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REPLACEMENT OF FISH MEAL BY POULTRY VISCERA MEAL IN THE FEED OF *Leporinus macrocephalus*

VOLNEI SCHWERTNER[1], ODAIR DIEMER[2], LETICIA HAYASHI HIGUCHI[2], SIDNEI KLEIN[3], WILSON ROGÉRIO BOSCOLO[4], ALDI FEIDEN[4]

[1]Undergraduate student in Fishing Engineering, Universidade Estadual do Oeste do Paraná, Toledo, PR, Brazil.
[2]Post-graduate students, Universidade Estadual Paulista Júlio de Mesquita Filho, Jaboticabal, SP, Brazil. odairdiemer@hotmail.com
[3] Post-graduate student, Universidade Estadual de Maringá, Maringá, PR, Brazil.
[4]Professors, PhD, Universidade Estadual do Oeste do Paraná, Toledo, PR, Brazil.

ABSTRACT

The present study aimed at evaluating the productive performance of *Leporinus macrocephalus* fed with different levels of inclusion of poultry offal meal replacing fish meal. The experiment was conducted in a greenhouse located in the Universidade Estadual do Oeste do Paraná during 45 days. We used 200 fish with average initial length of 4.7 ± 0.37 cm and average initial weight of 1.407 ± 0.03 g, distributed in 20 netcages. The experimental design was randomized with five treatments and five replicates with five levels of replacement of fish meal by poultry viscera meal (0, 25, 50, 75, 100%). The parameters evaluated were the productive performance and the chemical composition of animals. The inclusion of poultry viscera meal as a replacement of fish meal in the feeding of *Leporinus macrocephalus* can be used without impairing the performance of the animals.

KEYWORDS: aquaculture; native fish; nutrition.

SUBSTITUIÇÃO DA FARINHA DE PEIXE POR FARINHA DE VÍSCERAS DE AVES NA ALIMENTAÇÃO DO PIAVUÇU *Leporinus macrocephalus*

RESUMO

O presente estudo teve como objetivo avaliar o desempenho produtivo de alevinos de piavuçu, alimentados com diferentes níveis de inclusão de farinha de vísceras de aves na substituição da farinha de peixe. O experimento foi conduzido em uma estufa localizada na Universidade Estadual do Oeste do Paraná durante um período de 45 dias. Foram utilizados 200 alevinos com comprimento inicial médio de 4,7 ± 0,37 cm e peso inicial médio de 1,407 ± 0,03 g, distribuídos em 20 tanques-redes. O delineamento experimental foi inteiramente casualizado com cinco tratamentos e quatro repetições com cinco níveis de substituição de farinha de peixe por farinha de vísceras de aves (0, 25, 50, 75, 100%). Os parâmetros avaliados foram o desempenho produtivo e a composição química dos animais. A inclusão de farinha de vísceras de aves na substituição da farinha de peixe na alimentação de alevinos de piavuçu pode ser realizada sem comprometer o desempenho zootécnico dos animais.

PALAVRAS-CHAVE: aquicultura; nutrição; peixe nativo.

INTRODUCTION

Leoporinus macrocephalus, known as *piavuçu*, is found in the basin of the Rivers Prata and Paraguay. This species presents a fusiform elongated body, with dark spots, reaching up to 60 cm in length (ANDRADE et al., 2006). It has omnivorous eating habits although it shows herbivorous tendency and eats a wide variety of foods (RODRIGUES et al., 2006). Currently, this species is used in fish farming because it shows good performance indexes such as weight gain, feed conversion, growth, meat quality and rusticity (FEIDEN et al., 2009).

Brazil has huge potential for aquaculture, because it has favorable climate, excellent water quality and mostly a great diversity of fish species. Moreover, it presents a great water potential (CAVALLI, 2011).

Fish farming generally requires the use of a balanced diet, based on ration with diversified ingredients and from different manufacturing processes (pelletization and extrusion) for a better use of the feed. The use of rations currently accounts for over 50% of the cost of farming; thus, alternative ingredients have been tested on different fish diets, aiming mainly at reducing costs and providing more food options for the manufacturing of feeds that meet the nutritional requirements of the animals (SIGNOR et al., 2007).

One alternative is the use of poultry offal meal, a product obtained from the poultry industry waste resulting from pressing and grinding the viscera. This ingredient presents good levels of crude protein, between 55 and 68%, and wide availability of calcium and phosphorus (PEZZATO et al., 2002). Due to these characteristics, poultry offal meal is a great option to replace conventional protein sources in fish feed.

Therefore, the aim of this study was to evaluate the performance of *Leporinus macrocephalus* fed with different inclusion levels of poultry offal meal in replacement of fishmeal.

MATERIAL AND METHODS

The experiment was conducted in a greenhouse located at the State University of West Paraná (UNIOESTE), campus Toledo-PR, between April and May 2009, lasting 45 days. It had the support of the Management and Aquaculture Study Group (GEMAq).

We used 200 *Leoporinus macrocephalus* fingerlings with average initial length of 4.7 ± 0.37 cm and average initial weight of 0.03 ± 1.407 g, distributed in 20 netcages with a volume of 150 liters, arranged inside a 25 m³ circular masonry tank, which is constantly aeratated by means of hoses connected to a central air blower.

The experimental design was completely randomized with five treatments and four replications, and each experimental unit consisted of a tank containing 10 netcages. The treatments comprised five diets with five levels of replacement of fish meal by poultry offal meal (0, 25, 50, 75, 100%), being all isoenergetic, isoproteic and isoaminoacidic for lysine, methionine and threonine (Table 1). The feeding was carried out four times a day at 8h00 a.m., 11:00 a.m., 2:00 p.m. and 5:00 p.m., until apparent satiety.

To prepare the diets, the ingredients were milled in hammer-type mill with a sieve of 0.5 mm opening diameter, manually mixed according to the formulation, subsequently processed by extrusion with extruder of 10 kg/h capacity and then dried in a forced ventilation oven at 55 °C for 24 hours.

The physico-chemical parameters of water – dissolved oxygen, pH and electrical conductivity – were monitored weekly by electronic devices. The water temperature was monitored twice a day, before the first and after the last feeding. Water analyzes were performed weekly in circular tank by assessing ammonia, nitrite and phosphorus as described by DIEMER et al.(2010).

Table 1. Percentage composition of the experimental diets with different inclusion levels of poultry offal meal in replacement of fishmeal

Ingredients (%)	Replacement Levels (%)				
	0.00 %	25.00%	50.00%	75.00 %	100.00%
Poultry offal meal	29.89	22.42	14.95	7.47	0.00
Soybean meal	29.89	30.10	30.38	30.06	30.87
Corn grain	27.44	28.30	29.12	30.00	30.83
Soybean oil	6.00	5.98	5.29	4.61	3.92
Dicalcium phosphate	2.16	1.62	1.08	1.08	0.00
Premix*	1.00	1.00	1.00	1.00	1.00
Salt	0.49	0.49	0.49	0.49	0.49
Lysine	2.94	2.22	2.15	2.07	2.00
Methionine	0.14	0.12	0.08	0.04	0.00
Threonine	0.03	0.02	0.01	0.01	0.00
BHT	0.02	0.02	0.02	0.02	0.02
Fishmeal	0.00	7.72	15.44	23.15	30.87
Total	100.00	100.00	100.00	100.00	100.00
Nutrients					
Starch (%)	20	20	20	20	20
Calcium (%)	2.0	2.0	2.0	2.0	2.0
Digestible energy, fish (kcal/kg)	3.500	3.500	3.500	3.500	3.500
Total phosphorus (%)	1.4	1.4	1.4	1.4	1.4
Crude protein (%)	36	36	36	36	36

* Guarantee levels per kilogram of product: vit. A - 500.000 UI; vit. D3 - 250.000 UI; vit. E - 5.000 mg; vit. K3 - 500 mg; vit. B1 - 1.500 mg; vit. B2 - 1.500 mg; vit. B6 - 1.500 mg; vit. B12 - 4.000 mg; folic acid - 500 mg; Ca-pantothenate - 4.000 mg; vit. C - 10.000 mg; biotin - 10 mg; Inositol - 1.000; nicotinamide - 7.000; coline - 10.000 mg; Co - 10 mg; Cu – 1.000 mg; Fe - 5.000 mg; I - 200 mg; Mn - 1500 mg; Se - 30 mg; Zn - 9.000 mg.

At the end of the experimental period, the fish fasted for 24 hours and were anesthetized with Rugenol® (60 $mg.L^{-1}$). Subsequently we determined individual weight (g), total length (mm), survival rate, weight gain, feed conversion, specific growth rate (SGR) and condition factor (CF). Weight gain was determined by (final weight - initial weight), feed conversion by (weight gain / amount of feed offered), specific growth rate by the equation: SGR = [(ln final mean weight (g) - ln initial mean weight (g)) / time of experiment (days)] x 100, and condition factor by the formula: CF = [weight / (total length $^{-3}$) x100]. Afterwards, we randomly withdrew two fish from each cage to analyze the chemical composition of the whole fish, evaluating moisture (M), crude protein (CP), ether extract (EE) and mineral matter (MM), according to methodology described by SIMÕES et al., 2007.

The data referring to parameters were tabulated and submitted to analysis of variance and regression through the statistical program SISVAR version 5.3 (UFLA, 2010).

RESULTS AND DISCUSSION

The physical and chemical parameters of the water in the netcages remained within the range of optimum conditions for breeding fish (DIEMER et al., 2010): temperature 22 ± 1.21ºC (morning) and 23 ± 1.25ºC (afternoon); dissolved oxygen 4.93 ± 1.64 $mg.L^{-1}$; pH 7.46 ± 0.42; conductivity 108.79 ± 37.59 $\mu S.cm^{-1}$; ammonia 0.08 $mg.L^{-1}$; phosphorus 0.13 $mg.L^{-1}$ and nitrite 0.03 $mg.l^{-1}$.

We observed no statistical differences (P> 0.05) by analysis of variance and regression (Table 02) for any of the performance parameters evaluated.

The result of this experiment might be due to the similar characteristics of both ingredients. PEZZATO et al. (2002) assessed the apparent digestibility of ingredients such as fish meal and poultry offal meal by Nile tilapia *(Oreochromis niloticus)*. Based on the results, the authors reported that poultry offal meal showed the best apparent digestibility coefficients followed by fish meal.

Table 02 - Average values of the performance parameters of *L. macrocephalus* fed different inclusion levels of poultry offal meal in replacement of fishmeal

Parameters	Replacement Levels (%)					CV (%)
	0	25	50	75	100	
Initial weight (g)	1.36	1.34	1.37	1.33	1.30	4.90^{ns}
Final weight (g)	8.79	8.63	7.86	8.56	8.69	16.9^{ns}
Final length (cm)	8.64	8.40	8.15	8.45	8.28	4.44^{ns}
Weight gain (g)	7.38	7.23	6.56	7.16	7.28	20.1^{ns}
Survival rate (%)	90.0	82.0	80.0	97.0	82.5	16.4^{ns}
Apparent feed conversion	0.52	0.41	0.44	0.34	0.50	23.5^{ns}
Specific groth rate	4.06	3.99	3.81	3.99	4.13	10.1^{ns}
Condition Factor	1.35	1.43	1.46	1.40	1.52	5.93^{ns}

ns – non-significant (P>0.05).

Poultry offal meal is methionine, lysine and tryptophan deficient (FARIA et al., 2002). We added these amino acids to the diet in this experiment in order to keep the same aminoacidic levels, which can explain the lack of differences in performance.

Several scientific researchers have demonstrated the successful use of poultry offal meal in fish feed, such as BOSCOLO et al. (2005a), who studied poultry offal meal in diets for Nile Tilapia *(Oreochromis niloticus)* during the sex reversal phase, and SIGNOR et al. (2008), who analyzed the poultry offal meal in *(Astyanax altiparanae)* feed.

FINKLER et al. (2010), analyzing the replacement of fishmeal by poultry offal meal in the feed for hybrid *L. macrocephalus* fingerlings reported that the replacement of up to 50% can be made without altering performance; however, values higher than 50% affect weight gain, feed conversion and survival rate, disagreeing with the results of this experiment, which showed neither improvement nor worsening in productive performance.

The amounts of moisture, crude protein, lipids and ash content of the whole body of the fish in this experiment showed no differences (P> 0.05) at the different replacement levels (Table 03).

Table 03 – Chemical composition of whole fish in natural matter of *L. macrocephalus* fingerlings fed different inclusion levels of poultry offal meal in replacement of fishmeal

Parameters	Replacement Levels					CV (%)
	0	25	50	75	100	
Moisture (%)	71.46	71.74	71.74	70.69	71.86	1.33^{ns}
Crude protein (%)	14.83	14.50	14.30	14.64	14.47	5.35^{ns}
Lipids (%)	9.59	9.51	9.13	9.66	9.63	18.96^{ns}
Ashes (%)	2.87	3.06	2.99	3.13	2.92	6.30^{ns}

ns – non-significant (P>0.05).

The different replacement levels of poultry offal meal did not affect nutrients deposition. Similar results were described by FINKLER et al. (2010), who observed no differences for the replacement of fishmeal by poultry offal meal in the chemical composition of the carcass of hybrid *Leporinus macrocephalus*, and obtained similar chemical composition to this study.

BOSCOLO et al. (2005b), evaluating the addition of flour residue from tilapia filleting industry in diets for *Leporinus macrocephalus* fingerlings, observed that tilapia flour positively affected crude protein deposition, demonstrating that the inclusion of flour residues from tilapia filleting in the diet provides better nutritional quality of the fish, which was not verified in this experiment.

The chemical composition of the fish consists mainly of nutrients provided, i.e. the consumption of an imbalanced diet by fish may lead to different levels of body nutrients (SIGNOR et al. 2007). In this experiment, there were no differences in the chemistry composition of the carcass (Table 3), which can be directly related to the correct balance of nutrients supplied to the animals.

CONCLUSION

The inclusion of poultry offal meal as a replacement of fishmeal in the feed for *Leporinus macrocephalus* can be accomplished without impairing growth performance of fish.

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