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Tambaqui growth and survival when exposed to different photoperiods

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ABSTRACT

The use of different photoperiods (light) were investigated during tambaqui (*Colossoma macropomum*) juvenile growth under captivity. Light intensity tested was: continuous dark (24hrs without light), natural photoperiod simulation (10hrs of light and 14hrs without light) and continuous light (24 with light). No mortality was recorded among treatments. Significant differences was observed after 50 days of experiment among mean fish weight, fish kept under a continuous darkness showed a better specific growth rate (6.02%) when compared to control fish (natural photo period, 3.67%). Fish exposed to continuous light presented the lowest mean specific growth rate (2.04%). It is possible to improve tambaqui juvenile weight gain performance when kept under continuous darkness.

KEY-WORDS

Colossoma macropomum, juvenile fish, photoperiod, growth.

Crescimento e sobrevivência do tambaqui exposto a diferentes fotoperíodos

RESUMO

*Investigou-se o uso de diferentes fotos períodos (iluminação) durante o crescimento de juvenis de tambaqui (*Colossoma macropomum*) em cativeiro. As intensidades testadas foram: escuro contínuo (24hs sem luz), simulação do foto período natural (10hs de luz e 14hs sem luz) e iluminação contínua (24hs de luz). Não houve mortalidade nos diferentes tratamentos. Diferença significativa entre as médias do peso foi observada após 50 dias de experimento, a exposição ao escuro contínuo apresentou o melhor índice de crescimento específico (6,02%) em relação ao controle (foto período natural, com 3,67%). O menor índice de crescimento médio foi observado na exposição à iluminação contínua (2,04%). Assim, pode-se melhorar o desempenho de ganho de peso para juvenis de tambaqui quando mantidos no escuro contínuo.*

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Colossoma macropomum, *peixe juvenil, foto período, crescimento.*

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The flood pulse is the main factor that influences the central Amazon areas characterized by a great variation in the water level and changes in ecological and physical-chemical parameters, such as pH, transparency, dissolved oxygen, photoperiod and ion levels (Aride *et al.* 2004). In the Amazon we can find extremely different conditions among its three main waters types: muddy waters (pH 6.2-7.2), black waters (pH 3.8-4.9) and clear waters (pH 4.5-7.8) according to Sioli (1984). Tambaqui, *Colossoma macropomum*, is widely distributed across South America (Araújo-Lima and Goulding, 1998). Its feeding habit during the juvenile phase, range from seeds and fruits consumption during the rainy season to zooplankton and wild rice during the dry season. The flooded forest is the major representative tambaqui habitat in the Amazon basin, and this species occur in all types of Amazon waters. Tambaqui is the main cultured specie in the Brazilian Amazon (Roubach *et al.* 2003), and also in other South American countries, as Ecuador, Panama, Peru, Venezuela, and Colombia (Chellapa *et al.* 1995).

In the wild, tambaqui experiences different conditions in water transparency. Seasonally, during flood periods, tambaqui can be found in the flooded forest were the waters are obscure. During low water level periods, *Colossoma macropomum* can be found in more clear waters, like in the main river channels (Araújo-Lima & Goulding, 1998). Tambaqui is widely used in aquaculture systems where it is forced to comply with different water conditions through physiological and compartmental changes (Val & Honczaryk, 1995).

The manipulation of environmental factors such as temperature, salinity and photoperiod currently is used to modulate fish growth in culture (Jobling, 1994). Fish responses to changing photoperiod include changes feeding rhythms and growth (Thorpe, 1978). Photoperiod alterations are used to stimulate or delay gonodal maturation, and thus to change spawning period or somatic growth (Lam, 1983). Thus, the influence of photoperiod has been tested for improvement of growth tax in some species. The Atlantic salmon (*Salmo solar*) show an increased growth when exposed to extended day length, but another salmonid, the Artic charr (*Salvelinus alpinus*), may fed and grow well even in complete darkness (Jorgensen and Jobling, 1989). Silver catfish (*Rhamdia quelen)* achieved better growth when exposed to continuous darkness (Piaia *et al.*, 1999). For Atlantic halibut (*Hippoglossus hippoglossus* L.), Simensen *et al.* (2000) suggested that in the first 21 experimental days, the animals used it as an adaptation period for the photoperiod change. After that, fish exposed to continuous light had a significantly higher specific growth rate (1.05%/day-1) than those in the group exposed to 8h with light and 16h with darkness (0.98%/day) (Simensen *et al.*, 2000). The effect of photoperiod on the fish growth is probably related to the feeding and social habitats.

African catfish larvae (Britz & Pienaar, 1992) and channel catfish (*Ictalurus punctatus*) showed better growth rates when exposed to continuous darkness. The Atlantic salmon (*Salmo solar*) show increased growth when exposed to extended day length (Berg *et al.*, 1992). Fish with nocturnal feeding habit, like catfishes, or those species that are aggressive, may increase food intake when held in darkness, whereas those with a diurnal habit may grow better on extended photoperiods. The work of Boef and Bail (1999) described that a fish behavior may also be modified by concomitant diurnal changes in other factors, such as temperature or oxygen availability and the mechanism of photoperiod in fish growth are not so clear. In this study, data are presented to show that tambaqui (*Colossoma macropomum*) juveniles exposed to continuous darkness grow better than those exposed to natural photoperiod and continuous light.

Tambaqui juvenile were distributed among six 500 l aquaria with 10 fish per aquarium (two replicates per treatment). Fish were exposed to continuous light, normal photoperiod (10h Light and 14h Darkness), and darkness (24h D) for 50 days. The aquaria water was maintained at 25 ± 1ºC and continuously aerated by 40W air pumps which promoted water circulation through a plastic mesh and stones to reduce water turbidity (6.1±0,7 mg O_2/l). Water temperature and dissolved oxygen were measured using an YSI model 55 oxygen meter. The water pH was maintained among 5.8-6.2 were measured with pH meter VWR Scientific model 34100.

Fish were fed in excess once a day on ground commercial dry pellets (26% crude protein, digestible energy 2700 kcal/kg, and water content less than 13%, according to the manufacturer's). All faeces and pellet residues were removed daily by siphoning and water level was replaced. Every 10 days, after the start of experiment, all fish were measured and anesthetized with tricaine methano sulphonate (MS-222, 100 mg/l water) for individual weights measurement. Total anesthesia time was 6-8 minutes, and after that fish were then returned to their aquaria.

Fish growth performance among treatments were evaluated with the following parameters: specific growth rate (SRG) (Johnson and Dropkin, 1995), calculated as: SGR = (eg-1) X 100, where g = (ln W2 - ln W1) x (T2 - T1) – 1; W2 and W1 are weights (g) on days t2 and t1, respectively (Houde and Schekter, 1981) and coefficient of variation (CV) of weight were then calculated (Jobling, 1994). Data are expressed as means ± SE and were analyzed by one-way ANOVA.

There was no mortality during the experiment with *Colossoma macropomum*. Final weight of the fish reared in continuous darkness was significantly higher than those exposed to continuous light after 50 days (Figure 1). The SGR of fish in the continuous light treatment was significantly lower than those on natural photoperiod and darkness ($P<0.05$) (Table 1). Other

Table 1 - Juvenile tambaqui (*Colossoma macropomum*) growth performance submitted to different experimental photoperiod after 50 days. Continuous darkness – D; normal photoperiod – NP; and continuous light - CL. G is growth rate; CV is coefficient of variation for weight.

	D	NP	CL
Initial weight (g)	77.8 ± 5.6 n = 30	78.3 ± 5.8 n = 30	78.6 ± 4.5 n = 30
Final weight (g)	119.5 ± 7.8[A] n = 30	114.7 ± 6.3[AB] n = 30	104.1 ± 5.3[B] n = 30
SGR (%)	6.02 ± 0.61[A]	3.67 ± 0.30[B]	2.04 ± 0.21[C]
CV (%)	17.1 ± 0.10	15.3 ± 0.15	11.1 ± 0.10

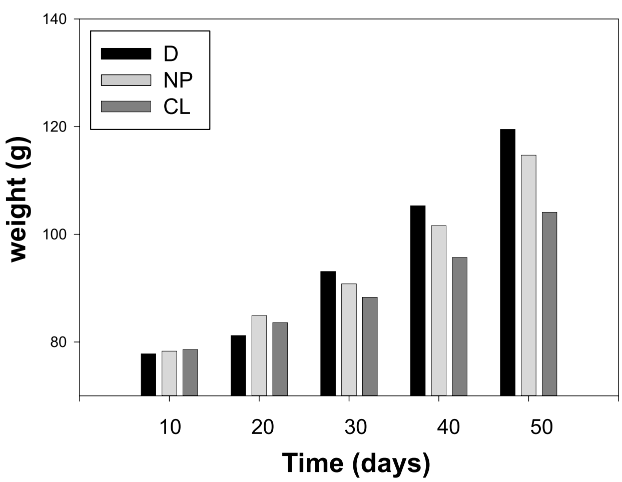

Figure 1 - Juvenile tambaqui (*Colossoma macropomum*) growth performance submitted to different photoperiod after 50 days. Continuous light (CL=24hrs light), normal photoperiod (NP=10/14 light/dark) and darkness (D=24hs dark). Values indicated are means (SE) of two replicates.

fish as Silver catfish, *Rhamdia quelen* (Piaia *et al.*, 1999), Channel catfish, *Ictalurus punctatus* (Stickney and Andrews, 1971) and African catfish larvae (Britz and Pienaar, 1992) also showed best growth rates when exposed to continuous darkness. This data contrast with Atlantic halibut (*Hippoglossus hippoglossus* L.) where the best growth rate was achieved in continuous light (Simensen *et al.*, 2000), but other salmonid, Artic charr (*Salvelinus alpinus*), may feed and growth well even in complete darkness (Jorgensen and Jobling, 1989), as tambaqui and catfishes. A Siluroidei species have a nocturnal feed habit and are described an aggressive (Boujard *et al.*, 1991).

In wild areas, photoperiod is an important environmental signal in the control of a variety of seasonally changing processes, including growth rate (Gwinner, 1986), but this response is delayed, as observed for tambaqui until 20 days, suggesting that this specie needed some time to adapt to the change in photoperiod. This delayed is also observed for other fish species (Simensen *et al.*, 2000).

Juveniles of tambaqui were restricted in flooded plains and moves seasonally between white (muddy) water and black water rivers of flooded jungle to feed during the rainy season. Thus, tambaqui try different types of water, with different luminous intensities for each type. The best performance of tambaqui in darkness can be explained due to the fish low activity during the experimental period. The continuous light can development a social stress, which result in decreased food intake (Volpato and Fernandes, 1994), and increase of aggression. The juveniles of tambaqui exposed to continuous light presented damaged fins (more than 70% of fish), possibly as a result of fight, different from the fish that were exposed to a darkness and normal photoperiod. The same was observed for Silver catfish (Piaia *et al.*, 1997; Piaia *et al.*, 1999). Although this, tambaqui is not usually described as an aggressive species in production systems (Aride *et al.*, 2004). Tambaqui exposed to continuous darkness did not show any fin damage. According to Volpato and Fernandes (1994) social stress alone can cause a lower fish feeding activity response.

The high coefficient of variation (CV) observed in tambaqui exposed to the darkness treatment also indicates that the levels of social interaction might have been increase in this treatment. This can be related to a decrease in swimming activity in darkness, different which observed for other fish species like African catfish and Silver catfish (Britz and Pienaar, 1992; Piaia *et al.*, 1999). Tambaqui is described as a pelagic species in wild areas (Araujo-Lima and Goulding, 1998), but in production systems not usually consider an aggressive species. The effects of photoperiod on growth of fishes probably relate to feed habits, not only with social habits or aggressive.

The best growth of tambaqui was achieved in continuous darkness although the specie has not a nocturnal feeding habit, like catfishes. Therefore, it is possible to improve tambaqui juvenile weight gain performance when kept under continuous darkness.

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