International Research Journal of Natural and Applied Sciences
Volume-2, Issue-2 (February 2015) ISSN: (2349-4077)

NUTRITIONAL PROTEIN REQUIREMENT OF STRIPED MURREL *CHANNA STRIATUS* FINGERLINGS FED ON DIFFERENT PROTEIN LEVEL DIETS

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ABSTRACT

The commercially important air breathing fish of India is Channa striatus ((Striped murrel) selected for the present work. In the current scenario protein requirement is one of the most important aspects for any living organism not only fish. Now a day's feed is playing a major role in the freshwater aquaculture industry. Protein as a major fish feed component not only provides essential amino acid, but also used for tissue repair and growth. Every organism they need a balanced feed to regulate their metabolic activity. In this present work dealing with the dietary crude protein requirement of Channa striatus fingerlings, five types of semi moist diets were prepared viz; 45%, 50%, 55%, and 60% protein level using with different ingredients viz, Chicken Intestine, Fish Waste and Silk Worm Pupae, GOC, Rice brane, Tabioca, Vit-Min. Mix and fed to the fish for a period of 42 day. The best SGR (1.079 %/day), FCR, (1.571), weight gain, (183.29 %), ADG (8.66 %) and survival (96.66 %) were obtained in 50% protein diets than the rest of the other diets recorded respectively.

Key words: *Channa striatus* fingerlings, nutrition growth survival

INTRODUCTION

The major nutritional needs of a number of species is important in aquaculture have been enlisted by NRC, (1983). Protein, being the principal dietary component for growth has received greater attention in nutritional studies (Daniels and Robinson, 1986). Majority of the fish species require 40-50% protein in diets (Cowey *et al.*, 1975). Several marine fish species require more

than half of the diet ingredients as protein components and thus are more carnivorous than terrestrial carnivorous (Yone *et al*., 1974). However freshwater teleost requires comparably less protein diet than those of marine species.

The *C.striatus* do not accept the purified diets, because of its carnivorous in nature Qin and Fast, (1996). Therefore different crude protein levels were prepared for the fingerlings of *C.striatus*. In the nutritional point of view no published work is available so far on the crude dietary protein requirement of *C.striatus* using different bio-waste. The present study was conducted to determine the optimum dietary protein requirement of *C.striatus* fingerling under laboratory conditions.

MATERIAL AND METHODS

Bio-waste collection and estimation

The bio-wastes of chicken intestine and fish waste were collected from the local market and silkworm pupae from Government Silk reeling center, Tenkasi, Tirunelveli District, Tamil Nadu. All the ingredients dried and powdered separately in the mixer grinder and sieved through a 200µ mesh and their Biochemical analyses were performed. and the moisture content was determined by drying a 5 g sample at 95^{o}C for 24 hr (AOAC, 1980) and ash content by burning in an electric muffle furnace from 6 to 8hrs at 560 o C (Paine, 1964).

Feed composition and preparation

The powdered feed ingredients were mixed in different quantity along with bio waste such as CI, FW and SWP which were used as a major source of protein to prepare the different crude protein levels from 40%, 45%, 50%, 55%, and 60%. And the feed composition and the nutrient content were presented in table 1.1. Required quantity of water was added to the dry homogenate in order to make dough. The dough was cooked for 10 min. After cooling, required amount of vitamin and mineral mix were added and thoroughly mixed. The prepared crude protein feed is going to determine the optimum dietary protein requirement of *C striatus* fingerlings.

Fish Collection and Experimental Set up

The fingerling (average weight 2.0 g) of *C.striatus* were collected from the Thamirabarani River and carefully transported to CARE Aqua farm, St. Xavier's College (Autonomous) Palayamkottai, Tirunelveli, Tamil Nadu, and India. The fish were fed on mixed plankton during

the acclimation period, and before the commencement of the experiment. Triplicates were maintained and the fish were fed with the semi moist diets twice a day (10.00 hr and 14.00 hr) at of 5% of body weight. Daily feed input was adjusted weekly based on the average weights of fish in each treatment. The unfed were separately collected from the trough.

The duration of the feeding experiments of fingerling was 42 days. Dissolved oxygen from 5.5 to 5.8 ppm and pH between 6.8 and 7.0. The ten individuals of same size were selected and were introduced into plastic troughs of 13 Lt capacity (1x1x1m) Initial length and weight and final length and weights of the experimental fish in each plastic trough were recorded individually using an electronic balance (Metler PM 480, Delta range). At every week interval length and weight was recorded. Water in the aquaria was partially changed once day daily. No aeration was provided. Weight of the fish was recorded at weekly interval of fingerling.

Formula

$$\text{Specific growth rate SGR (\%/day)} = \frac{\text{In log Final body weight-In log initial lives weight (g)}}{\text{Experimental duration}} \times 100$$

$$\text{Food conversion ratio (FCR)} = \frac{\text{Food consumed (g)}}{\text{Wet weight gain (g)}}$$

$$\text{Weight gain (\%)} = \frac{\text{Final live weight-Initial live weight}}{\text{Days}} \times 100$$

$$\text{Average daily growth rate (\%) (ADG \%)} = \frac{\text{Growth (live wt.g)}}{\text{Duration}} \times 100$$

$$\text{Survival (\%)} = \frac{\text{No of fish introduced}}{\text{No of fish survived}} \times 100$$

$$\text{Mean growth rate} = \frac{\text{Final mean weight}}{\text{Initial mean weight/days}}$$

Carcass composition

At the beginning and end of the experiment all the fishes in each triplicate group were sampled for final carcass analysis.

Statistical analysis

Statistical analyses were performed using SPSS Version 13.0 Software and, one way analysis of variance (ANOVA) followed by Duncan's Multiple Range Test were made to find out the difference between the treatment.

RESULTS

The nutrient contents of the different dietary protein levels prepared for fingerlings of the test animals. The proximate compositions of the experimental diets are shown in table 1. The protein content in different diets varied between 39.08 and 59.36%. The lipid values ranged from 7.97% to 13.25%. Whereas the carbohydrate content ranged between 3.77 and 10.5%. The calculated gross energy contents varied between 279.94 Kcal/100g and 392.89Kcal/100g. The protein to energy ratio varied between 6.489 and 7.16.

The result of the biochemical analysis of the feed ingredients and the different biowaste are presented in Table 1. The protein content observed in chicken intestine was 68.45%, fish waste 58.06% and silkworm pupae 55.02%. The carbohydrate content was highest in chicken intestine by 3.93% followed by fish waste 3.69% and silkworm pupae 1.0%. Lipid content was found to be highest in chicken intestine 10.12% followed by fish waste 6.18% and in silkworm pupae 17.12%. The highest calculated gross energy was recorded in chicken intestine 407.703 kcal/100g and followed silk worm pupae 396.73 kcal/100g and the lowest value was recorded in rice bran 175.11 Kcal/100g and the calculated E/P values is highest in tapioca and the lowest value is 5.625.

The growth performances of *C.striatus* fingerlings fed with the experimental diets are presented in table 3. The length and weight increment was presented in Fig 1.1, 1.2 and 1.3. And the best SGR%/day was obtained in those fed with the diet (D3) 1.079 while the poor values was found in (D5) diet fed fishes 0.73 (Table3). In term of best weight gain the value was more in diet (D3) 183.29% diet (D5) 102.89% (Table 1.3 Fig. 1.1) and the best average daily growth was in the diet of (D3) 8.66% and the lowest value (D5) (4.866 %) (Table 3). The best (low) FCR was exhibited by the fish fed with diet (D3) 1.57 and the highest value was found in diet (D5) 2.673 (Table 3 Fig 1.4). The best survival was in those fish fed with diet (D3) 96.66% and the lowest in diet (D5) 86.66 % (Fig 1.5).

The highest body protein content was noticed in the diet of (D3) (59.11%) fed fishes whereas the lowest value was in the diet (D5) 54.62% noticed (table 1.4). The highest lipid content was obtained with (D1) diet 7.88% and the lowest value was in the diet of (D5) 6.43%. The diet (D3) crude protein fed groups showed the highest gross energy is 329.326 kcal / g and the lowest in diet (D5) 304.41. And the E/P is more or less similar values were recorded in all the dietary treatments ranging from 5.56 to 5.608.

In the body composition of *C. striatus* fingerling the significantly higher protein value (59.11%) was in diet D3 and the poor value (51.71%) initially reported. And in carbohydrate the significantly higher value (1.81%) was in diet D4 and the poor value (0.88%) was initially noticed. In lipid significantly higher value (7.88%) in diet D1 and lowest value (6.43 %) in diet D5 reported. And in the calculated gross energy the higher value (329.32 Kcal/100g) was in diet D3 and the poor value (299.98 Kcal/100g) initially reported. And in the energy/protein the higher value (5.81) was in the initial fish was observed. (Table 4 and Anova Table 6).

DISCUSSION

In the present study the best specific growth, average daily growth rate and weight gain were observed for fingerling at 50% (D3). The hybrid tilapia O*reochromis niloticus* X *O. aureus* showed satisfactory growth performance when the dietary protein content decreased from 24 to 21% and dietary lipid raised from 9 to 15% (Shiau and Huang, 1990). Hybrid *Clarias* catfish

Clarias macrocephalus X C. gariepinus also showed a protein-sparing effect when increase from 35 to 40% in dietary protein gave similar performance when lipids were increased from 11 to 15% (Jantrarotai *et al.,* 1998).

The optimum protein requirement of mrigal and rohu fingerlings 45% (Singh and Sinha, 1981). The optimum protein requirement of *Cyprinus carpio* was 31-38% for Japanese common carp (Takeuchi *et al*., 1979) while the optimum for Indian strain of common carp was 45% (Sen *et al.,* 1978). The difference in the level of optimum protein requirements may be due to differences in strains (Austreng and Refstie, 1979).

The high protein level (60%) did not enhance the fish growth significantly at either fry or at fingerlings stage. This result may be due to the fact that each fish size has a certain protein limit after which excess protein level could not be utilized efficiently. The dietary protein requirements of air breathing fishes *Channa striatus* and *C. micropeltes* have been reported as 50% in the case of fingerlings. (Mohanty and Samantaray, 1997).Similar results were also observed in the present study. The difference may be due to different animal biowaste protein sources and components, and formulations methods, different environmental conditions, levels of dietary intake and experimental duration.

The apparent growth depressing effect fed with high protein diets in fish observed in this study has also been reported fish species, such as Snakehead *Channa striatus* (Wee and Tacon, 1982), grouper (Teng *et al*., 1978). For example in the experiment of Cho *et al.,* (1976) the increase of dietary protein level from 40-60% of diet resulted in a "Perplexing" decrease of growth rate at high level of feeding, while in our present study, the same type of results were observed in fingerlings of *Channa striatus,* the optimum level of dietary protein is 50% for fingerlings were reported from the present study.

The decrease in weight gain at higher dietary protein levels (above 45%) was also observed in mrigal fingerlings (Singh, 1984). The increase in weight gain 183.29 % at the crude protein levels of 50% was observed in *Channa striatus* fingerling was reported. Improved growth and survival rate with increasing dietary protein levels was observed in our study are well documented with other species. Jirsa *et al*., (1997) obtained a significant increase in weight gain

with red drum (*Sciaenops ocellatus*) fed increasing levels of dietary protein and energy levels (from 32 to 44 % protein and 3.4 to 3.8 Kcal /kg energy).

Fish growth performance in the present study was affected not only by dietary protein and energy levels, but also by the energy to protein (E/P) ratio as has been demonstrated by Garling and Wilson, (1976). Proteins to energy (E/P) requirements of Tilapia species have been investigated by some authors. A diet containing 45% crude protein and 400 Kcal GE/100 g with an E/P ratio of 100mg/cp/kcal GE produced the best growth rates of *O .niloticus* swim up fry (El-sayed and Teshima, 1992). In the present study the *C.striatus* fingerlings required the Gross energy was 329.32 Kcal/100g, with E/P are 5.57 and in the fry required the gross energy was 321.27 Kcal/100g with 5.32 E/P.

In general carnivorous fish require higher E/P ratio than omnivorous or herbivorous Winfree and Stickney, (1981). E/P ratio of 88 mg protein $Kcal^{-1}$ between protein levels of 24 – 36% for Channel cat fish *Ictalurus punctatus* (Garling and Wilson, 1976), 95 mg/kcal P/E for *L.rohita* (Dass *et al*., 1991) and 90.9 mg/kcal P/E for *Channa striatus* (Mohanty and Samantaray, 1997) have been reported as optimum levels. The result of the present study showed that 50% protein with 329.326 kcal/g gross energy with energy protein ratio 5.571 were found suitable for best growth based on the feed utilization of *Channa striatus* fingerling. This may be due to the fact that the protein level (50 %) in diet D3 was optimum to promote growth and the energy supplied by this diet was also adequate for maintenance and growth of *C. striatus* fingerlings.

Dietary protein did not affect the body moisture and ash contents of several other fish species (Santiago and Laron, 1991). Body moisture content tended to increase with increasing dietary protein level, show an inverse relationship with body lipid content as has been reported for other fishes (Khan *et al*., 1993). The body crude lipid content generally decreased as dietary protein level increased, which was in contrast to results obtained in rain bow trout by Shiau and Lan, (1996) and in accordance with Chen and Tsai, (1994). In the present study the moisture content of fish was higher before the experiment than in any of the treatments after the experiment. Dabrowski, (1977) found no change in the body moisture content of grass carp, *Ctenopharyngodon idella* when the dietary protein level was varied.

In the present study proximate composition of whole body *C.striatus* fingerling given in the Table 1.4. Ash and crude protein contents of whole body tended to increase in direct proportion to dietary protein level and they had a linear increment and a significant difference at $p<0.05\%$ level. The dietary protein level had an effect on the proximate carcass composition. In general, there was a progressive increase in body protein and slight decrease in the body lipid with increase in dietary protein increment. A similar trend has also been reported by various authors with common carp (Zeitter *et al*., 1984), tilapia (Jauncey, 1982). From the above stated results optimum dietary protein requirement of *Channa striatus* fingerlings was 50% which was needed for the growth performance and weight gain and the SGR were clearly shown that reported.

Conclusion

From the finding of this research work the best SGR (1.079 %/day), FCR, (1.571), weight gain, (183.29 %), ADG (8.66 %) and survival (96.66 %) were noticed in those fed with 50% crude protein diets and this diet is recommended for the optimum level for their best growth performence of *Channa striatus* fingerling respectively.

Acknowledgement

The authors are thankful to funding agency of Science and Engineering Research Board (SERB) File. No SR/FT/LS - 158/2009 dt 02.03.2012 for providing financial assistance.

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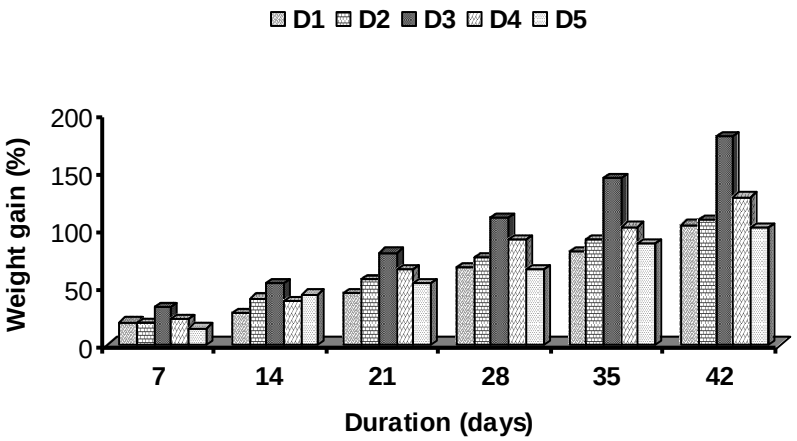

Fig 1.1.Weight gain of *Channa striatus* fingerlings fed on different dietary protein levels

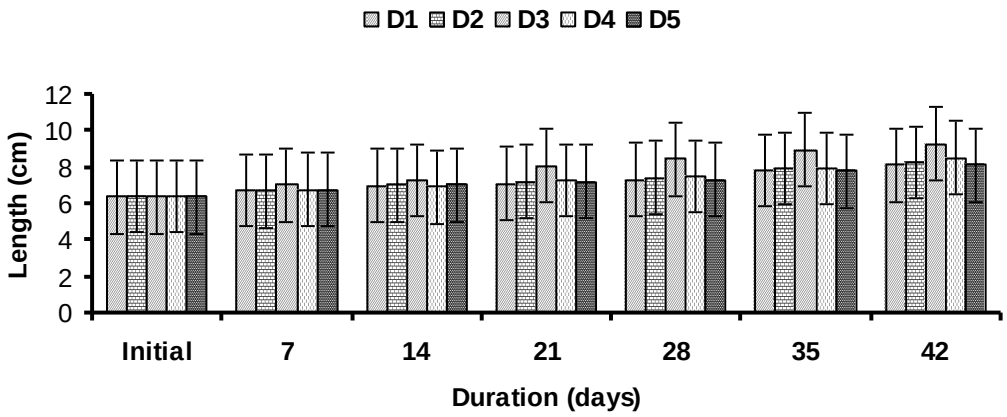

Fig.1.2.Length increment of *Channa striatus* fingerlings fed on different dietary protein levels

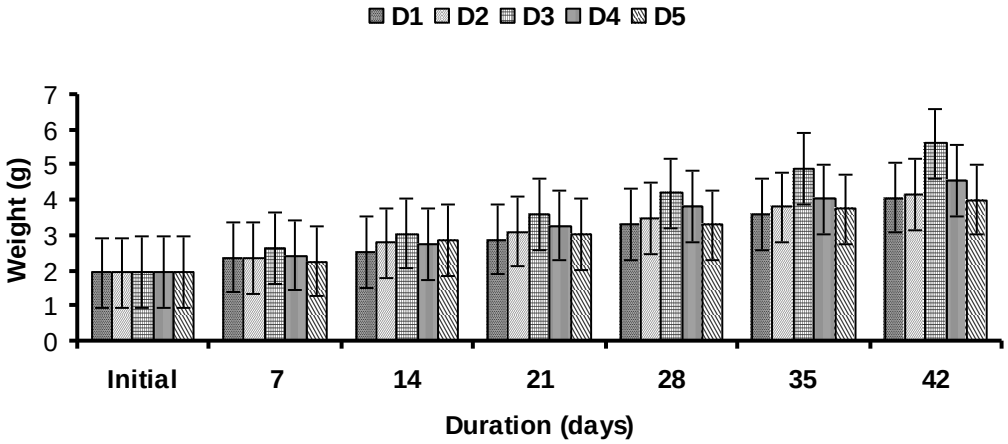

Fig.1.3.Weight increment of *Channa striatus* fingerlings fed on different dietary protein levels

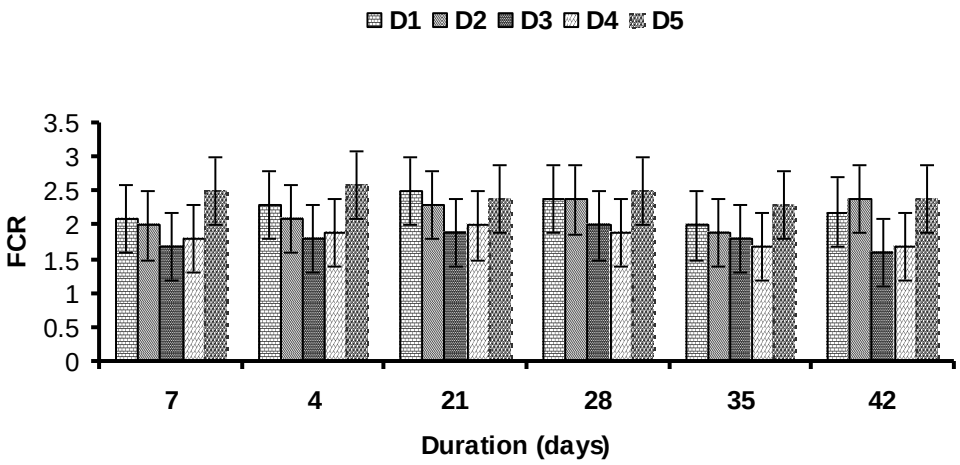

Fig.1.4. Food conversion ratio of *Channa striatus* fingerlings fed on different dietary protein levels

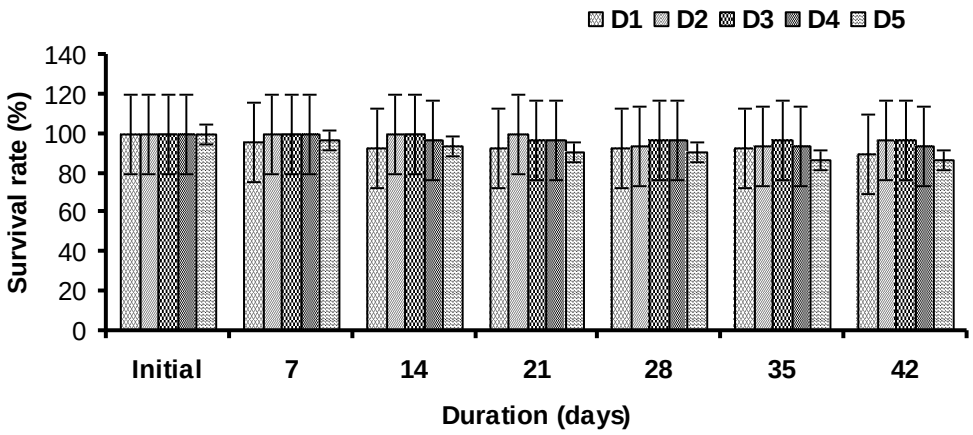

Fig.1.5. Survival rate of *Channa striatus* fingerlings fed on different dietary protein levels

Table- 1. Bio chemical composition of bio wastes* and feed ingredients

Ingredient	Protein (%)	Carbohydrate %	Lipid (%)	Ash (%)	GE/kcal/100g[a]	E/P**
Chicken intestine*	68.45	3.93	10.12	15.72	407.70	5.95
Fish waste*	58.06	3.69	6.18	24.21	326.59	5.62
Silkworm pupae*	55.02	1.00	17.12	22.01	396.73	7.21
Soya bean meal	49.64	9.20	9.70	5.20	337.66	6.80
Ground nut oilcake	48.04	6.90	10.9	11.64	332.74	6.92
Rice bran	15.90	20.4	3.90	7.90	175.11	11.01
Tapioca	14.60	43.7	0.20	8.60	218.16	14.94

Note:

*bio waste

**Energy/protein

[a] Gross energy

Table - 2. Percentage and proximate composition of formulated diets

	Crude protein level %				
Ingredients	**40**	**45**	**50**	**55**	**60**
Chicken intestine	13.8	22.9	32.8	40.0	47.0
Fish waste	18.0	18.0	16.8	20.0	20.0
Silk worm pupae	19.0	19.0	20.0	20.0	20.0
Ground nut oil cake	6.0	6.0	6.0	6.0	3.0
Soya bean flour	5.0	5.0	6.0	5.0	2.0
Rice bran	31.2	22.1	11.4	2	1.0
Cod liver oil	3	3	3	3	3
Tapioca flour	3	3	3	3	3.0
Vit.Min.mix [a]	1.0	1.0	1.0	1.0	1.0
Proximate composition	**Nutrient content (%)**				
Protein %	39.08	43.35	49.20	54.72	59.36
Carbohydrate %	10.50	8.88	7.239	5.248	3.77
Lipid %	7.971	8.181	8.569	12.732	13.25
Gross Energy (Kcal/100g)	279.94	304.29	319.32	372.69	392.89
E/P ratio (g/Kcal)	7.162	6.709	6.489	6.810	6.618

[a] Vitamin-mineral per 100g premix contained: Vitamin A 200,000 IU, Cholecalciferol 40,000 IU, Vitamin B_{12} 80 mg Vitamin E 30 units,Vitamin K 40 mg,calcium pantochenate 100mg,nicotinamide 400mg,vitamin B_{12} 240 mg, choline chloride 6 g, calcium 30g,manganese 1.1 g, idodine 40mg,iron mg, zinc 600mg,copper 80mg,cobalt 18 mg

Table -3. Growth performance of *Channa striatus* fingerling fed with different level of proteins for a period of 42 days

	Protein %				
	40 (D1)	**45 (D2)**	**50 (D3)**	**55 (D4)**	**60 (D5)**
Initial length (cm)	6.41±0.01 [a]	6.42±0.01 [a]	6.4±0.01 [a]	6.42±0.01 [a]	6.39±0.01 [a]
Initial weight (g)	1.955±0.011 [a]	1.96±0.011 [a]	1.981±0.011 [a]	1.982±0.01 1 [a]	1.98±0.011 [a]
Final length (cm)	8.1±0.015 [d]	8.31±0.015 [c]	9.31±0.015 [a]	8.58±0.03 [b]	8.13±0.004 [e]
Final weight (g)	4.09±0.01 [d]	4.18±0.015 [c]	5.56±0.012 [a]	4.568±0.02 5 [a]	4.03±0.001 [e]
SGR (%/day)	0.758±0.010 [d]	0.775±0.002 [c]	1.079±0.001 [a]	0.865±0.002 [b]	0.73±0.001 [e]
Weight gain (%)	105.87±1.29 [d]	110.57±1.56 [c]	183.29±1.51 [a]	129.95±0.083 [b]	102.89±1.16 [e]
ADG (%)	5.0±0.036 [d]	5.22±0.049 [c]	8.66±0.021 [a]	6.098±0.094 [b]	4.866±0.027 [e]
FCR	2.583 ± 0.025 [d]	2.53 ± 0.015 [c]	1.571 ± 0.013 [a]	1.69 ± 0.009 [b]	2.673 ± 0.025 [e]
Survival (%)	90±10 [a]	96.66±5.773 [a]	96.66±5.773 [a]	93.33±5.773 [a]	86.66±15.275 [a]

The mean values having different superscript in the same row are significant difference at p<0.05% level

Table - 4 Body compositions of *Channa striatus* fingerlings fed with different levels of protein diets.

	Protein %					
	Initial	**40 (D1)**	**45 (D2)**	**50 (D3)**	**55 (D4)**	**60 (D5)**
Protein (%)	51.71±0.844 ^{d}	55.5±0.091 ^{c}	57.62±1.01 ^{b}	59.11±0.041 ^{a}	58.08±0.52 ^{a,b}	54.62±0.22 ^{c}
Carbohydrate (%)	0.88±0.025 ^{d}	1.08±0.01 ^{a,b}	1.04±0.015 ^{b,c}	1.103±0.015 ^{a}	1.81±0.02 ^{a}	1.0±0.06 ^{c}
Lipid (%)	7.57±0.025 ^{b}	7.88±0.032 ^{a}	7.08±0.02 ^{c}	7.06±0.03 ^{c}	6.913±0.12 ^{d}	6.43±0.152 ^{e}
Ash (%)	22.6±0.02 ^{a,b}	23.85±0.005 ^{a}	22.48±0.015 ^{a,b}	20.58±0.025 ^{c}	21.68±0.02 ^{c}	21.63±0.107 ^{b,c}
Moisture (%)	77.47±0.025 ^{a}	74.83±0.051 ^{f}	75.3±0.04 ^{e}	75.66±0.011 ^{d}	76.76±0.107 ^{c}	77.06±0.02 ^{b}
GE (Kcal/100g)	299.98±0.026 ^{f}	319.93±0.02 ^{d}	322.92±0.03 ^{c}	329.32±0.004 ^{a}	322.95±0.04 ^{b}	304.41±0.003 ^{a}
E/P	5.81±0.01 ^{a}	5.77±0.015 ^{b}	5.608±0.004 ^{c}	5.57±0.002 ^{d}	5.56±0.004 ^{d}	5.57±0.002 ^{d}

The mean values having different superscript in the same row are significant difference at p<0.05% level

Summary table 5. Summary of ANOVA treatments on the effect of different levels of dietary protein on the growth performance of *Channa striatus* fingerling, (the means were compared using Duncan multiple range test).

Parameters	Source of variation	SS	df	MS	F-value	Significance
Initial length (cm)	Between groups	0.001	4	0.001	0.001	1.000
	Within groups	0.001	10	0.001		
	Total	0.001	14			
Initial weight (g)	Between groups	0.001	4	0.001	0.001	1.000
	Within groups	0.001	10	0.001		
	Total	0.001	14			
Final length (cm)	Between groups	2.834	4	0.708	2180.823	0.05*
	Within groups	0.003	10	0.001		
	Total	2.837	14			
Final weight (g)	Between groups	5.293	4	1.323	13014.601	0.05*
	Within groups	0.001	10	0.001		
	Total	5.294	14			
SGR (%/day)	Between groups	0.239	4	0.060	2510.123	0.05*
	Within groups	0.001	10	0.001		
	Total	0.239	14			
ADG (%)	Between groups	29.988	4	7.497	2705.614	0.05*
	Within groups	0.028	10	0.003		
	Total	30.015	14			
Weight gain (%)	Between groups	13421.253	4	3355.313	1985.119	0.05*
	Within groups	16.902	10	1.690		
	Total	13438.155	14			
FCR	Between groups	3.417	4	0.854	2419.805	0.05*
	Within groups	0.004	10	0.001		
	Total	3.421	14			

Survival (%)	Between groups	333.333	4	83.33	0.833	0.534
	Within groups	1000.000	10	100.000		
	Total	1333.333	14			

***Statistically significant difference at (p <0.05 % level).**

Summary table 6. Summary of ANOVA body composition of *Channa striatus* fingerling fed on different levels of dietary protein (the means were compared using Duncan multiple range test).

Parameters	Source of variation	SS	df	MS	F-value	Significance
Protein (%)	Between groups	111.234	5	22.247	64.252	0.05*
	Within groups	4.155	12	0.346		
	Total	115.389	17			
Carbohydrate (%)	Between groups	0.106	5	0.021	24.220	0.05*
	Within groups	0.010	12	0.001		
	Total	0.116	17			
Lipid (%)	Between groups	3.070	5	0.614	123.477	0.05*
	Within groups	0.060	12	0.005		
	Total	3.129	17			
Ash (%)	Between groups	13.136	5	2.627	5.486	0.05*
	Within groups	5.268	12	0.479		
	Total	18.404	17			
Moisture (%)	Between groups	17.132	5	3.426	1246.00	0.05*
	Within groups	0.033	12	0.003		
	Total	17.165	17			
Gross energy	Between groups	2036.872	5	407.374	2175887	0.05*
	Within groups	0.002	12	0.001		
	Total	2036.874	17			
Energy/protein	Between groups	0.171	5	0.034	537.690	0.05*
	Within groups	0.001	12	0.001		
	Total	0.172	17			

* - Statistically significant difference at ($p < 0.05$ % level).