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The effect of fairy shrimp "branchoneta" (*Dendrocephalus brasiliensis*) as the initial diet of tambaqui postlarvae

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ABSTRACT. The effect of fairy shrimp "branchoneta" as the first exogenous feed for tambaqui postlarvae was evaluated. A hundred and eighty larvae were distributed in 12 aquariums, containing 1.5L of water and the stocking density was 10 larvae per liter. The trials lasted for 20 days and postlarvae were submitted to three diets (T1: Commercial feed, T2: branchoneta, and T3: Commercial feed with branchoneta), with a completely randomized design with four replicates for each treatment. During the trials, the water quality parameters were kept within ideal conditions for the species. The tambaqui postlarvae submitted to T2 and T3 showed better survival rates respectively. Regarding the postlarval development, larvae fed with only branchoneta had a better final weight (3.48 mg), daily weight gain (0.14 mg day^{-1}), and the best specific growth rate (8.62%). The results also showed that the tambaqui postlarvae fed with only commercial feed developed less efficiently due to lower rates of survival and growth. The present study indicates that the branchoneta promoted greater development and survival rates of the tambaqui postlarvae and therefore, it presents good potential as a live food for the species.

Keywords: *Colossoma macropomum*; larviculture; live food; zooplankton.

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Introduction

In fish farming systems the constant demand for food of favourable nutritional quality is considered one of the key problems in fish larviculture. Fish larvae need food that meets the energy and protein requirements for their development, reduces the mortality rate and is also a suitable size for its mouth (Lima, Rodrigues, Varela, Torati, & Maciel, 2016).

Despite the benefits of artificial formulated diets for fish larvae, for most fish species, live feed is still the most important (Sales, 2011; Dhont, Dierckens, Stottrup, Van Stappen, & Sorgeloos, 2013). Several studies carried out with freshwater fish show that plankton promotes better larval development (Luz & Portella, 2002; Castañeda, Esquivel, Muelbert, Vásquez-Torres, & Machado, 2011; Leitão, Pai-Silva, Almeida, & Portella, 2011; Borges-Neto, Dutra, Ballester, & Portz, 2013). Different zooplanktonic organisms are used as live feed, such as brine shrimp nauplii, *Artemia sp*., due to being an excellent food source in the initial stages, as well as being easy to culture (Sales, 2011; Dhont et al., 2013; Le, Hoa, Sorgeloos, & Van Stappen, 2018). However, the high cost of production and difficulty of obtaining brine shrimp cysts ensures a continuous pursuit for an alternative live feed that has a greater survival period in freshwater, lower production costs and that can reduce or even replace the use of brine shrimp as live food.

The fairy shrimp "branchoneta" (*Dendrocephalus brasiliensis*) is considered to be the live feed that meets the ideal nutritional requirements of various larvae (Lopes, Silva, Santos, & Tenório, 1998) and is widely used in fish diets (Carneiro, Silva, Albinati, Socorro, & Neves, 2004; Lopes & Tenório 2005; Feiden, Hayashi, & Boscolo, 2006; Lopes & Santos-Neto, 2006). Furthermore, through suitable techniques of culture, it is possible to produce cysts and biomass under controlled conditions due to their greater filtration capacity and ease of production. Therefore, due to the potential of branchoneta as an alternative food source for many fish species, this study evaluated the effect of this crustacean as an initial diet for tambaqui postlarvae.

Material and methods

The study was carried out at the Zooplankton and Algae Culture Laboratory, in the Aquaculture and Fishing Studies Center of the University of Recôncavo of Bahia (UFRB), Cruz das Almas, Bahia State, Brazil, from January 9th to 27th of 2017.

The tambaqui postlarvae were obtained from the Rodolpho Ihering Fish Farming Station in Cachoeira, Bahia State, Brazil. One hundred and eighty tambaqui postlarvae (*Colossoma macropomum)* were distributed in 12 aquariums measuring approximately 10 x 14 x 13 cm (width x length x height), containing 1.5 L of water. The stocking density was 10 larvae per liter. Larvae were obtained through induced reproduction, 72 hours after hatching and with a mean length of 5.2 mm.

The twelve experimental units were distributed in a completely randomized design, consisting of three treatments (T1, T2, and T3) with four replicates each. The tested treatments were T1: commercial feed with 55% crude protein, T2: only branchoneta nauplii, and T3: commercial feed with 55% crude protein and branchoneta nauplii. The amount of feed was calculated based on 10% of the live weight of the postlarvae.

Branchoneta nauplii were obtained from 1 g of cysts. The cysts were hatched in incubators, with a capacity of 2L each, supplied with constant aeration and kept under a 60 W light bulb, according to the adjusted methodology of Lopes, Gurgel, Gálvez, and Pontes (2007). The maximum hatching rate occurred at 24 hours after incubation, and immediately after, nauplii were transferred to 20 L aquariums and fed with microalgae *Chlorella vulgaris*. The hatching process took place every three days.

The water quality parameters such as temperature (°C) and dissolved oxygen (mg L^{-1}) were monitored daily with a Hanna HI9146 portable dissolved oxygen meter after the meals were given. The pH and ammonia were measured weekly using a Hanna H1991300 digital pH meter and an Alcon Kit pH test, respectively.

The aquariums were siphoned daily and 10% of the water was replaced. The larval development was monitored during the experimental trials and the rates of survival, weight gain and specific growth were obtained. The survival rate was assessed by counting the animals in each experimental unit.

Measurements of larvae were taken on the first and last day of the experiment. The total length was measured in a 0.01 mm Petri dish and using an Olympus SZ2-LGD1 stereomicroscope. The weight of each experimental unit was measured using a Shimadzu AVY220 analytical digital scale (precision of 0.001 g).

At the end of the experiment, survival rate (SR), weight gain (WG), daily weight gain (DWG), and specific growth rate (SGR) of the larvae were calculated according to the following formulas described by Lombardi and Gomes (2008), respectively:

$$\text{SR} = \frac{\text{Nf}}{\text{Ni}}\ x\ 100$$

where: N_f is the final number of live individuals in the aquarium and N_i is the initial number of postlarvae in each treatment.

$$\text{WG} = W_f - W_i$$

where: W_f is the final weight and W_i is the initial weight.

$$\text{DWG} = \frac{W_f - W_i}{t}$$

where: W_f is the final weight, W_i is the initial weight, and t are days of experiment.

$$\text{SGR} = \left[\frac{(\ln mean\ W_f - \ln mean\ W_i)}{\Delta t}\right]\ x\ 100$$

where: W_f is the final weight, W_i is the initial weight, and Δt is the duration (in days) of experiment.

The data were submitted to an Analysis of Variance (ANOVA), and in the event of significant differences among treatments, a post-hoc Tukey test was run adopting a significance level of 5% ($p < 0.05$). Data values were expressed as mean ± standard deviation. Analyses were performed using the Statistical Analysis System, version 9.2.

Results and discussion

The mean values of the water quality parameters in the experimental units were 25.74 ± 1.00°C, 5.94 ± 2.31 mg L^{-1}, 6.96 ± 0.31 and 0.25 ± 0.1 mg L^{-1} for temperature, dissolved oxygen, pH and ammonia, respectively. These values are within the recommended levels for the growth of the species (Rotta, 2003; Araújo-Lima & Gomes, 2005; Dairiki & Silva, 2011).

The survival rate was 21.65% in the T1 fed with only commercial feed, 59.97% in the T2 fed with branchoneta and 58.32% for the T3 fed with branchoneta with commercial feed. Tambaqui postlarvae survival was greater when fed with branchoneta nauplii compared to commercial feed. There was no significant difference ($p > 0.05$) between the T2 and T3 treatments, with both treatments only differing from T1.

Regarding the larval development, postlarvae grew more when they were fed with branchoneta and branchoneta with commercial feed (Figure 1), without any significant difference between those treatments. In relation to the weight measurements, treatments were different from each other. Postlarvae fed with branchoneta reached a greater final weight, and also had a better daily weight gain and greater specific growth rate (Figure 2).

The results obtained in this study demonstrated the positive effect of live food in the early life stages of tambaqui. The lower rates of survival and growth of postlarvae fed with commercial feed can be explained by the underdeveloped digestive system at this stage, being unable to efficiently digest the feed particles due to the lack of specific enzymes and consequently low absorption of the nutrients present in this diet. According to Pedreira, Schomorer, and Ferreira (2015), which found results similar to those of the present study, both the ability and inability of fish larvae to digest artificial feed is related to the morphological and physiological characteristics of the digestive tract of each species, being only able to digest these molecules with the fully developed stomach.

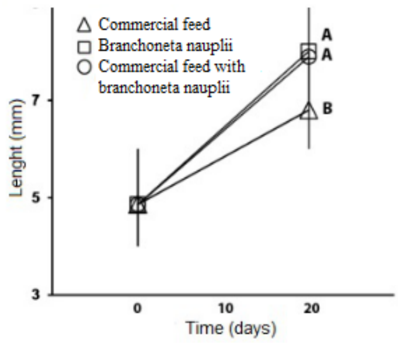

Figure 1. Tambaqui postlarvae mean length (mm) in the following treatments, T1 = Commercial feed, T2 = branchoneta nauplii, and T3 = Commercial feed with branchoneta nauplii. Means followed by different letters are significantly different according to Tukey's test ($p < 0.05$).

Menossi et al. (2012) showed that the ingestion of live food contributed not only to the growth of pacu larvae, but also to the organogenesis of the digestive systems, notably much more than the larvae which were fed with artificial diet.

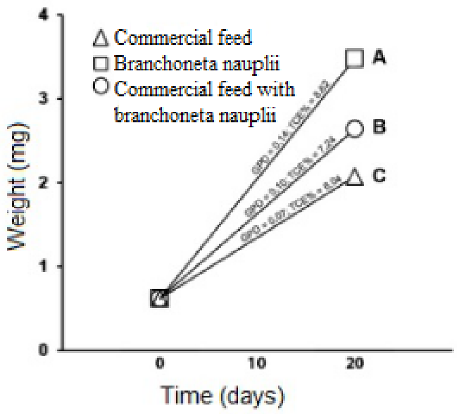

Figure 2. Tambaqui postlarvae mean weight (mg) in the following treatments, T1 = commercial feed, T2 = branchoneta nauplii, and T3 = commercial feed with branchoneta nauplii. Means followed by different letters are significantly different according to Tukey's test ($p < 0.05$). (DWG = Daily weight gain; SGR = Specific growth rate).

In addition, low dietary intake may have been another factor contributing to the observed results. According to Lombardi and Gomes (2008) who found similar results for tambaqui larvae fed with *Artemia salina* nauplii, the availability of live food in the experimental units is an advantage over the commercial feed that is only available for a short time for postlarvae, which cease consumption with the accumulation of the feed in the bottom of the aquariums. Similar results were obtained in other studies with larviculture of different fish species (Beerli, Logato, & Freitas, 2004; Diemer et al., 2012; Menossi et al., 2012; Pedreira et al., 2015).

Pedreira et al. (2015) evaluated the development of tambaqui larvae with different diets and observed that plankton in addition to commercial feed provided better results in the survival and development of postlarvae. Diemer et al. (2012) noticed dead brine shrimp at the bottom of the aquariums and attributed it to the low survival capacity of these animals in a freshwater environment. Thus, taking into consideration the results achieved in the present study and the ease of culture, branchoneta represents a promising high quality and more economically viable alternative food source for the early stages of tambaqui development.

Conclusion

The use of branchoneta nauplii as a diet for tambaqui postlarvae provided better development and survival of the animals. Therefore, branchoneta is a favorable alternative source of live food for the larviculture of freshwater species.

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