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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

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Growth Response and Feed Conversion Efficiency of *Tor putitora* (Ham.) Fry at Varying Dietary Protein Levels

Simple Sawhney and Roopma Gandotra
Department of Zoology, University of Jammu, Jammu (J and K) 180006, India

Abstract: The aim of this work was to study the effect of different dietary protein levels Viz. 30, 35, 40, 45 and 50% on growth and Feed Conversion Efficiency (FCE) of *Tor putitora* fry. Five iso-caloric diets containing different levels of protein such as 30, 35, 40, 45 and 50% were prepared in pellet form and fed to *Tor putitora* fry for a period of 120 days to determine the optimum protein requirement in laboratory conditions. Specific growth rates were 0.719, 0.696, 0.538, 0.486 and 0.364 in 45, 50, 40, 35 and 30% protein diet respectively. Food conversion efficiency was minimum at 30% (7.62), it further increased with increasing protein levels up to 45% (14.46) but beyond this it again decreases i.e. at 50% (13.85). On the basis of weight gain the following trend emerges 45%>50%>40%>35%>30%. The results confirm the best protein level for optimum growth of *Tor putitora* seems to be 45% and it is not significantly different from that achieved by 50% ($p<0.001$) protein diet.

Key words: Dietary protein levels, feed conversion efficiency , *Tor putitora*

INTRODUCTION

Golden mahseer or *Tor putitora* recognized as a king of mountain streams is a highly prized, delicious food fish of India, Pakistan, Bangladesh, Nepal, Afghanistan and Myanmar. It has been a source of intense thrill and fascination to the anglers, environmentalist and fisherman in view of its amazing size, leaping capacity and playful habits. However, from the last two decades there has been a lot of hue and cry regarding the dwindling population of mahseer species all over the country. Depletion of mahseer has been reported by many workers (Joshi, 1988; Nautiyal, 1994; Islam and Tanaka, 2004). The aquaculture potential of this fish has been identified only recently. Very little information is currently available on the nutrient requirement of *Tor putitora*. So nutritional studies are important from view point of culture related to conservation and propagation. Dietary protein plays a major role in determining the rate of fish growth. Accurate information on the protein requirement of fish is crucial for any aquaculture initiative owing to cost of protein ingredients that are usually required at high levels by most fishes (NRC, 1983). Information on the effects of dietary protein requirements of *Tor putitora* is scarce, reported by only a few workers (Joshi *et al*., 1989; Sunder *et al*., 1998; Islam, 2002; Islam and Tanaka, 2004). Therefore protein requirement studies are usually one of the first fish nutrition experiments to be conducted for intensive culture. The objective of the present study was therefore to assess the optimum protein level leading to optimum growth of mahseer, *Tor putitora* at fry stage.

MATERIALS AND METHODS

Five iso-caloric diets containing different levels of protein such as 30, 35, 40, 45 and 50% were prepared in pellet form using fish meal as a major source of protein as it is generally recognized that purified proteins, such as casein, are deficient with respect to certain amino acids and it is being expensive protein source for the average fish nutritionist in developing countries and this has led present investigator to formulate practical diets using cheaper locally available feed ingredients. Proportion (%) of different ingredients used in the formulated diets are shown in Table 1.

Table 1: Proportion (%) of different ingredients used in formulated diets for fry

	Diets				
Ingredients	30%	35%	40%	45%	50%
Fish meal	32.82	42.31	51.78	61.26	70.75
Rice bran	27.62	21.29	14.98	8.66	2.33
Mustard oil cake	10.94	14.11	17.26	20.42	23.59
Wheat flour	27.62	21.29	14.98	8.66	2.33
Vitamin and Mineral Premix*	1	1	1	1	1

a*Nutrimin Super forte (Rejuvenating combination of multivitamin and Multi minerals, AROSOL Chemicals PVT. Limited)

Vitamin A	700,000I.U	Vitamin D_3	140,000I.U
Vitamin E	250 mg	Folic acid	100 mg
Niacinamide	1000 mg	Iron	1500 mg
Iodine	325 mg	Cobalt	150 mg
Magnesium	6000 mg	Manganese	1500 mg
Zinc	3000 mg	Selenium	10 mg
Potassium	100 mg	Sulphur	7.2 gm
Calcium	270 gm	Phosphorous	130 gm
Copper	1200 mg	Fluorine	300 mg

Proximate composition of the feed ingredients and experimental diets were determined in the laboratory using standard methods. The crude protein content of

Corresponding Author: Simple Sawhney, Department of Zoology, University of Jammu, Jammu (J and K) 180006, India

Table 2: Proximate composition (%) of formulated diets for fry

Diets	Moisture	Dry matter	Crude protein	Crude fat	Ash	Crude fibre	Nitrogen free extract	Calorific content KJ/g
30%	9.79	90.21	29.06	5.39	14.32	9.28	32.16	13.51
35%	9.46	90.54	34.06	5.76	14.98	7.58	28.16	14.03
40%	9.73	90.27	38.92	5.92	13.06	7.02	25.35	14.63
45%	9.27	90.73	44.03	6.26	14.20	6.02	20.22	14.97
50%	9.40	90.60	48.99	6.97	15.24	5.98	13.42	15.14

feed ingredients was determined by microkjeltec method and the value obtained was multiplied by the factor 6.25 to obtain crude protein value. The crude lipid content was determined by extraction using petroleum ether in a soxhlet extraction apparatus for 16 h. The moisture content was determined by heating samples in oven at 105°C for 24 h. The ash content was determined by first igniting the sample and then heating it in a muffle furnace at 550°C (±10°C) for 6 h (AOAC, 1995). Crude fiber was determined by acid and alkali digestion (Pearson, 1976). Nitrogen free extract which was considered as carbohydrate was calculated by difference method (Hasting, 1976). The calorific value of the feed was calculated in terms of KJ/g using the energy value of 9Kcal/g for fat, 4 Kcal/g for carbohydrate (Hasting, 1976) and 5 Kcal/g for protein (Smith, 1975; Viola, 1977). Proximate composition of the experimental diets given in Table 2.

Tor putitora fry weighing (0.442 ± 0.009 g) were used for the experiment. The fry were collected from Govt. Anji fish farm, Reasi (J and K) in oxygen filled water bags. Before dividing the fish for conducting experiment, they were acclimatized in the laboratory for about 2 weeks. During that period the fish were fed (rice bran and mustard oil cake 1:1) *ad libitum*. The experiment was conducted in lab conditions in 100 l plastic tubs under flow through system along with aerators. *Tor putitora* fry were divided in five groups with 20 fish each. The fry were fed once daily in the morning at the rate of 5% of body weight during the period of 120 days and the fed quantity was readjusted after every fifteen day sampling, based on the growth of fishes.

Sampling and growth measurements: The fishes from each tub were captured once in fifteen days and were weighed individually and their growth was assessed by calculating following growth parameters.

Percentage weight (% WG): It was calculated by using the formula:

$$\%WG = [(W_f - W_i) / W_i] \times 100$$

Where W_f is the final weight of the fish and W_i is the initial weight of fish.

Specific growth rate: The formula used for calculating SGR was:

$$SGR = \frac{(\ln \text{final weight} - \ln \text{initial weight})}{\text{No. of days of experiment}} \times 100$$

Feed conversion ratio: The FCR was calculated by using the formula:

$$FCR = \text{Feed fed} / \text{Gain in weight of fish}$$

Feed conversion efficiency FCE (%): It was calculated by using the formula:

$$FCE (\%) = [(\text{Gain in wet weight of fish} / \text{Feed Fed})] \times 100$$

Protein Efficiency Ratio (PER): It was calculated using formula:

$$PER = \text{Increment in body weight (g)} / \text{Protein intake (g)}$$

Statistical analysis: A one way analysis (ANOVA) was conducted in each and every experiment, using the computer software 'Analyse it'.

RESULTS AND DISCUSSION

The present study on relative growth performance of mahseer, *Tor putitora* at fry stage, in response to diets with varying levels of protein viz. 30, 35, 40, 45 and 50% for a period of 120 days shows that fish fry fed on 45% protein diet attained best growth, while 30% protein diet exhibited least growth. On the basis of net weight gain the following trend emerged 45%>50%>40%>35%> 30%.

The average net weight gain of fry fed on different protein diets was 0.610, 0.581, 0.406, 0.354 and 0.236g at 45, 50, 40, 35 and 30% respectively (Table 3). However, there was insignificant difference ($p>0.001$) in net weight gain between 45% and 50% protein diets.

Similar to present observation protein requirement of 45.6% has been recorded in case of grass carp fry by Dabrowski (1977). Siddiqui *et al.* (1988), while working on Nile tilapia, *Oreochromis niloticus* fry, obtained best growth with 40% dietary protein followed by the diet containing 50, 30 and 20% protein. AlHafedh (1999) obtained significantly higher growth for *Oreochromis niloticus* fry fed on a practical diet containing 40% protein. Jana *et al.* (2006) reported significantly higher growth in terms of live weight gain and specific growth rate in milkfish *Chanos chanos* fry fed at 40% protein

Table 3: Showing percentage survival, net weight gain, Percentage Weight Gain (%WG), specific growth rate, food conversion ratio, food conversion efficiency, protein efficiency ratio of mahseer, *Tor putitora* fry at different protein levels in the diet

Protein levels	Experimental sets	Percentage Survival	Net weight gain (gm)	Percentage weight gain (%WG)	Specific growth rate (%)	Food conversion ratio	Food conversion efficiency	Protein efficiency ratio
30%	1	95	0.226	56.079	0.370	13.098	7.634	0.262
	2	95	0.287	64.639	0.415	11.187	8.938	0.307
	3	90	0.196	44.646	0.307	15.895	6.291	0.216
	Average	93.33	0.236	55.121	0.364	13.393	7.621	0.262
	SD	2.826	0.046	10.030	0.054	2.367	1.323	0.045
35%	1	90	0.365	82.766	0.502	9.877	10.124	0.297
	2	90	0.320	70.796	0.446	11.23	8.903	0.261
	3	90	0.379	84.409	0.509	9.385	10.654	0.312
	Average	90	0.354	79.324	0.486	10.164	9.894	0.290
	SD	0	0.030	7.430	0.030	0.955	0.897	0.026
40%	1	85	0.399	90.476	0.536	9.385	10.654	0.273
	2	90	0.412	91.15	0.539	8.996	11.115	0.285
	3	90	0.409	91.091	0.539	9.036	11.066	0.284
	Average	88.33	0.406	90.905	0.538	9.139	10.945	0.281
	SD	2.886	0.006	0.373	0.001	0.213	0.252	0.006
45%	1	95	0.612	140.366	0.73	6.857	14.581	0.331
	2	100	0.599	134.004	0.708	7.053	14.178	0.322
	3	100	0.620	137.168	0.719	6.833	14.633	0.332
	Average	98.33	0.610	137.179	0.719	6.914	14.464	0.328
	SD	2.886	0.010	3.181	0.011	0.12	0.249	0.005
50	1	90	0.556	127.522	0.685	7.547	13.249	0.27
	2	95	0.601	134.451	0.71	7.007	14.271	0.291
	3	100	0.587	129.867	0.693	7.124	14.036	0.286
	Average	95	0.581	130.614	0.696	7.226	13.852	0.282
	SD	5	0.023	3.524	0.012	0.284	0.534	0.01

level. Diyaware *et al*. (2009) showed that all the growth indices Mean Final Weight (MFW), Mean Weight Gain (MWG), Specific Growth Rate (SGR), Protein Index (PI), Mean Daily Weight Gain (MDWG), Apparent Protein Efficiency Ratio (APER), Food Conversion Ratio (FCR), Nitrogen Metabolism (NM), Relative Growth Rate (RGR) and percentage survival (%SR) were higher in hybrid catfish (*Heterobranchus bidosalis* x *Clarias anguillaris*) fry fed 50% crude protein.

During present investigation growth of fry was proportional to the dietary protein levels up to 45% beyond which it was not proportional i.e. percentage weight gain of fry increased with an increase in the dietary protein levels up to 45% and thereafter the growth increment was insignificant ($p>0.001$) Fig. 1. Similar growth pattern has been reported for mrigal fry (Singh *et al*., 1987), walking cat fish fry, *Clarias batrachus* (Chuapoehuk, 1987) and for *Heterobranchus* (Jamabo and Alfred-Ockiya, 2008).

During the present investigation the value of SGR was highest for fry fed with 45% protein (0.719%) and lowest for 30% dietary protein in fry (0.364%), Table 3, Fig. 1. SGR increases with increasing dietary protein content up to 45% in fry (Fig. 1) and above optimum protein level SGR decreased (Fig. 1). These results agree with those of Jauncey (1982b) who postulated that the decrease in specific growth rate at protein level above the optimum may be due to a reduction in the dietary energy available for growth to deaminate and excrete excess absorbed amino acid.

In the present investigation, FCR obtained with different diets having different levels of protein ranged from 6.91 in 45% protein diet to 13.39 in 30% protein diet in fry. Low feed conversion ratio at 45% protein level clearly reflects that these diets were utilized more efficiently. Further, in the present investigation the Food Conversion Ratio (FCR) decreased with increasing protein levels although not significantly above 45% in fry (Fig. 1). Similar to the present results, Siddiqui *et al*. (1988) and AlHafedh (1999) have all reported that FCR values decreases with increasing protein level.

In the present investigation, the Food Conversion Efficiency (FCE) was higher (14.46%) in fry fed with diet containing 45% protein level showing the best utilization of the diet and lowest for 30% dietary protein i.e. 7.62% (Fig. 1).

Present observation further reveals that food conversion efficiency increased with increasing protein level in the diet up to 45% in fry and in fingerling up to 35% protein level then decreased afterwards. Support for this can be drawn from Siddiqui *et al*. (1988) who also reported that feed conversion efficiency increased with increasing protein level up to 40% and then decreased for the diet containing 50% protein in Nile tilapia, *Oreochromis niloticus*.

In addition, feed conversion efficiency of fish fed with the varying levels of dietary protein in the present study indicated that the optimum dietary protein requirement was 45% in fry. Below and beyond these ranges, feed

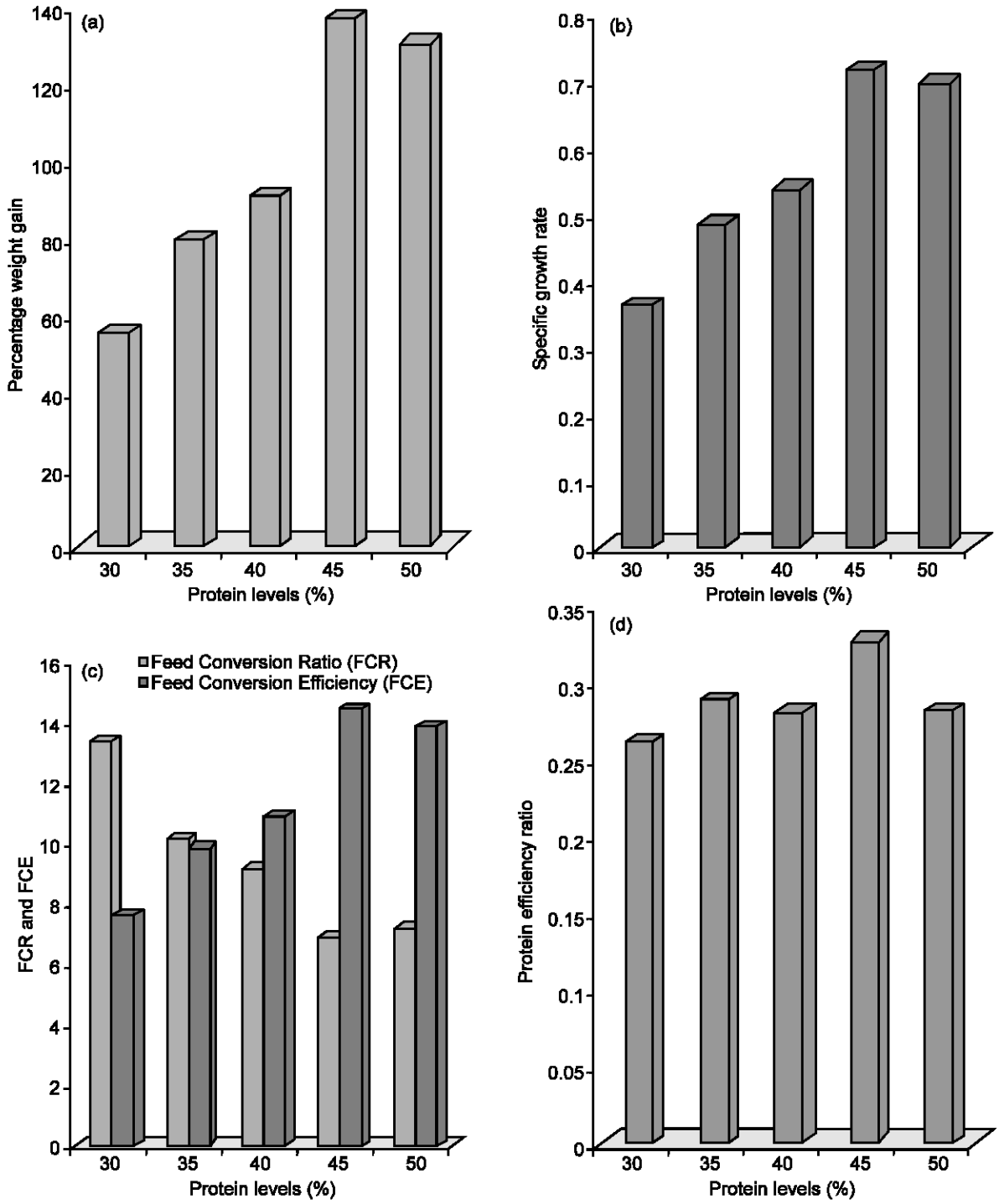

Fig. 1: Bar diagrams showing growth response of *Tor putitora* fry at different protein levels in the diet (a) Showing percentage weight gain (%WG); (b) Showing specific growth rate (SGR); (C) Showing food conversion ratio (FCR) and feed conversion efficiency (FCE); (d) Showing protein efficiency ratio (PER)

efficiency reduced. The present trend of FCE is similar to that reported for bagrid catfish, *Mystus nemurus* (NG *et al*., 2001).

Thus the present results clearly indicate that present fish species i.e. *Tor putitora* fry require higher protein level i.e. 45% or less than 50% when fed artificially, for better

growth. It was interesting to find that weight gain, SGR and FCE were lowered if protein in feed was higher then the required level of 45% by the present fish species.

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