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Short communication

Short-term cycles of feed deprivation and refeeding promote full compensatory growth in the Amazon fish matrinxã (*Brycon amazonicus*)

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ABSTRACT

Developing nutritional strategies that can reduce production costs for the fish industry without affecting productive performance is paramount to make the activity sustainable. We investigated if short-term cycles of feed deprivation and refeeding elicit compensatory growth in matrinxã (*Brycon amazonicus*) juveniles, using three feeding protocols for 60 days (Phase 1): two levels of deprivation (feed deprivation for two days and refeeding for three — D2R3, or four days — D2R4) and a control level (daily feeding). Following, all fish groups were fed daily at satiation for 15 days (Phase 2). At Phase 1, matrinxã achieved full compensatory growth in both deprivation levels by increasing feed intake and feed efficiency. Overall, deprived fish consumed 40% (D2R3) and 36% (D2R4) less feed than fish fed daily. In Phase 2, growth was similar for all fish. Feed intake increased in both deprived fish, but feed efficiency did not differ among groups and was lower than in Phase 1, indicating a reduced efficiency in feed utilization when food was freely available. We propose that intermittent cycles of feeding represent an effective means to reduce production costs.

1. Introduction

Modern aquaculture is searching for ways to reduce production cost and negative effect on the environment without affecting production efficiency. Feeding represents the highest cost in this industry, thus the establishment of strategies that can reduce this cost has been a constant target. One such strategy is feeding protocols based on compensatory growth after periods of food deprivation (Jobling, 2010). Feed restriction and compensatory growth in fish have been studied concerning the application of feeding strategy as a potential way to enhance the growth performance of fish, improving feeding activity after refeeding, and subsequently improving the efficiency of the production system (Chatakondi and Yant, 2001; Hayward et al., 1997; Känkänen and Pirhonen, 2009) besides minimizing water problems (Turano et al., 2008). During refeeding, growth rate is compensated by either a decrease in metabolic costs, an increase in feed intake or an improvement in feed utilization. Indeed, reduced basal metabolism (O'Connor et al., 2000), increased feeding conversion efficiency (Jobling, 2010; Skalski et al., 2005; Xiao et al., 2013), and hyperphagia (Gaylord and Gatlin, 2001; Gurney et al., 2003; Hayward et al., 1997; Jobling, 2010; Känkänen and Pirhonen, 2009; Wang et al., 2000; Xiao et al., 2013) have been observed in a number of fish species following periods of starvation or intermittent feeding.

The response of compensatory growth in fish varies depending on fish species (Wu et al., 2002), dietary nutrient content (Cho and Heo, 2010; Gaylord and Gatlin, 2001; Sevgili et al., 2012), water temperature (Falahatkar et al., 2012), and duration and severity of feed restriction imposed prior to refeeding (Cho and Cho, 2009; Hayward et al., 1997; Känkänen and Pirhonen, 2009; Li et al., 2005; Turano et al., 2008; Xiao et al., 2013).

In our study, we aimed to investigate if short-term cyclic periods without food followed by periods of food availability elicit compensatory growth in juvenile matrinxã (*Brycon amazonicus*), an omnivorous freshwater fish and one of the most valued species in commercial fish farming in Brazil, especially in the Amazonian region. Despite the increasing growth of aquaculture in Brazil, there is a lack of information on the general management of the farmed species, mainly concerning feeding management. Appropriate feeding protocols could help farmers to reduce costs and minimize negative effects on the environment while improving the rearing system of matrinxã and other species.

2. Material and methods

2.1. Fish and experimental procedure

Matrinxã juveniles were randomly distributed into nine 1000 liter tanks (44 fish per tank), in a running and aerated water system, where they were kept for one week adaptation, being fed at apparent satiation with a commercial extruded diet (33% CP) twice a day. Following, fish (29.8 ± 3.8 g) were submitted, during 60 days (Phase 1), to three feeding regimes as follows: C: feed every day at satiation; D2R3: feed deprivation

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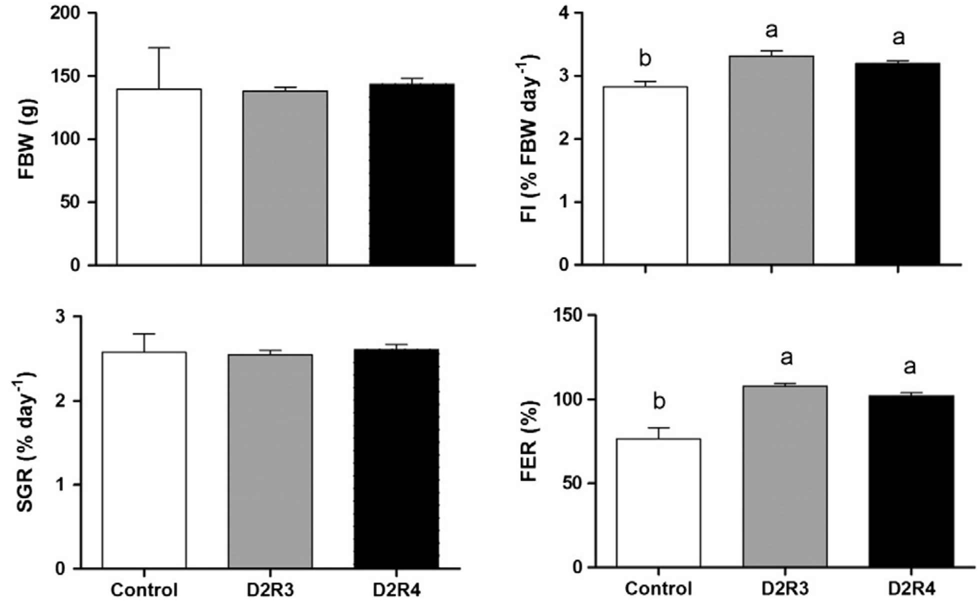

Fig. 1. Final body weight (g) (FBW), feed intake (% day^{-1}) (FI), specific growth rate (% day^{-1}) (SGR), and feed efficiency ratio (%) (FER) of matrinxã (*Brycon amazonicus*). Control (feed every day), D2R3 (feed deprivation for two days and refeeding for three days), and D2R4 (feed deprivation for two days and refeeding for four days) during 60 days (Phase 1). Bars represent means of samplings (n = 12) and vertical bars represent the standard deviation. Same letters do not differ (P > 0.05).

for two days and refeeding for three days; D2R4: feed deprivation for two days and refeeding for four days. After Phase 1, fish from all groups were fed at satiation (FS) every day for additional 15 days (Phase 2) (C, D2R3 + FS, and D2R4 + FS). Feed was offered twice a day and the daily feed consumption was registered.

Fish were sampled after Phase 1 (productive and metabolic parameters) and Phase 2 (productive parameters). After 24 h without food, anesthetized fish (benzocaine, 0.1 g L^{-1}) were weighed (n = 12, 4 per tank) to determine: final body weight (FBW-g); specific growth rate (SGR-% day^{-1} = (100× [(ln mean final weight–ln mean initial weight)/experimental days])); feed intake (FI-% FBW day^{-1} = 100× (mean feed intake/mean fish weight)/feeding days); feed efficiency ratio (FER-% = 100× (weight gain/dry feed intake)). Fish were euthanized and liver was removed for determination of glycogen (Moon et al., 1989) and lipid (Bligh and Dyer, 1959) concentrations. Samples of white muscle were collected for lipid determination. Dissolved oxygen levels (>5.5 mg L^{-1}) and temperature (24.6 ± 0.1 °C) were monitored daily and pH (7.4–7.9) and total ammonia (<0.5 mg L^{-1}) weekly throughout the experiment. Each 4 days, remaining food and feces in the bottom of the tanks were siphoned. This study was performed in accordance with the rules of the Animal Ethics and Welfare Committee of the Universidade Estadual Paulista (UNESP).

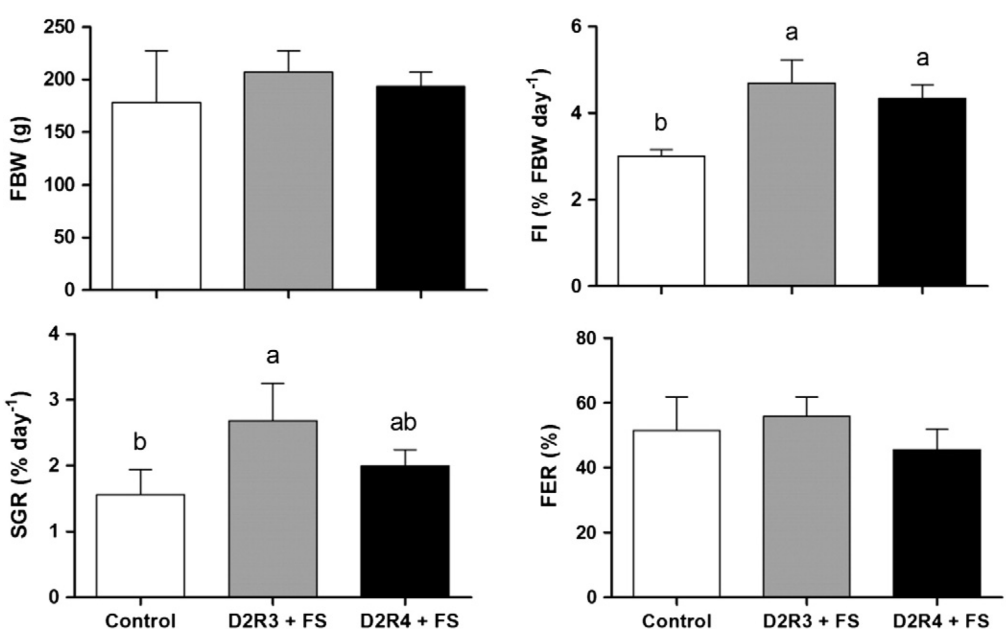

Fig. 2. Final body weight (g) (FBW), feed intake (% FBW day^{-1}) (FI), specific growth rate (% day^{-1}) (SGR), and feed efficiency ratio (%) (FER) of matrinxã (*Brycon amazonicus*). Control (feed every day), D2R3 + FS (feed deprivation for two days and refeeding for three days), and D2R4 + FS (feed deprivation for two days and refeeding for four days) for additional 15 days feeding at satiation (FS) (Phase 2). Bars represent means of samplings (n = 12) and vertical bars represent the standard deviation. Same letters do not differ (P > 0.05).