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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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Dietary Protein Requirement of Giant River Catfish, *Sperata seenghala* (Sykes), Determined Using Diets of Varying Protein Level

Muhammad Ramzan Ali[1], Muhammad Afzal[1], Muhammad Farhan Khan[1], S.M.H.M. Naqvi[1] and Shamim Akhtar[2]
[1]Aquaculture and Fisheries Program, National Agricultural Research Centre, Islamabad, Pakistan
[2]Department of Zoology, PIMAS Arid Agriculture University, Rawalpindi, Pakistan

Abstract: The giant river catfish (*S. seenghala*) is an imperative commercial species, contributing significantly to the total inland fish production in Pakistan. The aquaculture potential giant river catfish has not yet been explored. To ascertain the optimum dietary protein for the growth of giant river catfish fingerlings (9.0 g initial weight) a 6 week feeding trial with four dietary protein levels was conducted in 12 glass aquaria of about 42 L capacity. Diets containing 25, 30, 35 and 40% CP were prepared from locally available ingredients based requirements of catfish fingerlings. Growth performance of fingerlings of Giant River catfish increased significantly with increase in protein level from 25 to 40% in feed. The survival, final weight and of catfish fed the diet containing 40% protein were high and comparable to those of the other diets. Food conversion ratio decrease by increasing the protein levels in feed. Specific growth rate and feed efficiency of fish fed the 40% protein diet and 35% protein diet was higher than that of other diets. Protein efficiency ratio of fish decreased with increasing dietary protein level. Carcass crude protein was higher in fish fed with high protein diet, while value of lipid in carcass was lower in fish fed with diet having greater CP levels. Ash contents were significantly increased with increase of protein level. The results of this study indicate that an increase of dietary protein level can improve growth and protein utilization and the diet containing 35% protein would be suitable for optimum growth and effective protein utilization of giant river catfish fingerlings.

Key word: Giant river catfish, dietary protein, growth performance, efficiency, food conversion ratio

INTRODUCTION

Research on freshwater aquaculture in Asia has mainly gyrates on propagating carp culture and their breeding techniques that has been standardized or transferred to fish farmers. The catfish production mainly depends on catches from wild and, due to high demand and over exploitation of natural stock; the catfish population is decreasing in natural environment. Despite their great demand, catfish culture systems are not yet established in many countries of Asia including Pakistan. Catfish culture has advantages over carp culture in terms of greater survival in oxygen depleted waters, tolerance to crowding and high stocking rates on artificial feeds.

The giant river catfish (*Sperata seenghala*), locally known as "Seengharee". The habitat of Seengharee are rivers, floodplains, inundated swamp fields, ditches, canals and other freshwater areas The geographical distribution of Seengharee is in Pakistan, Afghanistan, India, Nepal and Bangladesh (Jayaram, 2002; Talwar and Jhingran, 1991; Rahman, 2005). It is considered to be the best fish as far as consumers are concerned because of it taste. Aquaculture potential is very low because it shows pure reproductive performance in pond culture and captive condition (Talwar and Jhingran, 1991; Rahman *et al*., 2005).

Recently, natural stocks of *S. seenghala* have drastically reduced due to natural and man-made catastrophes. These factors have created a serious problem to their genetic resources and thus, the fish has become gradually endangered (IUCN, 2010; Rahman *et al*., 2005). In order to maintain this fish population as well as to conserve their biodiversity, development of suitable techniques for the rearing and culture of *S. seenghala* is very essential but no systematic information is available on the culture techniques of this important fish (Jhingran, 1991; Rahman *et al*., 2005).

Nutrition is one of the most important factors influencing the ability of cultured fish to exhibit its genetic potential for growth and reproduction. Good nutrition in animal production systems is essential to economically produce a healthy, high quality product. Since Seengharee is carnivorous in nature and feeds on small fishes and other aquatic worms, it requires a sufficient supply of protein in its feeds (Ferraris, 2007). Catfish must be fed with a feed that is 100% nutritionally complete. Because protein is the most expensive part of fish feed, it is important to accurately determine the protein requirements for each species and size of cultured fish. Feed cost is the major variable operating

Corresponding Author: Muhammad Ramzan Ali, Aquaculture and Fisheries Program, National Agricultural Research Centre, Islamabad, Pakistan

cost associated with channel catfish production and commercial feeds contain a liberal amount of expensive, high-quality protein.

For any aquaculture initiative precise knowledge on the requirement of protein of fish is vital due to high cost ingredients of protein that are usually required at greater levels for the majority of fishes (NRC, 1993). When the intensive culture of a new fish species is taking into account, the first experiments to be conducted is studies of protein requirement. In present study, four kinds of artificial diet having crude protein level 40, 35, 30 and 25% were formulated from locally available feed ingredients to evaluate the balanced diet for *S. seenghala*.

MATERIALS AND METHODS

Experimental design: The experiment was conducted for 60 days at Aquaculture and Fisheries Programme (AFP), National Agriculture Research Center (NARC), Islamabad, Pakistan. Twelve glass aquaria of length 60 cm, width 35 cm and height of 30 cm were used. Four feeds having 25, 30, 35 and 40% CP were prepared from locally available ingredients. All aquaria were filled with about 42 L of water and this level was maintained throughout the experiment. Experimental Design was CRD with 4 Treatments having 3 replications.

Experimental diets: To determine the optimum level of balanced diet for *S. seenghala*, four kinds of artificial diet having crude protein level 40, 35, 30 and 25% were formulated from locally available feed ingredients viz., soybean meal, fish meal, sunflower meal, gluten, rice polish, wheat bran, oil and vitamin mineral premix (NCR, 1993b). To prepare diets, the dry ingredients were thoroughly mixed with oil in ribbon type mixture and the moist mixtures were pelleted. The feed were then dried in sun light. Proximate analysis of diets was done to determine percent crude protein, fat, fiber, moisture and total ash content (AOAC, 1990). The diets composition and the proximate analysis are shown in Table 1.

Experimental procedure: Fifteen fry (*S. seenghala*) of body sizes with average weight 9.0 g were placed in each aquarium. Body weight was measured and recorded at the time of stocking. Fish were offered feed at the rate of 7% of wet body weight with pelleted feed formulated to contain different levels of protein, twice daily. Aquariums were cleaned daily before giving the feed in the morning. Fish were sampled on fortnightly basis to record wet body weight and the total length. After recording the required data, fish were released back into their respective aquarium. Daily feed ration was adjusted according to total biomass of fish under experiment.

All fish were collected to record the final weight, weight gain, percent weight gain, food conversion ratio, feed efficiency, specific growth rate (SGR) and protein efficiency ratio (PER) at the end of the experiment. For whole body proximate analysis, four fish from each aquarium were randomly captured with hand net. Carcasses of fish were mixed, dried and crushed. The dry matter, moisture, lipid, crude protein, ash contents and crude fiber of fish were analyzed by standard methods (AOAC, 1990).

Water quality parameters Viz., temperature, salinity, EC, pH, dissolved oxygen (DO), TDS were measured daily with the help of limnology field meter (Consort Model C6030, Belgium) during the experimental period. Alkalinity and hardness were estimated by titration method on weekly basis.

Data analysis: The growth performance of fish was calculated through weight gain, feed consumed, FCR and Specific growth rate. All the data was analyzed through analysis of variance (ANOVA) by using Ms Excel. Significant difference among treatment means was tested through a Duncan's Multiple Rang Test (DMRT) by using statistical software MSTAT C (Steel and Torrie, 1986).

RESULTS AND DISCUSSION

The data on growth pattern of fingerlings of *S. seenghala* fed the experimental feeds are given in Fig. 1. The average final body weight of *S. seenghala* fed F_1 (40% CP) was higher followed by those fed on F_2 (35% CP) and F_3 (30% CP) which remained similar to each other within six weeks of the trial. The lowest average body weight was found in the fish fed F_4 (25% CP).

The data on average gain in weight, specific growth rate (SGR), feed conversion ratio (FCR), protein efficiency ratio and feed efficiency (%) of Seengharee fed the diet with different protein levels are given in Table 2. The average weight gain of *S. seenghala* fed the test diet increased with the increase in CP level. The feed F_4 (40% CP) was significantly better ($p<0.05$) in terms of weight gain than F_3 (35% CP) F_2 (30% CP) and F_1 (25%CP) within six weeks of the trial. Weight gain of fish fed with diet containing 35, 30% CP and those having 35 and 40% CP did not vary ($p>0.05$) with each other. Specific growth rate (SGR) and Food conversion ratio (FCR) values indicated that best feed was F_3 (35% CP) followed by F_4 (40%CP), F_2 (30%CP) and F_1 (25%CP). Feed efficiency (FE) of Seengharee fed 35% CP feed was considerably greater than that of fish fed diets containing 40, 30 and 25% CP.

For Seengharee fingerlings the optimum feed protein level find out in present experiment is parallel with the feed requirements of protein reported for some other catfish species like bagrid catfish, *Pseudobagrus fulvidraco* (Kim and Lee, 2005), *Mystus nemurus*, Malaysian freshwater catfish (Khan *et al*., 1993; Ng *et al*., 2001) *Clarias nieuhofii* (Kiriratnikom and Kiriratnikom,

Table 1: Percentage and proximate analysis of feed having different protein levels formulated from locally available feed ingredients

Feed ingredients	F1 (25% CP)	F2 (30% CP)	F3 (35% CP)	F4 (40% CP)
Fish meal	30	30	30	30
Soybean meal	4	10	10	10
Sunflower meal	4	5	10	10
Canola seed meal	4	5	10	5
Rice polishing	25	22	10	6
Gluten 30%	9	19	6	0
Gluten 60%	0	0	10	25
Wheat bran	20	5	10	10
Vitamin -C	0.5	0.5	0.5	0.5
Vitamin premixes	1.5	1.5	1.5	1.5
Soybean oil	2	2	2	2
Total	100	100	100	100
Proximate composition (%)				
Dry matter	89.7	90.0	89.9	90.1
Crude fat*	16.6	15.0	15.3	14.6
Crude protein*	25.2	30.34	34.96	40.1
Total ash*	8.5	11.0	10.0	9.5
Crude fiber*	8.14	7.24	6.54	5.23

*Percentage of dry matter

Table 2: Growth performance of Seengharee fingerlings fed on diet containing 25, 30, 35 and 40% CP

Parameters	F_1 (25% CP)	F_2 (30% CP)	F_3 (35% CP)	F_4 (40% CP)
Initial weight (g/fish)	9.35 ± 0.02^{a}	9.43 ± 0.01^{a}	8.65 ± 0.02^{b}	9.59 ± 0.03^{a}
Final body weight (g/fish)	21.47 ± 0.77^{c}	27.03 ± 0.55^{b}	27.90 ± 66^{b}	30.43 ± 0.78^{a}
Weight gain (g/fish)	12.13 ± 0.78^{c}	17.61 ± 0.55^{b}	19.25 ± 0.66^{ab}	20.84 ± 0.79^{a}
Food conversion ratio FCR	3.06 ± 0.03^{a}	2.91 ± 0.02^{b}	2.71 ± 0.01^{c}	2.87 ± 0.02^{b}
Specific growth rate SGR	1.38 ± 0.05^{c}	$1.76\pm.03^{b}$	1.95 ± 0.04^{a}	1.92 ± 0.04^{a}
Protein efficiency ratio PER	1.30 ± 0.64^{a}	1.15 ± 0.60^{b}	1.06 ± 0.61^{c}	0.87 ± 0.92^{d}
Feed efficiency FE (%)	32.61 ± 0.36^{c}	34.33 ± 0.28^{b}	36.95 ± 0.24^{a}	34.76 ± 0.22^{b}

Means with different superscript differ significantly ($p<0.05$) FCR: Food conversion ratio SGR: Specific growth rate
PER: Protein efficiency ratio FE: Feed efficiency

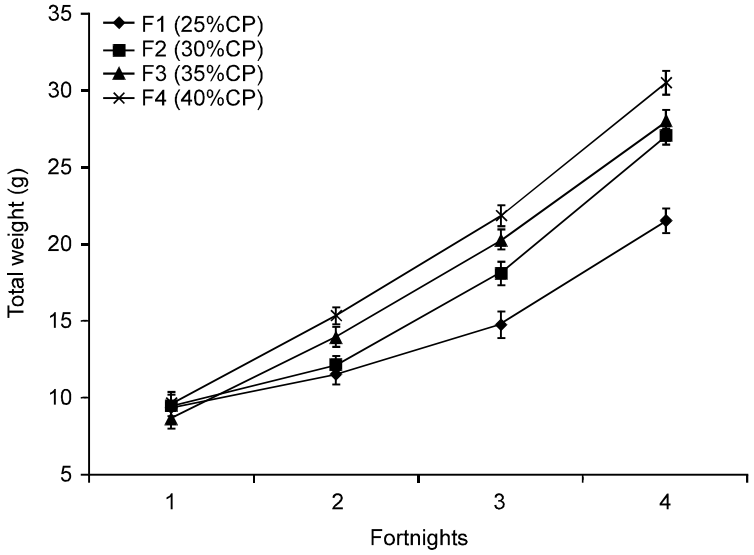

Fig. 1: Effect of different diets containing different levels of crude protein on the weight increment of *S. seenghala* fingerlings

2012) and other catfish, especially channel catfish, *Ictalurus punctatus*, (Rab *et al*., 2007) but was lesser than the protein requirements of Malaysian freshwater catfish, *Mystus nemurus* (42-44%) (Khan *et al*., 1993; Ng *et al*., 2001).

Protein efficiency ratio of fish fed with feed of lower protein (25%CP) was maximum while PER of fish fed 40% CP feed remained minimum. Excess dietary protein, did not enhance the growth of the fish, the reason may be that excess amino acids are metabolized

Table 3: Water quality characteristics of water during experiment

Parameters	F_1 (25% CP)	F_2 (30% CP)	F_3 (35% CP)	F_4 (40% CP)
Temperature (°C)	26.3±1.7	26.2±1.6	26.3±1.6	26.0±1.7
Dissolved oxygen (mg/L)	6.7±0.57	6.3±0.36	6.5±0.14	6.0±0.97
pH	7.9±0.00	7.9±0.01	8.0±0.06	7.9±0.02
Electrical conductivity (µsec/cm)	156.0±2.53	135.0±3.13	160.0±2.7	160.0±4.9
Alkalinity (mg/L)	174.5±11.8	135.0±20.2	145.0±19.2	187.0±16.9
Hardness (mg/L)	170.0±8.75	169.0±16.2	150.0±13.2	200.0±9.5

Values are Mean±SD

Table 4: Carcass compositions of *S. seenghala* fingerlings fed with diets containing different protein levels

Parameters	F_1 (25% CP)	F_2 (30% CP)	F_3 (35% CP)	F_4 (40% CP)
Dry matter	20.70^{b}	20.90^{b}	21.60^{a}	21.65^{a}
Moisture	79.30^{a}	79.10^{a}	78.40^{b}	78.35^{b}
Crude protein*	56.25^{d}	56.90^{c}	57.90^{b}	58.10^{a}
Crude lipid*	9.10^{a}	8.95^{ab}	8.33^{b}	8.10^{c}
Ash*	14.24^{b}	14.21^{b}	15.27^{a}	15.12^{a}

* Percentage of dry matter

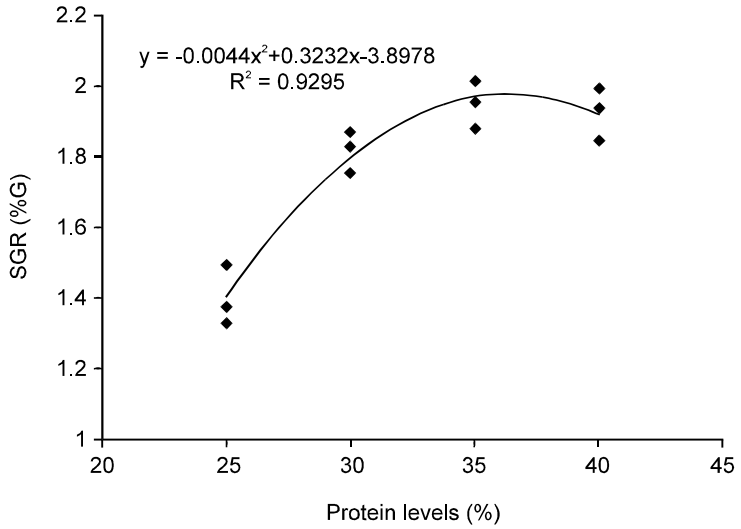

Fig. 2: Relationship of SGR and dietary protein levels for *S. seenghala* fingerlings fed feeds of various protein levels

by oxidative deamination and are used to generate energy (Cho *et al*., 1985; Shiau and Huang, 1989; Vergara *et al*., 1996; Kim and Lee, 2009). Excess protein levels in the feed increased the amino acid catabolism in the fish body and this resulted in higher ammonia excretion and accumulation of nitrogen waste in the culture system (Yang *et al*., 2002; Webb and Gatlin-III, 2003). Moreover, increasing excess protein in a practical diet resulted in higher feed costs, which is the major variable cost in the aquaculture production system (Goddard, 1996). On the other hand, insufficient dietary protein levels resulted in poor growth performance in many fish species (Giri *et al*., 2003; Kim and Lee, 2005) due to insufficiency of amino acids supplied to maintain the body composition (Halver and Hardy, 2002).

The data on water quality parameters of aquaria where feed having different levels of CP were fed to Seengharee are given in Table 3. Dissolved oxygen, water temperature, alkalinity, pH, electrical conductivity and hardness were not affected by experimental feeds having 40, 35, 30 and 25% CP levels and remained under suitable range of catfish culture throughout the study period (Buentello *et al*., 2000).

To approximate the requirements of protein of a number of fish species second order polynomial regression analysis have been used (De-Silva and Perera, 1985; Tacon and Cowey, 1985; Santiago and Reyes, 1991). Because specific growth rate was curvilinear, the second order polynomial regression analysis showed to be more suitable in the present experiment. The regression analysis (Second order polynomial) explained the maximum growth rate at 35% dietary CP level. The best SGR (1.95-1.92%/day) was obtained with feed having 35% and the 40% CP level. These results pointed to that a feed containing 35% protein was optimal for fingerlings of Seengharee.

The proximate composition of Carcass of Seengharee fed diet containing different levels of protein are

presented in Table 4. There were a positive effect of fish body's crude protein and dietary protein levels. Crude proteins in the Seengharee fed the diets containing 40% protein were higher ($p<0.05$) followed by the fish fed diets with 35, 30 and 25% protein, respectively. Kiriratnikom and Kiriratnikom (2012) reported body's crude protein of *Clarias nieuhofii* fed diets containing 40 to 44% protein were higher than the catfish fed diets with 32 to 36% protein. The body lipid content decreased with increasing protein in feed; the lower protein diets may increase the fat content of catfish. Davis *et al.* (1993) found that the catfish fed the low protein diet had more body fat than those fed higher-protein diets. Body moisture contents tended to decrease with increasing protein in diet. The ash contents were grater in fish fed at high protein levels these results were contradictory reported by Ali *et al.* (2003), they found that ash content in the fish fed diets containing varying levels of protein were non significant.

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