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A coloração do *Hyphessobrycon eques* (Steindachner, 1882) influenciada pela adição do óleo de *Attalea phalerata* Mart. ex spreng

The *Hyphessobrycon eques* (Steindachner, 1882) coloration influenced by the addition of *Attalea Phalerata* Mart. ex spreng crude oil

La coloración de los *Hyphessobrycon eques* (Steindachner, 1882) fue influenciada por la adición de *Attalea phalerata* Mart. ex spreng

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Everton Luiz Nascimento Porto
ORCID: https://orcid.org/0000-0002-6783-8911
Universidade Federal da Grande Dourados, Brasil
E-mail: everton_luiz2605@hotmail.com
Fernando Freitas de Lima
ORCID: https://orcid.org/0000-0001-5889-8165
Universidade Estadual de Campinas, Brasil
E-mail: flfernando_@hotmail.com
Rebeca Maria Sousa
ORCID: https://orcid.org/0000-0002-1195-3304
Universidade Federal da Grande Dourados, Brasil
E-mail: rebeca_sousa31@hotmail.com
Wesley Clovis Barbieri Mendonça
ORCID: https://orcid.org/0000-0001-9994-8966
Universidade Federal da Grande Dourados, Brasil
E-mail: wesley.clovis@hotmail.com
Claucia Aparecida Honorato
ORCID: https://orcid.org/0000-0002-7161-4996
Universidade Federal da Grande Dourados, Brasil
E-mail: clauciahonorato@ufgd.edu.br

Resumo

O óleo da polpa de bacuri (*Attalea phalerata* Mart. ex Spreng) possui propriedades medicinais devido a uma alta concentração de carotenoides e ácido palmitoleico do grupo dos Ômegas-7 que podem beneficiar a saúde e o bem-estar dos peixes. O objetivou-se avaliar os benefícios da inclusão do óleo de bacuri no desenvolvimento e coloração do Mato Grosso (*Hyphessobrycon eques* Steindachner 1882). Foram utilizados 51 espécimes de mato grosso distribuídos em quatro unidades de 10L em sistema de recirculação individual e água termostatizada a 28° C. Durante o ensaio de 60 dias os peixes foram alimentados com dietas comercial (DC) e dieta comercial acrescida de óleo essencial de bacuri (5g.kg-1) (DB). Ao final do período experimental foram avaliadas a sobrevivência, o crescimento, coloração e termogenicidade. Os dados foram analisados pelo teste de Duncan (P>0,05). O uso de óleo de bacuri proporcionou baixo índice de crescimento, no entanto destaca-se que apresentou maior comprimento em relação ao grupo DC. O consumo não foi afetado pelo acréscimo do óleo do bacuri, não tendo efeito na palatabilidade da dieta. No entanto a sobrevivência do ensaio foi de 73% para DB e 88% para DC. Não foi observado alteração na coloração e na termogenicidade dos peixes com a inclusão óleo de bacuri. O fator de condição dos peixes DB foi superior ao DC, o que demostra a capacidade em promover bem-estar aos peixes. Conclui-se que na dose utilizada o óleo essencial de bacuri não é recomendado para o Mato Grosso como suplemento para aperfeiçoar a coloração.

Palavras-chave: Peixes ornamentais; Pigmentação; *Tetra-serpae*.

Abstract

Bacuri pulp oil (*Attalea phalerata* Mart. Ex Spreng) has medicinal properties due to a high concentration of carotenoids and palmitoleic acid from the Omega-7 group that can benefit the health and well-being of fish. The objective was to evaluate the benefits of including bacuri oil in the development and coloring of Mato Grosso (*Hyphessobrycon eques* Steindachner, 1882). 51 specimens of coarse forest were used, distributed in four units of 10L in individual recirculation system and thermostated water at 28 ° C. During the 60-day trial the fish were fed with commercial diets (DC) and commercial diet plus essential oil of bacuri ($5g.kg^{-1}$) (DB). At the end of the experimental period, survival, growth, color and thermogenicity were evaluated. The data were analyzed using the Duncan test (P> 0.05). The use of bacuri oil provided a low growth rate, however it is noteworthy that it was longer in relation to the DC group. Consumption was not affected by the addition of bacuri oil, having no effect on the palatability of the diet. However, the trial survival was 73% for DB and 88% for DC. There was no change in the color and thermogenicity of the fish with the inclusion of bacuri oil. The condition factor of DB fish was superior to DC, which demonstrates the ability to promote fish welfare. It was concluded that in the dose used, bacuri essential oil is not recommended for thick bush as a supplement to improve color.

Keywords: Ornamental Fish; Pigmentation; *Serpae Tetra*.

Resumen

El aceite de pulpa de bacuri (*Attalea phalerata* Mart. Ex Spreng) tiene propiedades medicinales debido a una alta concentración de carotenoides Omega-7 y ácido palmitoleico que pueden beneficiar la salud y el bienestar de los peces. El objetivo de este estudio fue evaluar los beneficios de incluir el aceite de bacuri en el desarrollo y tinción de Mato Grosso (*Hyphessobrycon eques* Steindachner 1882). Cincuenta y un especímenes de arbustos gruesos distribuidos en cuatro unidades de 10L se usaron en un sistema de recirculación individual y agua termostatizada a 28ºC. Durante la prueba de 60 días, los peces fueron alimentados con dietas comerciales (DC) y dietas comerciales suplementadas con aceite esencial. bacuri (5g.kg^{-1}) (DB). Al final del período experimental, se evaluaron la supervivencia, el crecimiento, la coloración y la termogenicidad. Los datos fueron analizados por la prueba de Duncan (P> 0.05). El uso de aceite fijo de bacuri proporcionó al arbusto grueso una baja tasa de crecimiento, sin embargo, es notable que presentara una mayor longitud en relación con el grupo DC. El consumo no se vio afectado por la adición de aceite de bacuri, que no tiene ningún efecto sobre la palatabilidad de la dieta. Sin embargo, la supervivencia del ensayo fue del 73% para DB y del 88% para DC. No se observó ningún cambio en el color y la termogenicidad con la inclusión del aceite de bacuri. El factor de condición del pez DB fue mayor que DC, lo que demuestra la capacidad de promover el bienestar de los peces. Se concluye que en la dosis utilizada, el aceite esencial de bacuri no se recomienda como suplemento para mejorar la coloración.

Palabras clave: Peces ornamentales; Pigmentación; *Tetra-Serpae*.

1. Introduction

The Bacuri it's a Brazilian native fruit from the Arecaceae family also known as Acuri, these specific fruits occur in Mato Grosso and Mato Grosso do Sul states, its constituted by peel (exocarp), pulp (mesocarp) and almond (seed) (Lescano et al., 2018). The pulp oil extracted by population it's used by them to relieve the pains because the specie Attalea phalerata Mart. ex Spreng has medicinal properties confirmed with the presence of carotenoids, a very important pigment which are antioxidant too, increases coloration and immunity, but they can't be synthtized by vertebrates, however can be found in photosynthetic organisms (Sefc et al., 2014), and a high concentration compared to other food sources of palmitoleic acid, a fat acid from the Omega-7 group, that acid can reduces metabolic deregulation like Mozaffarian (2013).

Also, in accord to Lima et al. (2018) are attributed to the Bacuri oil an anti-inflammatory property that promote health, the fruit it's therefore a promising functional food, like the oil that have fitoterapic properties with no toxicity at the tested (Lima et al., 2016; Lima et al., 2017). They also have carotenoids; they are natural dyes that are present in natural products in general being considered bioactive compounds capable of promoting health like being against oxidative stress and preventing chronic disorders.

So, thinking in a possible addictive to stimulate coloration, possibly healthiness and well-being to ornamental fishes the Bacuri oil pulp was chosen for a test in one most common and high appreciated ornamental fish species, the Serpae-tetra or natively known "Mato Grosso fish" in Brazil, from Characidae family.

One of the most popular hobby's is to keep ornamental fishes in an aquarium, people who wants to has an entire saltwater or freshwater aquatic ecosystem in a glass tank and keep beautiful fishes and another aquatic organisms, like plants for example, for that the fishes needs to be healthy and colorful and to provide this the fish needs an excellent water and food quality, talking about the food the manufacturers produces a specialized diet for any species of ornamental fishes, and for that they use additives in theirs formula to maximize fish coloration and also increase the fish development (Sampaio et al., 2001), so thinking about that the Bacuri was chosen to be tested as a possibly potential food additive to ornamental fishes.

The objective from this study is evaluate the possible benefits to the inclusion of Bacuri pulp oil in commercial fish diet and measures the gains in coloration and fish development with the Serpae-tetra (*Hyphessobycon eques* Steindachner, 1882).

2. Methodology

The experiment was conducted in an Aquaculture laboratory at the Federal University of Grande Dourados (UFGD), Dourados-MS, Brazil. Fifty-one specimens of *Hyphessobrycon eques* fish with an average initial weight of 0.38 ± 0.01 g and an average length of 3.18 ± 0.01 cm were used; the fish were subjected to a 60-day experimental period, at a density of 1.7 fish per liter. A 7-day acclimatization was performed before starting the experiment. The methodology used to evaluate the data was the quantitative method, with an experimental design with two treatments, composed of a control diet (DC) and inclusion of 5g.kg^{-1} of bacuri oil (DB). The diet had levels of 35% of CP (crude protein), 6% of LIP (lipids) and 3800kcal.kg^{-1} with two repetitions. The animals were fed twice a day until apparent satiety. The cleaning of the experimental units was carried out daily. At the end of the experimental phase, the fish were weighed and measured and survival was assessed by direct counting of the individuals.

The water temperature was maintained at 28.73 ± 0.53° C by a thermostat. The pH remained at 7.22 ± 0.14 and the dissolved oxygen at 6.05 ± 0.26 mg L^{-1}, measured with the YSI Model 6920 V2 multiparameter probe (YSI Inc., Yellow Springs, OH, USA). Ammonia - at 0.10 ± 0.16 mg L^{-1} - was measured by the colorimetric method (Alfakit, Florianópolis, SC, Brazil).

The specific growth rate (SGR) was calculated based on the formula SGR = 100 (*ln* Pf-*ln* Pi) Δt-1, where: Pi is the initial mass; Pf is the final mass; and At is the length of the day between samplings. The coloring was evaluated using the method which, according to Vazzoler (1996), is a CIE *L**, *a**, *b** color model created by the International Lighting Commission to increase the color uniformity perceived by the human visual system. L * represents the color brightness value, while *a** can vary from green to red and *b** from yellow to blue, thermogenicity was also evaluated.

The condition factor (K) was calculated using the allometric method, from the expression K = W/Lb, where W represents the weight and L the standard length of the individuals. To estimate the value of the coefficient b, an equation of the weight / length ratio (W = aLb) was defined from the set of all individuals collected, according to the methodology proposed by (Leão, 2005). To assess weight uniformity, an adaptation of the equation was proposed by (Furuya, et al., 1998): U = (N/N1) x 100, where: U = uniformity (%); N = number of animals in the tank; N1 = total number of animals with weight or length 20% greater or less than the average live weight in each experimental unit.

At the end of the data from the experimental period, such as survival and growth were analyzed by the Tukey thesis test (P> 0.05).

All procedures were approved by the Animal Use Ethics Committee, University of Grande Dourados (CEUA/Unigran 004/2014).

3. Results and discussion

The utilization of bioactives in the aquatic organisms food have been reported as a growth promoter (Safari et al., 2016; Wang et al., 2018) consumption stimulator (Citarasu et al., 2002) and metabolism (Wang et al., 2018). The parameters of Bacuri oil supplemented diet (DB) is available in Table 1, the weight rate was decreased comparing to the Commercial Diet (DC) group, but in a very small difference.

Table 1. Results from evaluated parameters.

Test parameters	Commercial Diet	Commercial Diet plus Bacuri oil
Weight (g)	0,12±0,03	0,10±0,04
Size (cm)	1,42 ±0,38b	2,11±0,92[a]
Feed conversion rate	1,84±0,18	1,12± 0,46
Growth specific rate	0,80 0,21	0,83±0,32
Protein efficiency rate	0,009±0,0025	0,008±0,007
Survival (%)	88,24±8,32	73,52±6,47
Thermogenicity	30,22±0,81	31,52±0,16
Condition fator	0,04b	1,87[a]

Source: Own Study

The length of the fish was higher with the addition of bacuri oil to the diet. Consumption is not affected by the dependence on Bacuri oil, therefore, it does not affect the palatability of the diet. The condition factor of fish fed a supplemented diet was higher than that observed in the common diet. This result is correlated with animal welfare, provided by bioactive gifts in the supplement.

The weight/length ratio is used to estimate the general state, both for fish in their habitat and in captivity (Braga, 1997), healthy (Tavares-Dias et al., 2000). The condition factor is also used to estimate feeding conditions, density, climate, degree of feeding activity (Weatherley and Gill, 1987). The use of the condition factor as an important index to determine the best body shape, was tested for Nile tilapia submitted to microencapsulated diets, demonstrating the better welfare of fish submitted to a certain dietary condition (Honorato et al., 2012).

This result can be seen by the weight/length ratio, the greater condition factor in the diet supplemented with Bacuri oil than the common commercial diet, confirms the better management of nutrients in the metabolism, some researches report that some biochemical substances can positively influence in animal development (Güroy et al., 2012).

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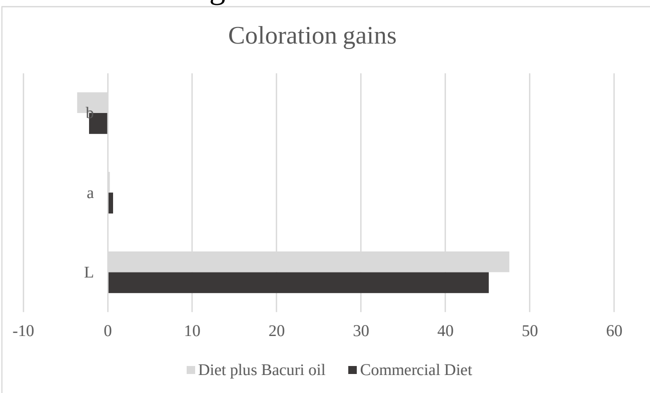
Herbal medicine was tested for aquatic organisms in order to promote improvements in zootechnical indices and animal well-being. In this context, some studies were observed such as passion fruit extract for Nile tilapia (Oliveira et al., 2010), herbal extract for Lateolabrax japonicus (Wang et al., 2018), Cinnamon extract for Pyrrhulina brevis larvae (Abe et al., 2016).

Thermogenicity gains were not observed, but the DB group condition factor was greater than the CD, which shows an ability to promote fish welfare. The gains in coloring were minimal, as seen in the graphs below (Figure 1).

Figure 1. Color of fish



Legend: Color (L* = Brightness (%); a* = red/green coordinate (+ a indicates more red and -a indicates green), b* = yellow/blue coordinate (+ b indicates yellow and -b indicates blue)).
Source: Own Study

We can see a minimal gain in coloration aspects even knowing about the carotenoids, which it is a pigment too, presented in the fruit oil. So, the α and β carotene found in relevant quantities (Lima et al., 2017; Lima et al., 2018) can be used as growth promotor like as seen in the length gains. The antioxidant action of the Bacuri extract was described by Lima et al (2018), and this may contribute to the protection against lipid oxidation, and oxidation action of fish metabolism (Liu et al., 2011) decreasing enzymes action that catalyze superoxide metabolism radicals that are indicative of oxidative stress (Wang et al., 2018). The carotenoids acts as an antioxidants bioactive, so they can reduce the oxidative stress in the cells (Sefc et al., 2014), basically this contributes to an optimized metabolism, promoting better conditions to growth with a supplemented diet.

4. Conclusion

The use of natural products is becoming more and more common in fish feeding, and studies aiming at its use for metabolic benefits and well-being are important. Bacuri oil is a promising product as a nutraceutical food. The results of this study, however, demonstrated that the Bacuri oil dose is not recommended as a complement to optimize the color in ornamental fish; yet however the substance is shown as a promising bioactive for the metabolic development of the fish. However, more advanced research must be verified as an efficiency of bacuri oil as a bioactive compound in other fish species.

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