DIETARY PROTEIN REQUIREMENT FOR ARMOURED CATFISH FINGERLINGS (*HYPOSTOMUS COMMERSONI* VALENCIENNES 1836)

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ABSTRACT

Rocha, C.B.; Fernandes, J.M.; Tavares, R.A.; Piedras, S.R.N. & Pouey, J.O.F., (2015). Dietary protein requirement for armoured catfish fingerlings (*Hypostomus commersoni* Valenciennes 1836). Braz. J. Aquat. Sci. Technol. 19(2). eISSN 1983-9057. DOI: 10.14210/bjast.v19n2. The objective of this study was to determine crude protein requirement for *Hypostomus commersoni* fingerlings. Seventy two fingerlings of armoured catfish were used with average weight of 2.44 ± 0.14g, distributed in nine tanks, totalizing eight fish per experimental unit. In a completely randomized design, with three treatments and three replications. Three experimental diets were prepared with protein levels of 25, 30 and 40% and isocaloric (3.500 kcal. kg-1). The fish were fed daily with at the rate of 5% of body weight for 10 weeks. Evaluated variables were final average weight, weight gain, specific growth rate (SGR), survival and body composition. Dietary levels of protein did not affect weight gain, specific growth rate and survival. Crude protein higher levels in the diet increased the deposition of protein and reduced body fat ($p \leq 0.05$). Levels of 25% crude protein in the diet of armored catfish are sufficient for good growth performance, however, raise levels may be beneficial, increasing protein deposition in the carcass and reducing body fat.

Keywords: Aquaculture, Fish cultivation, Nutritional management, Nutrient.

INTRODUCTION

In the last decades, an increasing number of fish species are being introduced in Brazilian fishery industry. However, average production is low compared to other countries, mainly due to precarious nutritional management (Portz et al., 2001).

Commercial aquaculture success depends of a series of factors, like biological, management and economical (Lazo et al., 1998). Protein is the most expensive dietary nutrient in any species and for fish this factor becomes relevant in view of the high requirements in their feeding (Furuya et al., 2005; Ribeiro et al., 2007; Feiden et al., 2009).

Estimation of diet crude protein content is the first procedure to determine nutritional requirements for a certain species (Kim et al., 2005; Zuanon et al., 2006).

The armoured catfish (*Hypostomus commersoni* Valenciennes 1836) belongs to the siluriform order (fish with scales) and to the family Loricariidae (body covered by bone plaques in several longitudinal series). This fish is also known as azudo-catfish and chocolate- armoured catfish.

In spite of the reduced number of studies, the armoured catfish is a potential option for commercial growing and/or as ornamental fish (Baldisserotto, 2009). According to to Bunkley-Williams et al. (1994) the South American armoured catfish (Liposarcus multiradiatus) is an edible fish and its eggs are valued as caviar and fingerlings can be commercialized as ornamental fish.

In addition, the increasing demand for quality foods increased the demand for fish cultivation in captivity, mainly of native species, due to better adaptation, commercial good acceptance and facility of obtaining matrices (Querol et al., 1996). The objective of this experiment was to determine crude protein dietary requirements in armoured-catfish fingerlings, based in productive performance and body chemical composition.

MATERIALS AND METHODS

Seventy two (72) armoured catfish fingerlings, with average weight of 2.44 ± 0.14g, were utilized, obtained through natural reproduction in excavated tanks. Fish were allocated in nine aquariums (water tanks) of 30L capacity, provided with bio-filters and artificial aeration, totalizing eight animals per experimental unit. A completely randomized experimental design was used, with three treatments and three replications. Experimental diet were formulated to contain three levels of crude protein (25, 30 and 40%) and equal digestible energy level (3,500 kcal. kg-1), accordingly to NRC (1993) for channel catfish (Ictalurus punctatus) (Table 1). After grinding and mixing of ingredients, warm water (30%) was added until a homogeneous mass for pelletization was obtained and drying at 50°C in stove.

Table 1. Experimental diets composition.

Ingredients	Levels of crude protein (treatments %)		
	25	30	40
Fish meal	16	30	40
Alcohol yeast	16	30	35
Corn (maize)	40	20	-
Soybean meal	15	11	20
Canola oil	12	8	4
Premix (VIT+Min)[1]	1	1	1
Total	100	100	100
Chemical composition (%)			
Crude Protein	25.90	30.23	40.88
Ether extract	15.15	12.58	7.78
Ashes	16.94	12.77	12.58
Dry matter	90.52	90.12	89.77
Digestible energy (kcal. kg^{-1})[2]	3,510	3,561	3,556

1 – Mineral and Vitamin supplement composition for fish: Magnesium – 15,000mg; Cooper – 3,000mg; Iron – 25,000mg; Folic acid – 1,500mg; Zinc – 30,000mg; Vit B12 – 10,000mg; Nicotinic acid – 37,500mg;Vit. A – 2,500 UIVg; Vit. C – 25,000mg; Pantotenic acid – 20,000mg; Vit. D3 – 5,000 IU/g; Vit. E – 20,000mg; Biotine – 50,000mcg; Vit K – 3,500mg; Vit.B1 – 7,000mg; Vit. B2 – 7,425mg; Vit. B6 – 7,250mg; Iodine – 660mg; Selenium – 110mg

2 – Based on digestible energy requirements recommended by NCR (1993) for channel-catfish

Fish were fed once a day, at the rate of 5% of live-weight. Diets were placed in a recipient (feeder) at the bottom of aquariums, using a PVC tube (100mm) due to the dedrital behavior of this species. Weekly aquariums water quality was controlled by physical and chemical analyses with readings of dissolved oxygen (mg. L-1), temperature (°C), hydrogen potential (pH) and total ammonia (mg. L-1).

After 10 weeks of experimental period fish were submitted to biometry to evaluate growth. Performance variables analyzed were: final average weight, weight gain, specific growth rate (SGR). Calculation of SGR was made by using the following formula: SGR (%)=(lnWf – lnWi/t) x 100, where: lnWf= final weight logarithm; lnWi= initial weight logarithm; t= time elapsed (days) in experiment.

For body chemical composition eight animals of each treatment were anesthetized (benzocaine – 100 mg. L-1), weighed, sacrificed and frozen (-18°C). Body chemical composition analyses were made with whole fish and included crude protein, ether extract, ashes and dry matter. Methodology of the Association of Official Analytical Chemist (1990) was used. Humidity (water content) was determined by oven drying at 105°C until constant weight.

Afterwards, aliquots of this samples were destined to analyses of ether extract (Sohxlet extractor), crude protein (N x 6.25, by Microkjeldal method) and ashes (Muffle at 550°C) for 6 hours.

Productive performance data and body composition were analyzed by polynomial orthogonal regression (Software Statistica).

RESULTS AND DISCUSSION

Water physico-chemicals parameters remained uniform during the experiment, showing no significant differences (p>0.05) among treatments. Values of evaluated parameters were: dissolved oxygen (6.1 ± 0.4 mg. L-1); temperature (22.72 ± 0.9 °C); pH (7.3 ± 0.4) and total ammonia (0.01 ± 0.005 mg. L-1), being compatible with the range suggested for tropical fish species (Kubitza, 2003).

Average final weight, weight gain and specific growth rate were not affected (p>0.05) by diet crude protein levels (Table 2).

Table 2. Performance of armoured catfish fingerlings (*Hypostomus commersoni*) fed a diet with different levels of crude protein.

Variables	Treatments (levels of crude protein)			
	25	30	40	p-value*
Initial weight (g)	2.45 ± 0,17	2.42 ± 0,22	2.47 ± 0,20	-
Final weight (g)	3.82 ± 0,50	4.15 ± 0,20	4.39 ± 0,58	0.09
Weight gain (g)	1.37 ± 0,62	1.73 ± 0,35	1.92 ± 0,59	0.15
SGR (%)[1]	0.76 ± 0,07	0.84 ± 0,14	0.89 ± 0,13	0.24
Survial (%)	100	100	100	-

*Polynomial orthogonal regression. [1]Specific Growth Rate.

This result can be explained by the fact that in natural environment the Loricariidis present dreggy feeding habit, making use of foods of low digestibility and low nutritional value (Dalariva & Agostinho, 2001), thus having its crude protein requirements supplied by the 25% crude protein level. On the other hand, Bonfim et al. (2005) determined that 26% protein requirement for curimbatá (Prochilodus affins) which also is a detrital species, suggests that species of similar feeding behavior present similar nutritional requirements.

In relation to chemical body composition a linear positive effect was observed for deposition o crude protein, with the increase of ration crude protein levels (Table 3 and Figure 1). The positive correlation between dietary crude protein level and the increase of muscle protein is common in fish (Kim & Lee, 2009; Abdel-Tawwab et al., 2010).

Studying the ratio energy:protein in tucunaré (Cichla ocellaris), Sampaio et al. (2000) demonstrated that low crude protein level diets result in low efficiency in its utilization; the increase of protein levels in diets favors the utilization of the nutrient which has its maximum efficiency close to the minimum level required by the species and can be applied for armoured catfish.

Table 3. Body composition of whole armoured catfish fingerlings (*Hypostomus commersoni*) (on a dry basis) fed different crude protein levels during ten weeks.

Variables	Crude protein levels (%)			
	25	30	40	p-value*
Crude protein (%)	43.39 ± 0,97	45.07 ± 0,72	46.52 ± 0,23	0,005
Ether extract (%)	32.07 ± 1,91	30.52 ± 0,80	28.14 ± 0,81	0,019
Ashes (%)	13.98 ± 0,27	13.84 ± 0,06	14.07 ± 1,69	0,930
Dry matter (%)	86.14 ± 0,41	82.74 ± 0,38	85.15 ± 0,83	0,490

*Polynomial orthogonal regression. Means of three replications ± mean standard deviation.

In relation to ether extract an opposite effect was observed, decreasing as the diet crude protein levels increased (Figure 1).

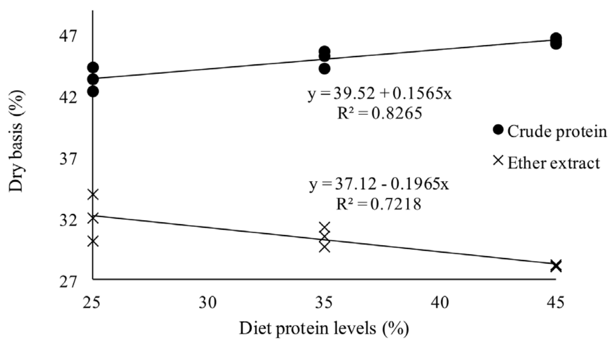

Figure 1. Dietary protein levels effect on body composition of armoured catfish fingerlings (*Hypostomus commersoni*).

This fact also reported by Bomfim et al. (2005), for curimbatá fingerlings. It is suggested (Sá & Fracalossi, 2002) that a lower diet energy:protein ratio, as in the 40% crude protein used in the present experiment, may result in a lower lipids concentration and body fat deposition. This could be explained by the fact that armoured catfish having a low protein requirement, when submitted to high level, shows a metabolism difficulty of this protein, making use of the energetic component for the protein catabolism and reducing body fat deposition, as observed.

An opposite result of the present experiment, is related by Veiverberg et al. (2010), studying a protein diet with grass carp (Ctenopharyngodon idella), where an increase in body fat deposition occurred, following the increase of dietary protein level. This difference between the two species can be attributed to the fact that grass carp is not much efficient in the use of carbohydrates (Takeuchi et al., 1994).

As far as for ashes and dry matter no significant differences among treatments (p>0.05) was observed, similarly to results related by Kim et al. (2002) for the olive flounder (Paralichthys olivaceous), fed diet with increasing protein levels.

CONCLUSIONS

Levels of 25% crude protein in the diet of armored catfish are sufficient for good growth performance, however, raise levels may be beneficial, increasing protein deposition in the carcass and reducing body fat. Forthcoming studies of the ratio energy:protein will define in a most effective form, a diet for this species.

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REFERENCES

Abdel-Tawwab, M.; Ahmad, M.H.; Khattab, Y.A.E. & Shalaby, A.E. 2010. Effect of dietary protein level, initial body weight, and their interaction on the growth, feed utilization, and physiological alterations of Nile tilapia, Oreochromis niloticus (L.). Aquaculture, 298: 267-274.

AOAC. Official methods of analysis of the Association of Official Analytical Chemists. 1990. 15thed. Association of Official Analytical Chemists, Arlington, USA,1298 p.

Baldisserotto, B. 2009. Piscicultura continental no Rio Grande do Sul: situação atual, problemas e perspectivas para o futuro. Ciênc. Rural, 39(1): 291-299.

Bomfim, M.A.D.; Lanna, E.A.T.; Serafini, M.A.; Ribeiro, F.B. & Pena, K.S. 2005. Proteína bruta e energia digestível em dietas para alevinos de curimbatá (Prochilodus affins). R. Bras. Zootec., 34: 1795-1806.

Bunkley-Williams, L.; Williams Jr., E.H.; Lilystrom, C.G.; Corujo-Flores, I.; Zerbi, A.J.; Aliaume, C. & Churchill, T.N. 1994. The South American sailfin armored catfish, Liposarcus multiradiatus (Hancock), a new exotic established in Puerto Rican fresh waters. Carib. J. Sci., 30: 90-94

Dalariva, R. L. & Agostinho, A.A. 2001. Relationship between morphology and diet of six Neotropical loricariidis. J. Fish Biol., 58: 832-847.

Feiden, A.; Signor, A.A.; Boscolo, W.R.; Signor, A. & Reidel, A. 2009. Exigência de proteína de alevinos de piavuçu. Ciênc. Rural, 39(3): 859-865.

Fernandes, J.B.K.; Carneiro, D.J. & Sakomura, N.K. 2000. Fontes e níveis de proteína bruta em dietas para alevinos de pacu (Piaractus mesopotamicus). R. Bras. Zootec., 29(3):646-653.

Furuya, W.M.; Botaro, D.; Macedo, R.M.G.; Santos, V.G.; Silva, L.C.R.; Silva, T.C.; Furuya, V.R.B. & Sales, P.J.P. 2005. Aplicação do conceito de proteína ideal para redução dos níveis de proteína em dietas para tilapia do Nilo (Oreochromis nilóticos). R. Bras. Zootec., 34(5): 1433-1441.

Kim, K.W.; Wang, X. & Bai, S.C. 2002. Optimum dietary protein level for maximum growth of juvenile olive flounder Paralichthys olivaceus (Temminck et Schlegel). Aquacul. Res., 33: 673-679.

Kim, K.W.; Kang, Y.J.; Choi, S.M.; Wang, X.; Choi, Y.H.; Bai, S.C.; Jo, J.Y. & Lee, J.Y. 2005. Optimum dietary protein levels and protein to energy ratios in olive flounder Paralichthys olivaceus. J. World Aqua. Soc., 36(2): 165-178.

Kim, S.S. & Lee, K.J. 2009. Dietary protein requirement of juvenile tiger puffer (Takifugu rubripes). Aquaculture, 287: 219-222, 2009.

Kubitza, F., 2003. Qualidade da água no cultivo de peixes e camarões. 1ª ed. Jundiaí: São Paulo, 229p.

Lazo, J.P.; Davis, D.A. & Arnold, C.R. 1998. The effects of dietary protein level on growth, feed efficiency and survival of juvenile Florida pompano (Trachinotus carolinus). Aquaculture, 169: 225-232.

NRC (National Research Council). Nutrient Requirements of Fish. 1993. National Academy Press, Washington, DC, USA,114p.

Portz, L.; Cyrino, J.E.P. & Martino, R.C. 2001. Growth and body composition of juvenile largemouth bass Micropterus salmoides in response to dietary protein and energy levels. Aquac. Nutr., 7: 247-254.

Querol, M.V.M.; Querol, E. & Passos, V.M. 1996. Estudo preliminar do cascudo Loricariichthys platymetopon (Isbrucker & Nijssen, 1979) (Siluriformes locariidae) visando seu aproveitamento comercial, na região de Uruguaiana, Rs, Brasil. Rev. da Fava, 2/3(1): 110-117.

Ribeiro, F.A.S.; Rodrigues, L.A. & Fernandes, J.B.K. 2007. Desempenho de juvenis de acará-bandeira (Pterophyllum scalare) com diferentes níveis de proteína bruta na dieta. Bol. Inst. Pesca, 33(2): 195-203.

Sá, M.V.C. & Fracalossi, D.M. 2002. Exigência proteica e relação energia/proteína para alevinos de piracanjuba (Brycon orbignyanus). R. Bras. Zootec., 31(1): 1-10.

Sampaio, A.M.B.M.; Kubitza, F. & Cyryino, J.U.P. 2000. Relação energia: proteína na nutrição do tucunaré. Sci. Agric., 57(2): 213-219.

Takeuchi, T.; Hernández, M. & Watanabe, T. 1994. Nutritive value of gelatinized corn me;al as a carbohydrate source to grass carp and hybrid tilapia Oreochromis niloticus x O. aureus. Fish Sci., 60: 573-577.

Veiverberg, C.A.; Radunz-Neto, J.; Silva, L.P.; Sutili, F.J.; Rossato, S. & Corrêa, V. 2010. Teores de proteína bruta em dietas práticas para juvenis de carpa capim. Arq. Bras. Med. Vet. Zootec., 62(5): 1241-1249.

Zuanon, J.A.S.; Salaro, A.L.; Balbino, E.M.; Saraiva, A.; Quadros, M. & Fontanari, R.L. 2006. Níveis de proteína bruta em dietas para alevinos de acará-bandeira. R. Bras. Zootec., 35(5): 1893-1896.

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