Fisheries and Aquaculture Journal
ISSN: 2150-3508

Gandotra et al., Fish Aqua J 2017, 8:3
DOI: 10.4172/2150-3508.1000210

Research Article Open Access

Growth Response of Juveniles of Rohu, *Labeo Rohita* to Different Levels of Lipid in the Diet

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Received date: April 06, 2017; **Accepted date:** July 03, 2017; **Published date:** July 10, 2017

Abstract

Present study was conducted to study the effect of varying level of dietary lipid on the growth, Feed conversion ratio (FCR) and body composition of the juveniles of *Labeo rohita*. Group of 25 juveniles in triplicate (average weight 0.022 gm ± 0.002 gm) were fed on three iso-nitrogenous experimental diets containing (40% protein) and varying levels of lipid i.e., 6%, 9% and 12% for a period of 60 days. Results revealed that the best increment in growth was obtained with 9% supplementary lipid (%WG 26.08 ± 0.681) followed by the diet containing 12% lipid (%WG 23.41 ± 1.646) and least with 6% lipid (%WG 22.71 ± 1.540). FCR and FCE shows inverse relation as highest value of FCE (9.35) and least value of FCR (10.70) was obtained in juveniles fed on 9% lipid diet with significant differences ($p \leq 0.001$). Further biochemical analysis revealed that highest value of muscle lipid has been found in juveniles fed on 9% lipid diet i.e., 1.11 gm and least with diet containing 6% lipid i.e., 0.78 gm. Thus, based on the present results, it could be concluded that an artificial feed with 9% supplemented fish oil is sufficient without any adverse effects on growth performance and muscle quality.

Keywords Dietary lipid levels; Weight gain; Feed conversion ratio; Fish oil; Percentage weight gain (WG); *Labeo rohita*

Introduction

Lipids are a group of natural organic compounds that comprise of fats, oils, phospholipids and sterols. As a necessary nutrient, lipid is assimilated by fish for tissue remodelling and new tissue growth [1]. Dietary lipid play a major role in providing a good source of concentrated energy, essential fatty acids and fat soluble vitamins as the fishes have a limited ability to utilize carbohydrates as an energy source. Apart from this, dietary lipid play an important role to spare proteins, thereby providing essential fatty acids needed for the proper functioning of many physiological processes and maintenance of membrane fluidity and permeability as well as for growth and survival [2].

Requirement of fatty acids vary considerably from species to species. Fish generally require omega-3 (linoleic acid) while terrestrial animals prefer omega-6 (linoleic acid) fatty acids. Fish oil is the main source of lipid used in the formulation of commercial aqua feeds, providing essential n-3 fatty acids. A recent trend in fish feeds is to use higher levels of lipids in the diet. Although increasing dietary lipids can help reduce the high costs of diets by partially sparing protein in the feed, problems such as excessive fat deposition in the liver can decrease the health and market quality of fish. Thus the objective of the present study was to find out the suitable lipid level for the juveniles of *Labeo rohita* and also to evaluate the effect of lipid level on the rate of growth and body composition.

Material and Methods

Experimental fish and acclimatization

Juveniles of *Labeo rohita* were brought from Nawabad fish farm in Jammu City and brought to the Department of Zoology, University of Jammu, where they were kept in plastic troughs of 20 L capacity. Fingerlings captured, were then acclimated in plastic troughs at a temperature of about 22-25°C for about 7 days and were fed on a mixture of rice bran and mustard oil cake.

Experimental diets

Three iso-nitrogenous diets with 40% crude protein were formulated to contain three lipid levels (6%, 9% and 12%) shown in Tables 1-3. Control diet was not supplemented with fish oil and contain 6% lipid from feed ingredients, while the other two experimental diets contained two supplemental levels of fish oil (9% and 12%). Dietary ingredients were ground into fine power and passed through the sieve. Distilled water and fish oil were added to the premixed dry ingredients and dough was made. Using a hand pelletizer 0.5 mm thick pellets were obtained and dried in oven at 40°C.

Experimental design

Juveniles of *Labeo rohita* at the beginning of experiment were stocked at a density of 25 in each plastic trough of 20 L capacity in triplicates. The experiment was conducted for 60 days. Initial weight and proximate composition of muscle of fish were determined prior to the commencement of the experiment. Juveniles of *Labeo rohita* were fed at 5% of their body weight twice daily. The left over feed and excreta were removed on every second day by siphoning method separately from each tub. Before stocking, weights of the fingerlings were recorded.

Measuring indices and methods

Weight gain=Final weight (g)-Initial weight (g).

Specific growth rate (SGR)=In final weight (g)-In initial weight (g) × 100/time (days).

Feed conversion ratio=Diet fed (g)/total weight gain (g).

PER=Increment in body weight (g)/Protein intake (g).

Analysis

At the end of the experiment (after 60 days), juveniles were observed for weight increment followed by biochemical analysis. Proximate composition of the feed ingredients and experimental diets were determined in the laboratory using standard methods. The crude protein and lipid contents of feed ingredients were determined by Lowry method and Folch method. The ash content was determined by first igniting the sample and then heating it in the muffle furnace at 550°C (± 10°C) for 6 h [3]. Crude fibre was determined by acid and alkali digestion [4].

Statistical analysis

Differences between treatments were analysed using independent-measures one-way ANOVA. The values were expressed as mean ± SE. values $p<0.05$ were considered as significant and p values <0.001were considered as highly significant p.

Ingredients	Wt. in grams	% contribution					
		Crude protein	Crude lipid	Ash	Moisture	Crude fibre	Nitrogen free extract.
Fishmeal	38	18.7	3.08	8.57	2.7	0.625	1.175
Soybean	26	8.91	1.14	2.6	1.72	1.753	6.12
Mustard oil cake	22	10.33	1.4	3.39	1.81	1.684	5.881
Rice bran	5	0.55	0.16	0.65	0.21	1.055	1.625
Wheat bran	8	0.53	0.01	0.82	0.32	0.143	3.27
Vitamins+minerals	1	1	-	-	-	-	-
Total	100	39.02	5.79	16.03	5.261	5.261	18.071

Table 1: Showing the proximate contribution of ingredients in diet containing 40% protein and 6% lipid.

Ingredients	Wt. in grams	% contribution					
		Crude protein	Crude lipid	Ash	Moisture	Crude fibre	Nitrogen free extract
Fishmeal	39	19.7	3.08	8.57	2.7	0.642	1.206
Soybean	26	8.91	1.12	2.6	1.72	1.753	6.12
Mustard oil cake	21	10.33	1.38	3.39	1.81	1.604	5.614
Rice bran	4	0.45	0.15	0.65	0.21	0.851	1.3
Wheat bran	6	0.53	0.08	0.32	0.32	0.115	2.615
Fish oil (FO)	3	-	3	-	-	-	-
Vitamin+minerals	1	1	-	-	-	-	-
Total	100	39.92	8.81	16.03	6.76	4.965	16.855

Table 2: Showing the proximate contribution of ingredients in diet containing 40%protein and with 9% lipid.

Ingredient	Wt. in grams	% contribution					
		Crude protein	Crude lipid	Ash	Moisture	Crude fibre	Nitrogen free extract
Fishmeal	39	19.7	3.08	8.57	2.7	0.642	1.206
Soybean	26	8.91	1.12	1.14	1.72	1.753	6.12
Mustard oil cake	21	10.33	1.38	2.4	1.81	1.604	5.614

Rice bran	4	0.55	0.15	0.65	0.21	0.851	1.3
Wheat bran	6	0.53	0.08	0.82	0.32	0.115	2.615
Fish oil (FO)	3	-	6	-	-	-	-
Vitamins+minerals	1	1	-	-	-	-	-
Total	100	39.92	11.81	16.03	6.76	4.965	16.855

Table 3: Showing the proximate contribution of ingredients in diet containing 40% protein and with 12% lipid.

Results and Discussions

Growth

Growth parameters of juveniles of *Labeo rohita* are shown in Table 4, it is clear that fish fed on diet containing 9% supplemented lipid attained a maximum weight of 0.120 ± 0.002 gm, while those fed on diet containing 12% reached 0.103 ± 0.003 gm and fish fed on control diet attained 0.097 ± 0.006 gm in 60 days. The statistical evaluation of results revealed that fish fed on diet containing 9% fish oil had significantly ($p<0.05$) higher weight followed in a decreasing order ($p<0.05$) by the 12% and the control group [5].

Specific growth rate

The value of the Specific Growth Rate was calculated at the termination of the experiment and the highest value for the SGR was found to be the diet 9% (0.253 ± 0.010) followed by diet 12% (0.231 ± 0.042) and least with diet 6% (0.184 ± 0.038). Similarly, Jafri et al. [6] while working on the fingerlings of *Cirrhinus mrigala* (Ham.) recorded the best SGR in the group of fishes fed with 5 to 7% dietary lipid as compare to 3%, 9%, 11% and 13%. Gumus and Ikiz [6] also evaluated that 6% dietary lipid to be effective in the diet of rainbow trout, *Oncorhynchus mykiss*. Similarly, Erdogan et al. [7] reported that 9% lipid is the optimum level for weight gain in juvenile African cichlids (*P. socolofi* and *H. ahli*).

Feed conversion ratio and feed conversion efficiency

In the present investigation the best FCR and FCE were obtained in experimental groups fed on diet containing 9% lipid level i.e., 10.70 ± 0.508 and 9.35 ± 0.462 followed by 11.21 ± 2.039 and 9.14 ± 1.835 in 12% and poorest i.e., 14.02 ± 3.328 and 7.37 ± 1.555 in diet 6%. Thus, the present finding clearly shows that there is significant difference ($P<0.05$) among diet Control (6%) and fish oil supplemented diets 9% and 12%. However, diet containing 9% shows best results. Through the present finding it can safely informed that FCR could be improved by increasing dietary lipid levels. Similarly, Chou et al. [8,9] reported that supplementation of diet with sardine oil shows improved FCR. Koprucu [10] observed in juveniles of *Ctenopharyngodon idella* that increase in dietary lipid level does not shows any negative effect on FCR. That might be due to increase in dietary lipid helps in protein sparing and also in best feed utilization.

Protein efficiency ratio

The value of protein efficiency ratio was found to be maximum for the fingerlings fed on diet 9% i.e., 0.246 ± 0.011, followed by diet 12% i.e., 0.241 ± 0.048 and least with diet 6% i.e., 0.194 ± 0.041.). PER is an indicative of the lipid level that gives optimal growth at a particular protein level. In this study, with increasing dietary lipid level, the PER tended to increase up to a certain level and then decrease. It shows that high dietary level could improve the utilization of protein in feed. This study shows the improvement in growth and PER with increasing dietary lipid level.

Proximate composition

Biochemical analysis of fish whole body are shown in Table 5, there was no significant differences ($p>0.005$) in protein content between fish fed on 9% lipid level and 12% lipid level. In the present study, the highest value of muscle lipid has been found in the fingerlings fed on diet R2 i.e., 1.11 and least with diet R1 i.e., 0.78%. This shows that with the increase in dietary lipid level, the carcass lipid content also goes on increasing. Similar trend has also been found by [11]. Similarly, Du et al. [12] reported that body lipid content of grass carp increased with increase in dietary lipid levels, indicating that this fish could deposit lipid in the muscle. Thus in many fish species, the increase of dietary lipid levels should be evaluated carefully for it may lead to increased fat deposition in fish. Koprucu [10] reported an increase in carcass muscle lipid with increasing dietary lipid levels (Figures 1 and 2).

Growth parameters	% Of Lipid In Diet		
	6% (R1)	9% (R2)	12% (R3)
No. of Fishes	25	25	25
Initial Average Weight	0.430 ± 0.001	0.435 ± 0.002	0.439 ± 0.003
Final Average Weight	0.527 ± 0.006	0.580 ± 0.001	0.541 ± 0.003
Weight Gain	0.097 ± 0.006	0.120 ± 0.002	0.103 ± 0.006
% Weight Gain	22.71 ± 1.540	26.08 ± 0.681	23.41 ± 1.646
Survival	93.56 ± 1.63	95.76 ± 1.190	93.51 ± 0.057
Specific Growth Rate	0.184 ± 0.038	0.253 ± 0.010	0.231 ± 0.042
Feed Conversion Ratio	14.02 ± 3.328	10.70 ± 0.508	11.21 ± 2.39
Feed Conversion Efficiency	7.37 ± 1.55	9.35 ± 0.462	9.14 ± 1.835
Percentage Efficiency Ratio	0.194 ± 0.001	0.246 ± 0.002	0.241 ± 0.001

Table 4: Showing various growth parameters of the juveniles of *Labeo rohita* fed on diets containing varying levels of lipid.

The proximate moisture content shows inverse relation with dietary lipid levels. It was maximum in diet R1 i.e., 71.33% and minimum i.e., 70.30% in diet R2.

Ash content almost showed similar value of 1.48, 1.40 and 1.43 respectively.

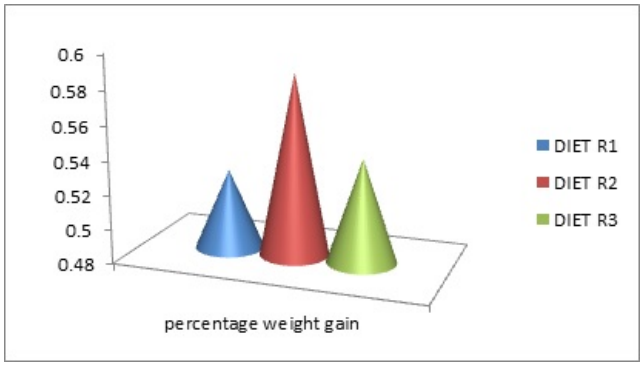

Figure 1: Showing increment in weight of the juveniles of *Labeo rohita* fed on different lipid diets.

Diets	Crude Protein	Crude Lipid	Moisture	Ash
R1	7.61	0.78	71.33	1.48
R2	8.19	1.11	70.3	1.4
R3	8.1	1.06	70.46	1.43

Table 5: Showing proximate composition of the muscle of juveniles of *Labeo rohita* fed on different lipid diets.

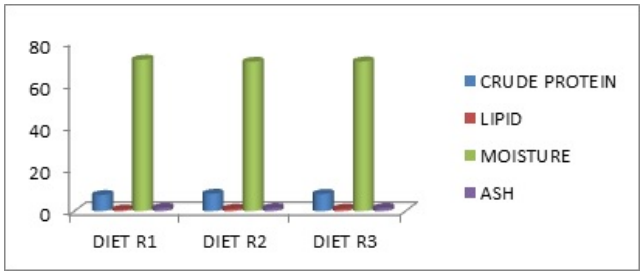

Figure 2: Showing proximate composition of muscle of *Labeo rohita* fed on different lipid diets.

Present study thus suggest that supplementation of dietary lipid up to 9% could support good growth of the juveniles of *Labeo rohita*. Dietary lipid above 9% can have negative effects in the growth.

References

1. John R, Douglas RJ, Gordon B (2002) Fish nutrition. Copyright: Elsevier Science, USA. 181-258.
2. Stickney RR, Hardyn RW (1989) Lipid requirements of some warm water species. Aquaculture 79: 145-156.
3. AOAC (1995) Official Methods of Analysis. 16th edn. Association of Official Analytical Chemists, Washington DC, USA.
4. Pearson D (1976) The chemical analysis of foods, 7th edn. Churchill living stone, London.
5. Jafri AK, Anwar MF, Usmani N, Samad R, Alvi AS (1995) Influence of dietary lipid levels on the growth and body composition of fingerlings of an Indian major carp, Cirrhinus mrigala (Ham.). J Aqua Trop 10: 151-15.
6. Gumus E, Ikiz R, (2009) Effect of dietary level of lipid and carbohydrate on growth performance, chemical contents and digestibility in rainbow trout, Oncorhynchus mykiss Walbaum. Pak Vet J 29: 59-63.
7. Erdogan F, Erdogan M, Gumus E (2012) Effects of dietary protein and lipid levels on growth performances of two African cichlids (Pseudotropheus socolofi and Haplochromis ahli). Turkish journal of fisheries and aquatic sciences 12: 635-640.
8. Chou BS, Shiau SY (1996) Optimal dietary lipid level for growth of hybrid tilapia (Oreochromis niloticus × Oreochromis aureus). Aquaculture 143: 185-195.
9. Lim PK, Boey PL, Ng WK (2001) Dietary palm oil level affects growth performance, protein retention and tissue vitamin E concentration of African catfish, Clarias gariepinus. Aquaculture 202: 101-112.
10. Koprucu K (2012) Effects of dietary protein and lipid levels on growth, feed utilization and body composition of juvenile grass carp (Ctenopharyngodon idella). 6: 243-251.
11. Vergara JM, Robaina L, Izquierdo MS, De la Higurea M (1996) Protein sparing effect of lipids in diets for fingerlings of gilthead sea bream. Fish Sci 62: 624-628.
12. Du ZY, Liu Yj, Tian LX, Wang JT, Wang, et al. (2005) Effect of dietary lipid level on growth , feed utilization and body composition by juvenile grass carp (Ctenopharyngodon idella). Aquaculture Nutrition 11: 130-146.