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Effect on growth performance and proximate composition of juveniles of *Cirrhinus mrigala* fed on varying levels of protein

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Abstract
Present study was conducted to evaluate the impact of varying levels of dietary protein on the growth and proximate composition of the juveniles of *Cirrhinus mrigala* (0.228±0.002). Five iso-nitrogenous diets containing 25%, 30%, 35%, 40% and 45% protein was formulated and fed @ 5% of the body weight to the juveniles of *Cirrhinus mrigala* for the period of 90days. The results showed that growth performance in terms of weight gain (WG), specific growth rate (SGR), Food conversion ratio (FCR) and Food conversion efficiency (FCE) was best found in juveniles fed on 40% protein diet. It was observed that FCR reduced as dietary protein level increased while FCE increased with increase in the percentage of protein in the diet. The minimum FCR was found to be 14.48 at 40% protein diet and maximum was 81.3 at 25%. Also FCE was minimum i.e. 1.88 at 25% and maximum to be 6.8 at 40%. SGR was found to be 0.300, 0.391, 0.45, 0.833 and 0.547 in 25%, 30%, 35%, 40% and 45%. Proximate composition of body revealed that dietary protein significantly affect the body protein level. Juveniles fed on 40% protein diet obtain a significant ($p<0.001$) higher body protein as compared to other diets. Thus the present findings suggest that a practical diet having 40% protein provide sufficient nutrients and energy to support the acceptable growth in the juveniles of *Cirrhinus mrigala.*

Keywords: dietary protein, food conversion ratio, specific growth rate, *Cirrhinus mrigala*

Introduction
Aquaculture is playing a great role in the welfare of mankind. It is one of the most viable and promising industry which provides notional and food security for humans. It's one of the fastest growing industry in the world (FAO, 1997) [5]. The intensification of fish culture has led to the dependence on artificial feeds.

Protein is one of the major organic material in fish tissue and form an important component of the diet. One of the major requirement of fish culture is the efficient transformation of dietary protein into tissue protein (Webster and Lim, 2002) [28]. If adequate protein is not provided in the diet, there is rapid reduction or cessation of growth and a loss of weight due to withdrawal of protein from less vital tissues to maintain the functions of more vital tissues. On the other hand, if too much protein s supplied in the diet, only part of it will be used to make new proteins and remainder will be catabolized to produce energy (Alatise *et al.*, 2006) [1].

Thus optimization of fish production requires research into feeding techniques which promotes growth and at the same time reduces the quantity of waste products released in water (Singh *et al.*, 2005) [26]. Similarly, Kalla *et al.* 2003 [14] reported that determination of optimum dietary protein level is important to get highest growth and reduce the water deterioration problems related with supplementary feed intake of the fish.

Material and Methods
Experimental fish and acclimatization.
Juveniles of *Labeo rohita* were brought from Gho-manasas fish farm in Jammu City and brought to lab in 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 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 @ 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, weight of the fingerlings were recorded.

Measuring indices and methods
1. Weight gain = Final weight (g) – Initial weight (g).
2. Specific growth rate (SGR) = in final weight (g) – In initial weight (g) × 100/ time (days).
3. Feed conversion ratio = Diet fed (g)/ total weight gain (g).
4. Feed conversion efficiency = [(Gain in wet weight of fish / feed fed)] ×100.

Biochemical 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 660ºC (±10ºC) for 6h (AOAC, 1995) [2].

Statistical Analysis

Differences between treatments were analyzed using independent-measures one-way ANOVA. The values were expressed as mean ± SE. values $p<0.005$ were considered as significant and p values <0.001were considered as highly significant *p*.

Table 1: Proximate composition of different ingredients used in formulated diets for juveniles of *Cirrhinus mrigala*

Ingredients	Dry matter	Crude protein	Crude lipid	Ash	Moisture	Crude fibre	Nitrogen free extraxt
Fish meal	92.88	56.00	6.10	7.94	7.90	2.36	14.58
Rice bran	91.73	11.82	10.11	10.12	7.80	14.12	32.52
Soybean	92.67	36.02	7.21	10.97	7.30	7.29	23.01
Wheat bran	92.60	8.02	2.01	20.01	7.29	7.66	27.64
Mustard oil cake	91.70	37.39	8.92	19.63	8.32	7.85	25.42

Table 2: Proportion (%) of different ingredients used in formulated diets

Ingredients	25%	30%	35%	40%	45%
Fishmeal	….	26.00	32.00	38.00	46.00
Rice bran	49.50	20.00	15.00	05.00	02.00
Wheat bran	……	24.00	15.00	05.00	02.00
Soy bean	……	15.00	22.00	24.00	24.00
Mustard oil cake	49.50	14.00	18.00	22.00	25.00
Vegetable waste	……	….	05.00	05.00	……
Vitamin and mneral premix	01.00	01.00	01.00	01.00	01.00
Total	100	100	100	100	100

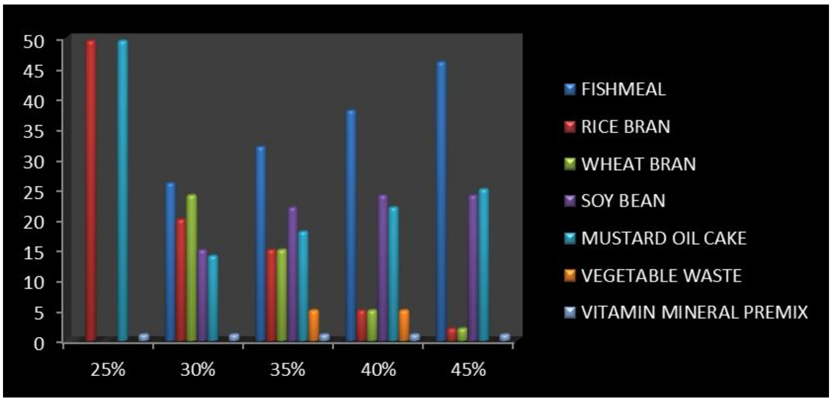

Fig 1: Proportion (%) of different ingredients used in formulated diets

Table 3: Showing the Initial weight, Final weight, Weight gain, Specific growth rate, Feed Conversion Ratio and Feed Conversion Efficiency of fingerlings of *Cirrhinus mrigala*

Growth parameters	25%	30%	35%	40%	45%
Initial average weight	0.228± 0.022	0.247± 0.005	0.247 ±0.005	0.248± 0.003	0.245 ±0.008
Final average weight	0.397 ±0.021	0.518 ±0.005	0.557± 0.005	0.732± 0.050	0.716± 0.058
Percentage weight gain	74.78 ±52.15	109.44± 9.803	119.10± 16.05	194.86± 22.04	192.04± 14.70
Specific growth rate	0.300± 0.140	0.391± 0.096	0.451± 0.148	0.833± 0.314	0.547± 0.046
Food conversion ratio	81.3± 7.48	32.97± 6.521	22.90± 2.399	14.48± 0.365	14.92± 0.472
Food conversion efficiency	1.88 ±1.111	3.10± 0.554	4.39 ±0.442	6.89± 0.174	6.69 ±0.205

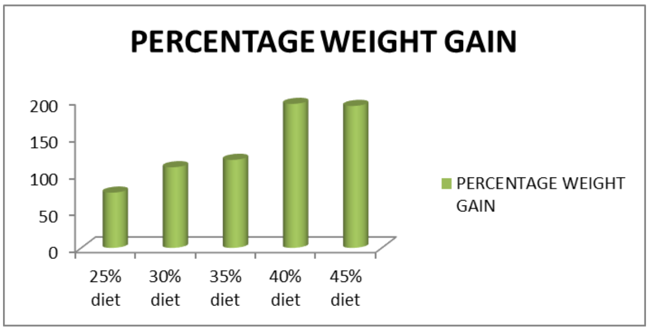

Fig 2: Showing Percentage Weight Gain (PWG).

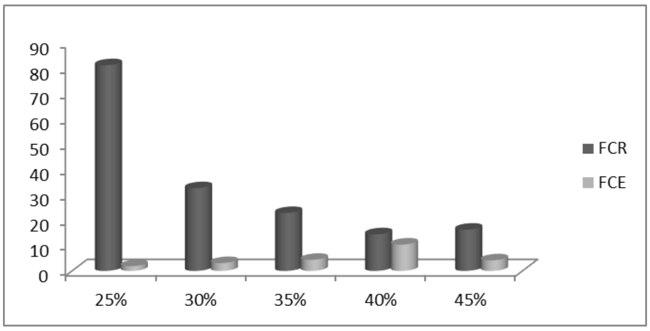

Fig 3: Showing FCR and FCE

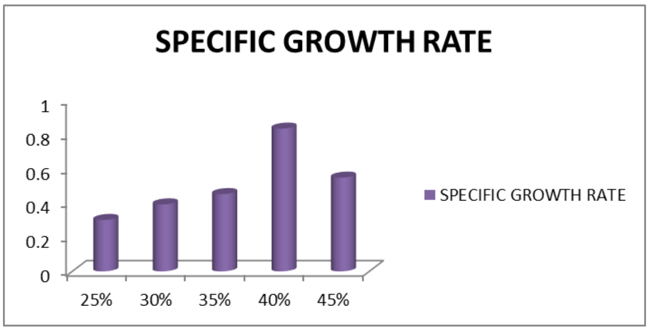

Fig 4: Specific Growth Rate (SGR)

Nutrition super forte (Rejuvenating combination of multivitamin and multi minerals,

Table 4

Vitamin A 700, 0001. U	Vitamin D 3140, 0001. U	Folic acid 100mg
Vitamin E 250mg	Niacin amide 100mg	Iron 1500mg
Iodine 325mg	Cobalt 150mg	Magnesium 6000mg
Manganese 1500mg	Zinc 3000mg	Selenium 10mg
Potassium 100mg	Sulphur 7.2gm	Calcium 250gm
Phosphorous 130gm	Copper 1200mg	Fluorine 300mg

Nutrition super forte (Rejuvenating combination of multivitamin and multi minerals, AROSOL chemicals PVT. Limited).

Table 5: Showing proximate contribution of muscle of juveniles of *Cirrhinus mrigala* at different protein level

Diets	Crude protein	Crude lipid	Moisture	Ash
25%	8.92	0.74	73.98	1.10
30%	9.03	0.73	72.09	1.22
35%	9.37	0.71	71.10	1.34
40%	9.70	0.66	70.01	1.40
45%	9.64	0.63	71.29	1.49

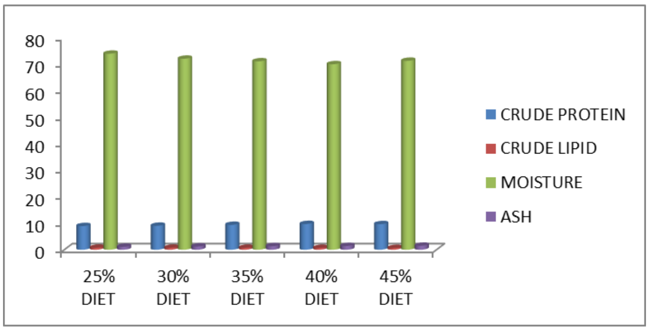

Fig 4: Showing biochemical contribution of muscle of juveniles of *Cirrhinus mrigala* at different protein level

Results and discussion

Growth performance of the juveniles of *Cirrhnus mrigala* fed on diets containing graded levels of protein over the 90 day feeding experiment was presented in Table no.3. No mortality was observed among the dietary treatment levels during the entire length of feeding trail. Growth paramneters like weight (WG), Specific growth rate (SGR), Food conversion ratio (FCR) were found to be significantly affected with the increase of dietary protein level in the diets.

Present study on growth performance of juveniles of *Cirrhnus mrigala* in response to diets with varying levels of protein viz. 25%, 30%, 35%, 40% and 45% for a period of 90 days shows that fish juvenile fed on 40% protein attained best growth, while 25% (control) protein diet exhibited least growth. On the basis of the net weight gain, the following trend emerged 40%

> 45% > 35% > 30% > 25%. Therefore inclusion of 40% protein in the diets for the juveniles of *Cirrhnus mrigala* is more appropriate and economical. A decrease in growth rate above the optimum level may be attributed to the fact that fish body cannot utilize the dietary protein once after reaching the optimum protein level (Jauncey *et al.* 1982) [12]. Excess protein could reduce the growth performance of fish due to higher energy requirement for catabolism rather than for protein deposition. Decrease in weight gain after the optmum level of protein may also be attributed due to inadequate non-protein energy necessary to deaminate the high protein feed (Kim *et al.*, 2002, Jobling *et al.*, 1983) [18, 13]. Similar reports have also been suggested by Lee *et al.* 2002 [18].

Specific growth rate

In the present study, SGR was found to be significantly lower ($p<0.05$) for the fish fed on 25% protein diet which increased with increasing protein level and maximum SGR was found to be for the fish fed on 40% protein level diet. (Table 3, fig 4). It has also been observed the above the optimum level of protein the value of SGR falls. These results agree with the findings of Gazala *et al.* (2011) and Ebrahimi and Ouraji (2010) [9] who reported increased SGR with increasing dietary protein level from 32% to 42%. Similar trend has also been reported by Gandotra *et al.* 2014 [8].

Food conversion ratio

During the present investigation, it has been observed that FCR decreases with increase in the protein level in the diet. The highest value of FCR was obtained with fish fed on 25% protein diet i.e 81.3 and lowest with 40% diet i.e 14.48 (Table 3, Fig3) although not significantly above 40%. Similar trend has also been reported by Ghazala *et al.* (2011) [10], Otchoumou *et al.* 2012 [22], Gandotra *et al.* (2015) [7]. It may be due to the fact that the more suitable the diet, the less feed is required to produce a unit weight gain i.e lower FCR.

Food conversion efficiency

During the present course of study, FCE increases with increase in protein level up to 40% and then decreases but not significantly. This illustrates that the protein consumed by fish is used efficiently to increase the growth as compared to fishes fed on other proportions of protein levels. Previous work done by Gandotra *et al.* 2014 [8], Sawhney and Gandotra (2010) [24] also reported the similar trend.

Proximate composition of fish muscle fed by different dietary protein levels.

In fishes, the proximate composition of muscle (moisture, protein, lipid, ash etc.) is affected by development stage, sexual maturity, spawning, environmental conditions and the type of food ingested (Table 4, Fig 4). The effectiveness of formulated feeds with different nutrient composition on the fish body composition varies between species and also among the individual of the same species (Love *et al.*, 1959; Srikar *et al.*, 1979) [19, 27].

Protein

The maximum deposition of protein was obtained in diet (40%), but thereafter no increment was observed above 40% protein diet. Similar trend had been reported by Ogino and Saito (1970) [21], Yang *et al.* (2002) [29]. The increase in carcass protein with increase in dietary protein level up to 40% is due to the increase in protein utilization and digestibility which decreases with the increase in the protein level above the optimum level.

Lipid

The carcass lipid composition decreases with increasing dietary protein levels. In the present investigation on juveniles of *Cirrhinus mrigala*, the lipid was estimated to be highest i.e., 0.74% in fish fed by 25% diet and it goes in decreasing order 0.73%, 0.71%, 0.66% and 0.63% at 30%, 35%, 40% and 45%. These values clearly reveal that there is insignificant differences (P>0.005) in carcass lipid composition among the fishes fed on different dietary protein levels (25-45%). Khan *et al.,* (1993) [16] reported in *Mustus nemurus* reported higher lipid levels in fish fed with the 470 and 500kg^{-1} protein diets, which they attributed to the possibility of the excess dietary protein being deaminated and stored as body fat. However, studies of Siddiqui *et al.,* (1988) [25] observed that the dietary lipid content did not appear to have a significant effect on the body lipid content on Nile tilapia.

Moisture

During present course of investigation (Table-20 fig 23) on biochemical analysis of fish muscle after 60 days of feeding on various dietary protein depicts that the moisture content of flesh was highest i.e.,73.98% in 25% diet, followed by 72.09% in 30% diet,71.10% in 35% diet, 71.01% in 40% diet and 70.01 in 40% diet. The carcass moisture content exhibited inverse relationship with the carcass lipid and also with the dietary lipid level. Similar observations have been reported by Kausch and Ballion-Cusmano, 1976; Dabrowska and Wojna, 1977 [3]; Grayton and Beamish, 1977 [11].

Ash

The ash content represents the total inorganic matter as mineral constituents. In the present study, ash content of the fish muscle estimated on dry basis from ranged from 1.10% to 1.49% in 25% to 45%. Thus, it is clearly revealed that body ash was unaffected by different protein level in the diet. (Table 4 fig 4). Minerals act as a cofactor of fish nutrition and are essential in metabolism and growth of fish**.** Fish absorb essential minerals through their gills from water or even through body surface. The requirement of minerals by fish varies from species and with variation in certain environmental factors such as mineral concentration, so it is difficult to determine it. The mineral content (Ash) may be leached out from the commercially produced compound feeds during the processing of the food and only insoluble mineral are left. The comprehensive conception about the mineral requirement of fish was given by muscle ash. The ash content represents the total inorganic matter as mineral constituents.

Conclusion

The present study indicates that the dietary protein level influences fish growth, feed conversion ratio, Specific growth rate and Feed conversion efficiency of fish and therefore, it is recommended that the inclusion of 40% dietary protein in the diet is optimum for the growth, efficient feed utilization of the juveniles of *Cirrhinus mrigala*

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