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Feeding level to pacamã fingerling (*Lophiosilurus alexandri*)

Nível de alimentação para alevinos de pacamã (*Lophiosilurus alexandri*)

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ABTRACT

The present work is aimed to determine the best feeding level to pacamã (*Lophiosilurus alexandri*) fingerlings at performance, survival, and body parameters. One hundred One hundred and twenty five fingerlings with mean body weight of 3.57±0.05g were used and distributed in a completely randomized design with five treatments and four replicates during 30 days. The treatments were five feeding levels: 3, 6, 9, 12, and 15% of body weight day^{-1} of to pacamã fingerlings fish, were feeding twice times daily, 08h00 and 18h00. The diet contained 57,28% crude protein and 3.405,98 Kcal kg^{-1} gross energy. Water temperature ranging of 27.3°C to 28.6°C, and dissolved oxygen was 5.0 mg/L. A quadratic effect (P<0.01) was observed to final weight, weight gain, specific growth rate, and final length. Survival, carcass yield, carcass without head yield, height, head length parameters no showed difference (P>0.05) in function of feeding level. Feeding level of 9.5 % of body weight is recommending to pacamã fingerlings.

Keywords: Brazilian native fish; carnivorous fish; feed management; feed efficiency

RESUMO

O presente trabalho tem como objetivo determinar o melhor nível de alimentação dos alevinos de pacamã (Lophiosilurus alexandri) nos parâmetros desempenho, sobrevivência e corpo. Cento e cento e vinte e cinco alevinos com peso corporal médio de 3,57 ± 0,05g foram utilizados e distribuídos em um delineamento inteiramente casualizado, com cinco tratamentos e quatro repetições durante 30 dias. Os tratamentos foram cinco níveis de alimentação: 3, 6, 9, 12 e 15% do peso corporal dia-1 dos peixes de alevinos da pacamã, estavam sendo alimentados duas vezes ao dia, 08h00 e 18h00. A dieta continha 57,28% de proteína bruta e 3.405,98 Kcal kg-1 de energia bruta. A temperatura da água variando de 27,3 ° C a 28,6 ° C e o oxigênio dissolvido foi de 5,0 mg / L. Um efeito quadrático (P <0,01) foi observado para o peso final, ganho de peso, taxa de crescimento específica e comprimento final. Os parâmetros sobrevivência, rendimento de carcaça, rendimento de carcaça sem cabeça, altura e comprimento da cabeça não apresentaram diferença (P> 0,05) em função do nível de alimentação. O nível de alimentação de 9,5% do peso corporal é recomendado para os alevinos de pacamã.

Palavras-chave: peixe nativo brasileiro; peixe carnívoro; gerenciamento de ração; eficiência alimentar

1 INTRODUCTION

The pacamã (*Lophiosilurus alexandri*) is a native fish São Francisco river. This species present a very flattened head (Mello et al. 2015), carnivorous feed habit, sedentary behavior, and it prefers lentic environment with sand or pebbles deep (Travassos, 1959). The interest to farming of this species is related to excellent quality flavor of flesh and spines free (Meurer et al. 2010).

Despite the low rainfall of the Brazilian Semi-Arid Northeast, it has an economic potential for fish culture. The presence of some rivers, particularly the São Francisco River and its dams, irrigation canals, and lakes, affords suitable conditions for fish production systems. The adequate climate for tropical fish culture and the proximity of the sites of production of raw materials for the manufacture of feeds (west of Bahia State) are also positive factors for the development of fish culture in the region. From the social viewpoint, fish culture may become an important income source for the local population, particularly riverside ones, through both large firms and small production associations or cooperatives (Meurer et al. 2009).

To fish farming success, feed management has a great importance to provide a sustainable production (Hasan and New, 2013). In this way, improve fish growth, contribute to reduce feed waste, and sanitary problems (Cho et al. 2003); minimize aquaculture effluents in the Rivers, and reduce fish production costs (Scorvo Filho et al. 2004).

An excessive feed amount is a factor that influences fish performance because feeding levels over fish requirements could be results in a decrease of growth, and consequently fish farming period increase, and feed wastefulness decrease pond water quality (Meurer et al. 2005). Low feeding level results small fish growth and a great size variation (Tabata et al. 1998; Barbosa et al. 2011). Therefore, the correct choice of fish feeding level, at different growth phases, is very important to fish culture success (Tacon and Cowey, 1985).

Feed efficiency and growth of fish are main factors to define viability of fish production in industrial scale (Hung et al. 1989). Studies with nutritional requirements of fish need to be done with the best feeding level to prevent error of these values (Tacon and Cowey, 1985).

The objective of this assay was to determine the best feeding level to pacamã (*L. alexandri*) fingerlings on the performance, survival and carcass parameters.

2 MATERIAL AND METHODS

The present study was carried out lasted 30 days, from october to november 2009, at Aquaculture Laboratory in Agriculture Sciences *Campus* of Universidade Federal do Vale do São Francisco, Petrolina, Pernambuco. One hundred One hundred and twenty five pacamã fingerlings were used, from Companhia de Desenvolvimento do Vale do São Francisco (CODEVASF), with an average body weight 3.57±0.05g and, distributed in a completely randomized experimental design with five treatments and five replicates. Each experimental

unit was made up of an aquarium with five fingerlings. All recommended norms and procedures for the use of animals in scientific experimentation were followed.

Twenty rectangular plastic aquaria with 36L of useful volume were utilized and installed in a recirculation system connected to a biofilter. The aquarium was constantly aerated by microporous stones connected to an air blower.

To evaluate the water quality of experimental units, dissolved oxygen, electric conductivity were measured weekly. To pH and temperature, two daily measurements were done at 08h30 and 18h00. After water measurement and before feeding the tanks were siphoning to withdrawal wastes.

The treatments were five feeding levels: 3, 6, 9, 12, and 15% of body weight day^{-1} of to pacamã fingerlings fish, were feeding twice times daily, 08h00 and 18h00. The feed was manufactured (Table 1) by the ingredients grinding 0.5 mm mesh, mixed and pelletized according Meurer et al. (2007a). After pelletizing process the feed was dried in a ventiled oven for 24h at 56º C. Pellets were crushed and separated for size by bolters, for adequacy fingerlings mouth width. The diet contained 57,28% crude protein and 3.405,98 Kcal kg^{-1} gross energy (Meurer et al. 2000).

Table 1. Ingredients and chemical composition of experimental feed

Ingredient	Level (%)
Fish meal	34.45
Poultry by product meal	30.41
Soybean meal	15.00
Meat and bone meal	10.00
Soybean oil	4.13
Mineral and vitamin supplement[1]	3.00
Corn	2.00
Salt	0.50
Ascophyllum nodosum	0.50
BHT	0.01
Total	100.00
Chemical composition	
Moisture (%)	7.99
Ash (%)	0.77
Gross Energy (Kcal/Kg)	3,405.98
Fat (%)	39.98
Crude Protein (%)	57.28

[1]Warranty levels per kilogram of product: Vit. A, 1,200,000 UI; Vit. D3, 200,000 UI; Vit. E, 12,000 mg; Vit. K3, 2,400 mg; Vit. B1, 4,800 mg; Vit. B2, 4,800 mg; Vit. B6, 4,000 mg; Vit. B12, 4,800 mg; folic acid, 1,200 mg; Calcium Pantothenate, 12,000 mg; Vit. C,

48,000 mg; Biotin, 48 mg; Choline, 65,000 mg; Niacin, 24,000 mg; Fe, 10,000 mg; Cu, 6,000 mg; Mn, 4,000 mg; Zn, 6,000 mg; I, 20 mg; Co, 2 mg; Se, 20 mg.

At the end of experimental period, fish of each experimental unit were counted, weighed and measured to determination of final weight, weight gain, specific growth rate ({[ln final weight – ln initial weight]x100}/days), survival, length, width, height, and head. The fish were numbed with cold water (0-2 ^{o}C), euthanized and then eviscerated for calculation of the carcass yield with and without heads.

Initial fish sample as well as all carcass and viscera were kept in freezer to posterior chemical analyzes. Due to small carcass sample size, all experimental units were analyzed together; therefore, any statistical analysis was being done to this parameter.

The parameters studied were subjected to analysis of variance (ANOVA), and when differences were significant they underwent regression tests, using SAEG software (Sistema de Análises Estatísticas e Genéticas, Statistical and Genetic Analysis System) (UFV, 1997).

3 RESULTS AND DISCUSSION

The results to physical and chemical water parameters were 27.3°C, 28.6°C, 5.3 mg L^{-1}, 8.02 e 156.9 mS cm^{-1}, respectively to morning temperature, afternoon temperature, dissolved oxygen, pH and electric conductivity. The physical-chemical water parameters were within the range of values recommended to tropical fish culture (Boyd, 1990). The best temperature for the growth and feed conversion ratio of *L. alexandri* juveniles (measuring 12.6 ± 0.5 cm and weighing 30.6 ± 3.6 g) is from 27 to 28°C, and the levels of dissolved oxygen above 5 mg L^{-1} (Costa et al. 2016).

Mean final weight of pacama fingerlings varied quadratically ($P<0.01$) with a feeding level increase, with maximum at 9.63% of body weight (Figure 1).

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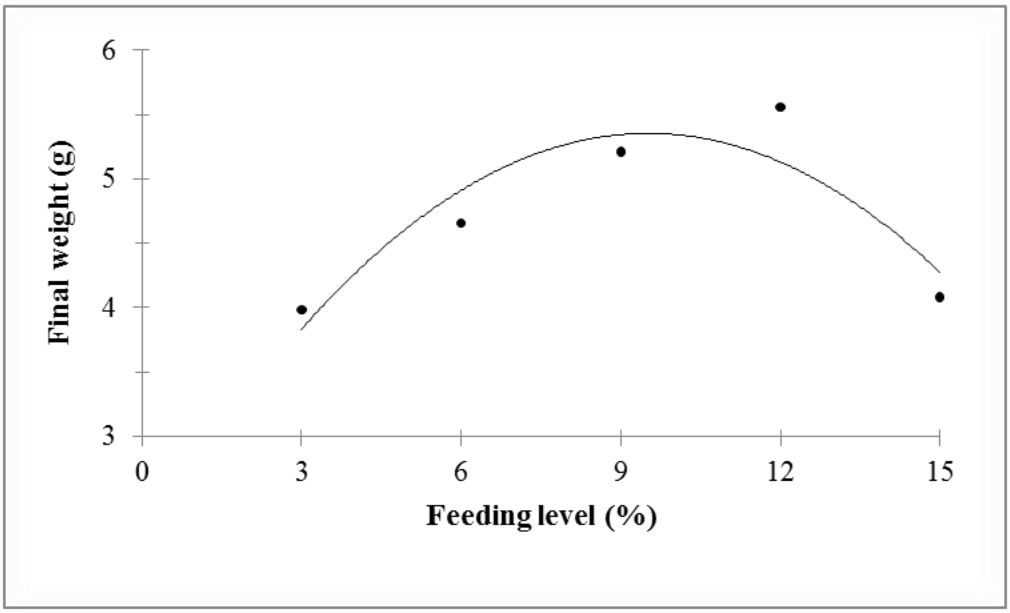

Figure 1. Final weight of pacamã fingerlings submitted to different feeding level

$y = -0.0359x2 + 0.6824x + 2.108$; $R^2 = 0.83$

A quadratic effect was also observed to weight gain, specific growth rate and final length ($P<0.01$) with increase of feeding level and with maximum points respectively at 9.56%, 9.50% and 8.51% of body weight (Figures 2, 3 and 4).

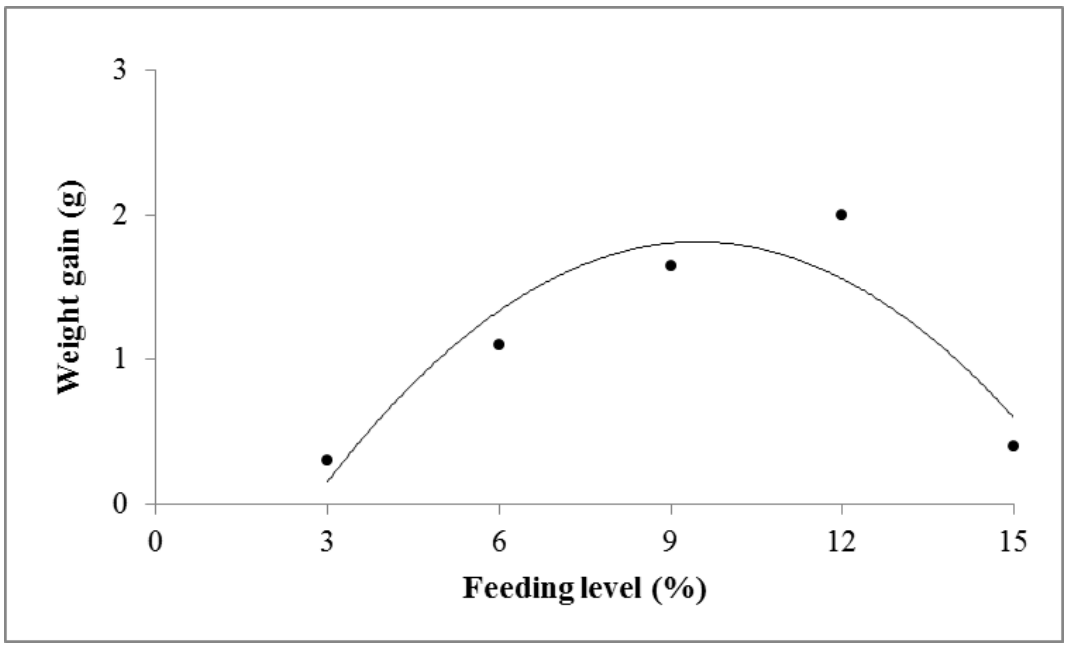

Figure 2. Weight gain of pacamã fingerlings submitted to different feeding level.

$y = -0.0359x2 + 0.6824x + 2.108$; $R^2 = 0.83$

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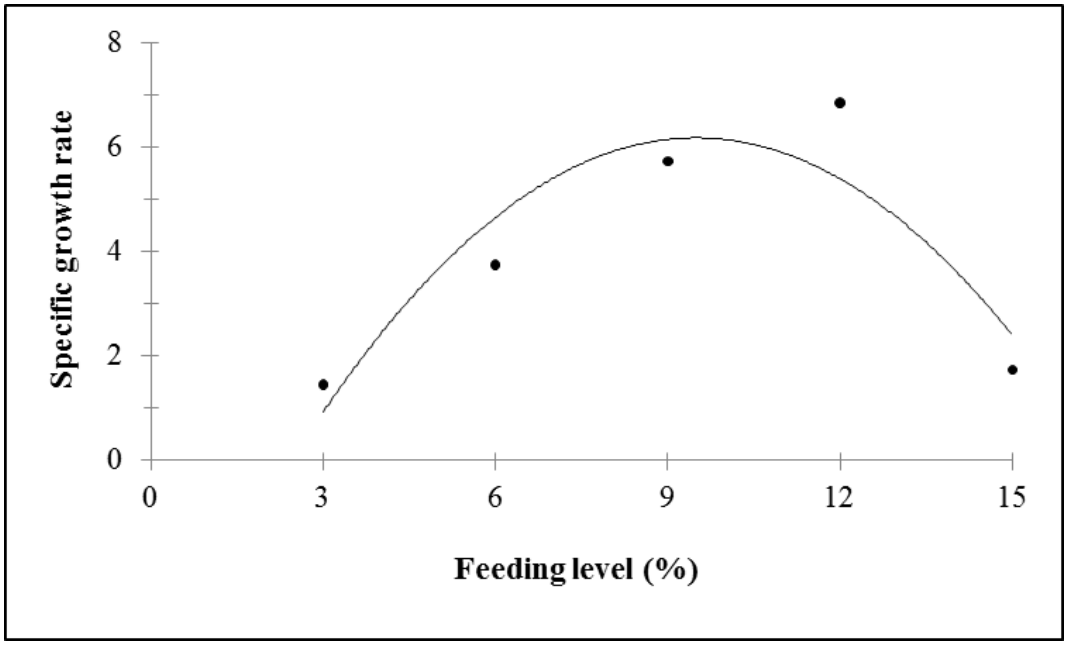

Figure 3. Specific growth rate of pacamã fingerlings submitted to different feeding level.

$y = -0.1248x2 + 2.3701x - 5.072$; $R^2 = 0.8322$

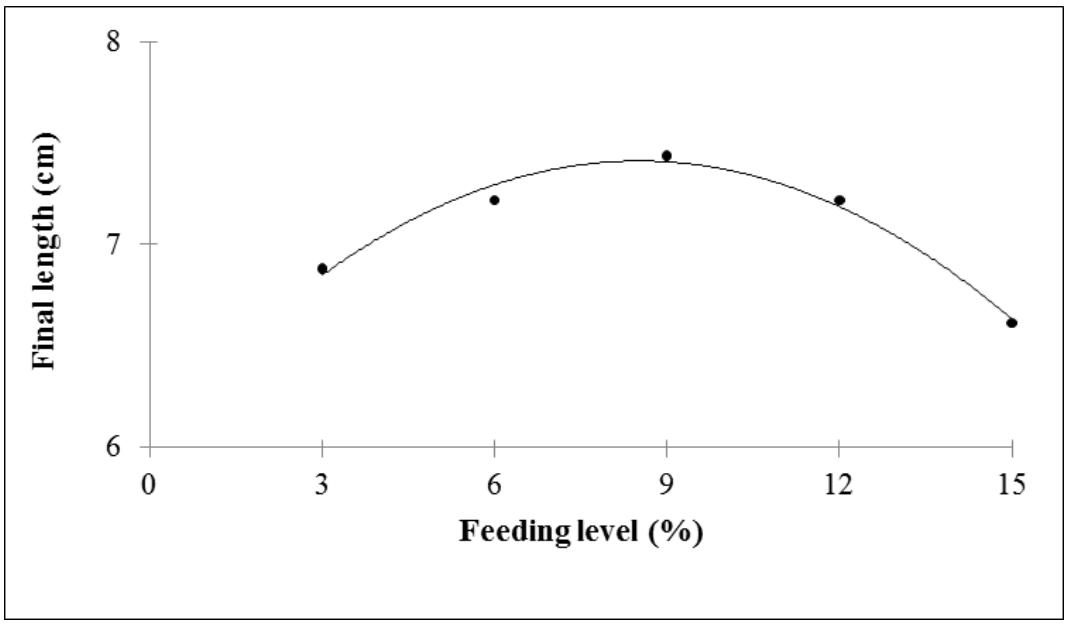

Figure 4. Final length of pacamã fingerlings submitted to different feeding level.

$y = -0.1248x2 + 2.3701x - 5.072$; $R^2 = 0.8322$

An adequate feeding rate is essential for the growth and diet utilization. For juveniles of L. alexandri with 1.3 g, after feed training, a feeding rate ideal is of approximately 5.5% of body weight, using an extruded commercial diet contained 400 g kg^{-1} of protein, 65 g kg^{-1} of

lipids, fibre 60g kg^{-1}, 160 g kg^{-1} ash and a complete mixture of vitamins, and the pellets measured 1.7 mm (Melillo Filho et al. 2014).

Data on carcass chemical composition of pacamã fingerlings submitted to different feeding levels were presented in Table 2.

Table 2. Initial and final chemical carcass composition of pacamã fingerlings submitted to different feed levels (as feed basis)

Treatments	Ash (%)	Gross energy (Kcal/Kg)	Fat (%)	Crude protein (%)
Initial	0.81	3,449.10	29.98	68.91
3%	0.71	3.439,82	30.92	67.31
6%	0.74	3,235.10	20.87	77.51
9%	0.76	3,429.46	28.69	69.52
12%	0.74	3,453.53	26.40	71.81
15%	0.75	3,448.44	31.75	67.09

Parameters of initial weight and survival, width, height, head length, carcass yield, carcass without head yield, were showed in Table 3. No differences ($P>0.05$) on survival, carcass yield, carcass yield without head, height, width, and head length parameters function of different feeding levels were observed.

Table 3. Performance parameters of Pacamã fingerlings submitted to different feed levels

Feed level (%)	CY (%)	CH (%)	HE (cm)	WI (cm)	IW (cm)	SU (%)	HL (cm)
3	86.61	50.47	0.44	1.35	3.56	95.00	1.61
6	89.61	55.11	0.46	1.57	3.58	95.00	1.74
9	86.58	52.98	0.45	1.59	3.55	100.00	1.80
12	81.73	49.41	0.39	1.39	3.57	90.00	1.74
15	86.94	48.12	0.35	1.31	3.57	75.00	1.66
CV(%)	9.55	8.00	27.85	14.52	0.37	20.66	9.38

IW: initial weight; SU: survival ; WI: width; HE: height; HL: head length; CY: carcass yield; CH: carcass yield without head; CV: Coefficient of variation.

Mean final weight results of pacamã fingerlings submitted to different feeding levels, present a quadratic response function that was also observed to weight gain, specific growth rate, and length. In agreement with the present study, Meurer et al. (2005) to yellow tail lambari (*Astyanax bimaculatus*) fingerlings submitted to different feeding levels observed quadratic effect to mean final length, final weight and weight gain.

Similar results to weight gain were reported by Santiago et al. (1987) with Nile tilapia post-larvae, and Storebakken and Austreng (1987) with Atlantic salmon (*Salmo salar*) fry and fingerlings. Chagas et al. (2007) evaluated different feeding levels to tambaqui (*Colossoma macropomum*) juveniles and observed an increase of final weight and length with higher feeding levels.

On the other hand, studies indicated that increasing feeding levels present a linear effect to weight gain and specific growth rate to *Odontesthes argentinensis* (Tesser and Sampaio, 2006) and no effects to weight gain and length to trairão (*Hoplias lacerdae*) (Salaro et al. 2008).

Meurer et al. (2005) suggested that the quadratic effect to performance parameters of fingerlings can be explained, due to the fact that lower feeding levels no provided adequate intake of nutrient levels for the expression of the maximum fingerling growth. Therefore, feeding levels over of ideal level, promote lower weight gain. Waste feed, after some time in the water, causes loss of soluble nutrients as vitamins and minerals, in addition to humidify and swell resulting in appetite loss (satiation) and lower nutrients intake, leading to growth reduction.

The feeding level of 9% of body weight promotes up to 100% of survival but no present differences compared to the others. Salaro et al. (2008) observed similar results to trairão fingerlings submitted to different feed levels, obtaining 100% survival in all treatments. Eroldogan et al. (2004) observed survival range between 83.3 to 100% to European sea bass (*Dicentrarchus labrax*) juveniles, submitted to increasing feeding levels. Similar results were found to *Mystus nemurus* juveniles (Ng et al. 2000), to grass carp *Ctenopharyngodon idella* (Marques et al. 2004), to Nile tilapia post-larvae (Meurer et al. 2007b), and to gilthead sea bream (Mihelakakis et al. 2002).

The establishment of reference values to adequate feeding management of fish have been little studied, like pacamã, should be given great importance to research related to feeding level at different live phases. In fry and fingerlings phases, occurs higher weight gain percent, leading to fast changes of adequate feed levels. Therefore, preventing management errors related to ration lack or wastefulness.

4 CONCLUSION

It was recommend feeding level of 9.5% body weight to pacamã (*Lophiosilurus alexandri*) fingerlings, with daily water temperature between 27.3°C to 28.6°C, and 5.0 mg L^{-1} of dissolved oxygen.

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