty acids. In fish diet, lipids are added as per the requirement of individual species. The oils added to the fish diet act as antimicrobial, anti-oxidative and growth promoter agent. Besides, oils also enhance the palatability, digestibility and binding capacity of the feed (Yadav et al 2019). The use of vegetable oils (Soybean and linseed oils) is considered as a good source of lipid in salmonids or freshwater fish diet (Bell et al 2001, Rosenlund et al 2001, Caballero et al 2002). The marine fish species are not capable to exchange linoleic or linolenic acids of vegetable oils, into arachidonic, eicosapentaenoic (EPA) or docosahexaenoic acids (DHA). These are impotent for marine fish and are available in vegetable oils in high quantity. Provided that essential fatty acid requirements of finfishes were met, partial replacement (60-75%) of fish oil with lipid source did not affect the fish performance (feed efficiency, growth, feed intake, etc.) significantly (Turchini et al 2009). The present study was aimed to evaluate the efficacy of selected vegetable oils concerning fish growth and other feed utilization parameters.

MATERIAL AND METHODS

The study was conducted from November 8 to January 8, 2019, at MPUAT, Udaipur (Rajasthan). Fingerlings of *Labeo rohita* (Hamilton 1822) were procured from the Aquaculture Research unit MPUAT fish farm. The fingerlings were healthy and free of any infection. Initially, the fingerlings were conditioned for 15 days in fibre reinforced plastic (FRP) tanks.

Experimental detail: The experimental diet was prepared by adding selected vegetable oils in the basal diet. Treatment groups were incorporated with different vegetable oils such as sunflower (T_1), mustard (T_2), sesame (T_3) and soybean oil (T_4) each @10 percent in the basal diet. The experiment was conducted in triplicate following completely randomized design for 60 day. The dry ingredients of the basal diet (groundnut oil cake, rice bran and wheat flour) were thoroughly mixed into dough and were placed in an autoclave at 15 lbs pressure for 30 minutes. After cooling, vegetable oil and mineral mixture were added and pellets were prepared by using a hand pelletizer. Thus, the prepared vermicelli (2.0 mm diameter) was air-dried and stored in airtight containers (Table 1). The experiment was conducted in 200-liter rectangular plastic tanks. Each tank was washed before the introduction of fish. All the experimental tanks were cleaned and filled with filtered tube well water. Each tank was stocked with 5 fingerlings of almost in equal size. The experimental fish were fed @ 3 per cent of body weight twice a day (10 00 and 1700 hours) in two split-dosages for 60 days.

Water quality sampling: The quality of experimental waters (i.e. temperature, pH, dissolved oxygen, alkalinity, electrical conductivity and total dissolved solids) was monitored on the initial day and subsequently after every 15 days. Water quality parameters were analysed following the standard methods of APHA (2005).

Growth parameters: At the end of the experiment, all the fishes from experimental tanks were harvested with a hand net. The weight of individual fish was measured. The growth parameters were calculated.

Weight gain (g) = Final weight (g) – Initial weight (g)

$$\text{Specific growth rate \%} = \frac{(\text{Log Wt} - \text{Log W0})}{\text{D} \times 100}$$

Where, Ln = Natural log; W_0 = Initial fish weight (g); W_t = Final fish weight (g); D = Duration of feeding (days)

$$\text{Gross conversion efficiency} = \frac{\text{Weight gained (g)}}{\text{Food given (g)}}$$

Feed utilization parameters: The feed utilization parameters such as feed conversion ratio (FCR) and protein efficiency ratio (PER) were calculated.

$$\text{Feed conversion ratio} = \frac{\text{Food given (g)}}{\text{Weight gain (g)}}$$

$$\text{Protein conversion efficiency} = \frac{\text{Total wet weight gained}}{\text{Crude protein fed (\%)}}$$

Digestive enzyme activities: Lipase was analyzed by the method of Cherry and Crandall (1932). Protease was analyzed by the casein digestion method Drapeau (1997) while amylase was determined by the dinitro-salicylic-acid (DND) method of Rick and Stegbauer (1974).

Energy value of diet: The energy value of experimental diet was calculated by method of Halver (1976).

Energy (kcal/100g) = protein (%) x 4.5 + lipid (%) x 9.5 + carbohydrates (%) x 4.

Statistical analysis: The data were statistically analysed by using SPSS 16.0.

Table 1. Feed composition (Ingredients g/kg)

Particular	Experimental diet				
Diet Ingredients (g/100g)	T_0	T_1 (Sunflower oil)	T_2 (Mustard oil)	T_3 (Sesame oil)	T_4 (Soybean oil)
Basal diet*	100	90	90	90	90
Vegetable oils**	00	10	10	10	10
Total	100	100	100	100	100
Proximate composition (%)					
Moisture	10.40	10.28	10.23	10.18	9.87
Crude protein	24.56	23.52	23.34	23.29	23.48
Fat	7.58	17.38	17.30	17.25	17.42
Ash	6.40	6.34	6.45	6.24	6.20
Carbohydrates	61.46	52.76	52.76	53.22	52.60
Energy (kcal/100g)	428.37	481.99	480.42	481.55	481.55

*Basal diet constitutes groundnut oil cake, rice bran, wheat flour which was taken in the ratio of 40: 40: 20, respectively.
**Vegetable oils: Sunflower oil; Mustard oil; Sesame oil; Soybean oil

RESULTS AND DISCUSSION

Water quality: The water quality did not differ significantly in different treatments (Table 2).

Growth

Weight gain (g): The net weight was significantly higher in treatments than t in T_0 (4.017g). The significantly higher growth was in T_4(7.417g) followed by T_2, T_3, T_1 and T_0 (Table 3). The significantly higher growth rate in vegetable oil supplemented diet fed fish has also been reported by different workers (Abbas 2007, Dalbir et al 2015, Zupan et al 2016).

Weight gain (%): The per cent weight gain was significantly higher in all treatments than in T_0(32.71%). The significantly higher growth was in T_4(60.076%) followed by T_2, T_3, T_1 and T_0 (Table 3). Zupan et al (2016) also concluded that the soybean oils significantly increase the fish per cent weight.

Specific growth rate: The specific growth rate was significantly increased in treatment. The significantly higher growth was in T_4(0.784) followed by T_2, T_3, T_1 and T_0 (Table 3). Gandotra et al (2017) also concluded the vegetables oils directly impact the fish growth parameters like SGR, FCR, and GCE etc.

Gross conversion efficiency: The gross conversion efficiency was significantly higher in all treatments than in T_0 (0.16g). The significantly higher growth was in T_4 (0.27g) followed by T_2, T_3, T_1 and T_0 (Table 3). Figueiredo et al (2005) also observed that replacement of fish oil with soybean oil had no adverse effect on fish gross conversion efficiency.

Feed utilization parameters: The feed utilization was significantly different among all treatments.

Feed conversion ratio: The feed conversion ratio was significantly higher in control diet (T_0) as compared to other treatments (T_4 T_2, T_3 and T_1). The significantly higher growth was in T_4(3.76) followed by T_1, T_3, T_2 and T_0 (Table 3).

Protein efficiency ratio: The minimum (0.163) and maximum (0.322) PER were in T_0 and T_4 respectively. PER within treatments and between treatments were significantly different (Table 3). Parallel results have been found for turbot fed a soybean oil (SO) containing diet after a re-feeding period of 8 weeks with a 100 per cent fish oil diet.

Digestive enzyme: Activity of amylase and protease did not show significant difference while lipase activity was significantly different among the experimental groups. The lipase activity was significantly higher in treatment groups than that of those in T_0. The lowest (0.79) and highest (3.35) lipase were in T_0 and T_4. In fish, protease is a major group of digestive enzyme which hydrolyzes the bonds of peptide

Table 4. Effect of selected vegetable oils on amylase, protease and lipase in intestine of *L. rohita*

Treatments	Amylase (min/gm/protein)	Protease (min/gm/protein)	Lipase (mg protein)
T_0	4.69	0.202	0.79
T_1	4.51	0.240	1.45
T_2	4.09	0.238	1.26
T_3	4.88	0.233	1.17

Table 2. Range of selected water quality parameters

Parameters	T_0	T_1	T_2	T_3	T_4
Temperature (^{0}C)	14.8-23.5	14.7-23.5	14.7-23.7	14.9-23.7	14.9-23.8
pH	8.0-8.4	8.0-8.3	7.9-8.4	8.0-8.3	8.0-8.3
Alkalinity (mg/l)	110-140	120-130	120-130	110-140	112-134
Dissolved oxygen (mg/l)	5.6-8.8	4.8-8.0	4.8-8.0	5.6-7.2	5.6-8.0
TDS (mg/l)	830-920	850-990	810-930	840-950	840-940
EC (μS/cm)	1640-1950	1700-1960	1700-1950	1710-1960	1700-1920

Table 3. Summary data on growth performance of *L. rohita* fed with different vegetable oils supplementation diet

Treatments	Parameters							
	Initial weight (g)	Final weight (g)	Net weight gain (g)	Per cent weight gain	SGR	FC R	GCE	PER
T_0	12.27	16.29	4.017	32.711	0.472	6.22	0.161	0.163
T_1	12.29	17.33	5.040	41.020	0.573	5.10	0.196	0.235
T_2	12.32	19.06	6.737	54.666	0.727	4.06	0.246	0.276
T_3	12.29	18.07	5.787	47.7110	0.643	4.56	0.220	0.264
T_4	12.28	19.69	7.417	60.076	0.784	3.76	0.266	0.322

Mean value in the same column sharing different superscripts are significantly different ($P<0.05$)

among neighboring amino acids in protein. The intestinal protease activity was higher than hepatic protease. This was in agreement with the result of earlier scientist (Kumar et al 2007, Bishnoi et al 2017). Due to the supplementation of vegetable oils, the protease activity in experimental treatments was significantly higher than that in T_0 (Table 3). The highest (0.289) protease activity was in T_4 and minimum in T_0 (0.202). In the present study, the supplementation of vegetable oil (@10 per cent in fish diet enhanced the activity of protease. Kumar et al (2007) also observed similar protease profile in different carp species. The improve activity of amylase was also observed in the present study, the minimum and maximum amylase activity was in treatment T_0 (4.6) and T_4 (4.09). Similar findings was found by (Ojha et al 2014, Bishnoi et al 2017).

CONCLUSION

The application of soybean oil in carp diet is most suitable because comparatively higher growth performance, improved growth parameters, proximate composition and digestive enzyme activities were recorded in soybean oil. Thus it is recommended that the use of soybean oil @10 per cent in fish diet for better growth. However, further field studies on different species and testing of different levels are also recommended.

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