



Previous chronic stress does not alter the cortisol response to an additional acute stressor in jundiá (*Rhamdia quelen*, Quoy and Gaimard) fingerlings

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Received 21 December 2004; received in revised form 19 May 2005; accepted 24 May 2005

Abstract

Lately, a considerable amount of work has been carried out on fish response to acute and chronic stress. However, very few studies have been attempted to ascertain the effects of combined stressors. In fish, the larviculture is a critical period because the practices employed in this phase are able to provoke a characteristic stress response, which may have chronic characteristics, and may impair further responses to acute stress. In the experiment reported herein, 120-day-old, mixed-sex jundiá fingerlings were used to study the ability of jundiá to cope with a combination of chronic and acute stress. Two hundred and forty fingerlings were evenly distributed in six 2000-L concrete tanks. In three of the six tanks, the fish were exposed to chronic stress, provoked by daily soft handling in spatial restriction, during a period of 20 days. Following this, at the 21st day, the fingerlings were submitted to acute stress by holding them in a dipnet, out of water for 60 s. In the other three tanks, during the first 20 days, the fish were maintained without any disturbance and were exposed to the same acute stressor, on the 21st day, as the other groups. The aerial exposure provoked a characteristic acute stress response in both groups, with plasma cortisol peak reaching 130 ng/ml 1 h after the acute stressor. The capacity of jundiá to respond to an acute stress stimulus was maintained even for those fish chronically stressed. In the non-stressed group of fish, the acute response occurred with the same pattern, with values similar to those observed in chronically stressed fish. The similarity between the secretion pattern of cortisol in both chronically stressed and unstressed jundiá fingerlings strongly suggests that the occurrence of a period of chronic stress did not impair the capacity of the HPI axis to respond to a further acute stressors. Thus, the results of the present study show that jundiá fingerlings are capable of responding to acute stress even following a chronic period of stress.

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Keywords: Stress response; Cortisol; Chronic stress; Acute stress; Jundiá; *Rhamdia quelen*

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¹ CNPq fellowship (300259/2003-4).

1. Introduction

The jundiá (*Rhamdia quelen*), a Siluridae fish, is widespread in the southern part of South America. Jundiá grows fast in summer and has high prolific rates (Gomes et al., 2000); thus, it has been intensively cultured and might be used as a model to improve the management of several fishes of this family.

The most feasible sequence for jundiá culturing is hatchery, larviculture (1–6 g), nursery (from 5–6 g to 30–60 g), and termination (from 30–60 g to 600–800 g). The larviculture is a crucial phase and might be divided in three distinct stages. The first stage initiates with eclosion, ending with complete absorption of the yolk (post-larvae); in the second stage, the post-larvae are transferred to outdoor tanks and allowed to grow up to the time commercial weight is achieved (fingerlings, 1–6 g); in the third stage, the fingerlings are transferred to indoor tanks and kept up to transferring to outside ponds for termination. In the third stage, the diet is changed from plankton to commercial artificial food. In addition, besides the high density, fingerlings are constantly stressed mainly when batches are captured for sale. Thus, the third stage represents a period of chronic stress, and might be followed by acute stress caused by transportation. The combination of chronic stress followed by an acute stress might affect the viability of fingerlings and even be the cause of mortality. Currently, it is not known yet how fingerlings cope with this situation.

Stress response is the reaction of the organism to a variety of adverse factors called stressors. It comprises a number of physiological processes coordinated by the hypothalamus–pituitary–interrenal (HPI) axis. Cortisol, as the main end product of the HPI axis in teleost fish, exerts several physiological actions (as reviewed by Barton and Iwama, 1991; Wendelaar Bonga, 1997) and have been measured in fish blood to evaluate the stress response to several stimuli.

The stress response is differentiated in acute and chronic (as reviewed by Barton and Iwama, 1991; Wendelaar Bonga, 1997). Considerable work has been done on isolated stress responses (Barcellos et al., 2001); however, very few studies have been conducted on jundiá using combined chronic and acute stressors. In addition, few studies have been carried out to evaluate the response to a further acute stress in chronically stressed fish.

Research on the modulation of HPI axis during the third stage of the larviculture period is necessary to elucidate the effects of this chronic stress on a further acute stress response. The possible impairment of HPI axis may prevent fish from responding to common acute and chronic stressors occurring following the third stage, such as the capturing, transport, and stocking in ponds.

The modulation of the acute stress response by a previous chronic situation has been shown for other teleost fish as the Nile tilapia *Oreochromis niloticus* (Barcellos et al., 1999), and the salmonid fish *Oncorhynchus tshawytscha* and *Oncorhynchus kisutch* (Salonius and Iwama, 1993). In addition, it has been demonstrated that rainbow trout stressed in the initial phase of its development showed a lower acute stress response, probably due to HPI axis attenuation (Barry et al., 1995).

Pottinger (1990) suggested that in chronic stress situations or in exogenous cortisol administration treatments, the attenuation of the HPI axis may occur by a reduction in the number of specific sites, and that this attenuation is a protective mechanism to avoid an over-response in situations of additional acute stressors. However, this mechanism has not been observed in red porgy (*Pagrus pagrus*) (Rottlant and Tort, 1997).

Thus, because a period of chronic stress might be followed by an acute stress event, the present study aimed to understand the relation between previous chronic stress and an additional acute stress in *R. quelen* fingerlings.

2. Methods

The study was conducted at the facilities of the University of Passo Fundo, Rio Grande do Sul, Brazil (28°15'S/52°24'W, 687 m above sea level).

2.1. Fish

The fish used in the present study were jundiá fingerlings (mean weight 12 ± 0.2 g), reared and maintained at the Laboratório of Aquaculture of the Universidade de Passo Fundo. Two hundred and forty 120-day-old, mixed-sex jundiá fingerlings were transferred to six concrete tanks, filled with 2000 L of

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