

HEMATOLOGICAL PROFILE OF THE RED SNAPPER *Lutjanus analis* CAPTURED IN FLORIANÓPOLIS, SC, BRAZIL, AND CULTURED IN FLOATING NET CAGES

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ABSTRACT

This study evaluated the hematological profile of 24 red snapper *Lutjanus analis* specimens before and after the culture in floating net cages. The fish were caught with baited traps in Lagoa da Conceição, Florianópolis, Santa Catarina, Brazil, and stocked in floating net cages for 30 days. At the beginning and at the end of the culture period, hematological parameters such as hematocrit percentage, differential count of leukocytes and total count of erythrocytes, leukocytes and thrombocytes were analyzed. Additionally, the fish were weighed and measured in both sampling periods. Fish showed a mean weight of 364.8 ± 63.7 g and total length of 28.7 ± 1.8 cm before culture and a mean weight of 417.4 ± 86.5 g and total length of 30.3 ± 0.7 cm after culture. Significant increase ($p < 0.05$) in the hematocrit percentage and total leukocytes and monocytes counts after culture were observed. This study showed that *L. analis* cultured for 30 days showed changes in the hematological parameters that might be related to adaptive physiological mechanisms of this species to farming conditions.

Keywords: Lutjanidae; hematology; marine fish farming

PERFIL HEMATOLÓGICO DE CIOBA *Lutjanus analis* CAPTURADOS EM FLORIANÓPOLIS, SC, BRASIL, E CRIADOS EM TANQUES-REDE

RESUMO

Este estudo avaliou o quadro hematológico de 24 espécimes de cioba *Lutjanus analis* antes e depois da criação em tanques-rede. Os peixes foram capturados com armadilhas do tipo covo na Lagoa da Conceição, Florianópolis, Santa Catarina, Brasil, e estocados em tanques-rede por 30 dias. No início e no final do período de cultivo, os parâmetros hematológicos como percentual de hematócrito, número total de eritrócitos, além das contagens totais de leucócitos e trombócitos e contagem diferencial de leucócitos foram analisados. Adicionalmente, os peixes foram medidos e pesados em ambos os períodos de amostragem. Os peixes apresentaram peso médio de $364,8 \pm 63,7$ g e comprimento total médio de $28,7 \pm 1,8$ cm antes do cultivo, e peso médio de $417,4 \pm 86,5$ g e comprimento total médio de $30,3 \pm 0,7$ cm depois do cultivo. Foi observado aumento significativo ($p < 0,05$) no percentual de hematócrito, número total de leucócitos e monócitos após o período de cultivo. Este estudo mostrou que *L. analis* mantidos em cativeiro durante 30 dias, apresentaram poucas alterações nos parâmetros hematológicos que podem estar relacionadas à mecanismos fisiológicos adaptativos desta espécie às condições de cultivo.

Palavras chave: Lutjanidae; hematologia; piscicultura marinha

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INTRODUCTION

Among the species with potential for marine fish farming, the species from the genus *Lutjanus* are highlighted due to their productive performance, high demand and high market value (BENETTI *et al.*, 2002; CAVALLI and HAMILTON, 2007). The genus harbors 64 species that live in rocky and coral bottoms (FIGUEIREDO and MENEZES, 2000). The red snapper *Lutjanus analis* (Cuvier, 1828) is considered vulnerable by the International Union for Conservation of Nature and Natural Resources (IUCN), presenting occurrence along the Atlantic coast of the Americas (FOWLER *et al.*, 2005). Experimental cultures developed in the Caribbean, Colombia and Brazil, have demonstrated the potential of this species for marine aquaculture (BENETTI *et al.*, 2002; BOTERO and OSPINA, 2003; SANCHES, 2011).

Despite the potential for farming, most of these fish comes from fisheries - even with stagnant stocks or under high fishing efforts (FREITAS *et al.*, 2010). Thus, the development of snapper culture and the consequent decrease in wild stock fishing due to the supply of farmed fish, may provide a tool for preserving this important group of reef fishes (SANCHES *et al.*, 2007).

In Brazil, marine fish farming is in early stages of development, therefore, basic information on the species biology with potential for culture becomes essential for the future sustainability of the productive chain. Hematological parameters are important tools for assessing the general fish health status (MARTINS *et al.*, 2008a). Hematology is useful in verifying the effects of diseases, parasites, diets and other environmental conditions either in farmed fish from different husbandry systems or in nature (TAVARES-DIAS and MORAES, 2004).

Studies describing hematological parameters in marine fish are limited (WELLS and BALDWIN, 1990; MONTERO *et al.*, 1999; ELAHEE and BHAGWANT, 2007; PAVLIDIS *et al.*, 2007; DEL RIO-ZARAGOZA *et al.*, 2010). In Brazil, studies on the hematological parameters were made in mullet *Mugil platanus* from Cananéia, SP (RANZANI-PAIVA, 1995;

RANZANI-PAIVA and TAVARES-DIAS, 2002), fat snook *Centropomus parallelus* (SANTOS *et al.*, 2009) from Cananéia, SP, and common snook *Centropomus undecimalis* from Bragança, PA (FUJIMOTO *et al.*, 2009). There are no records on the hematology of snapper in Brazil.

Hematological parameters are susceptible to changes in the aquatic environment and may vary in wild and farmed conditions. Although important, studies that compare the hematological variables of fish before and after culture are scarce. The objective of this study was to evaluate the hematological profile of the red snapper *L. analis*, caught in their natural environment and after they have been cultured in floating net cages during 30 days.

MATERIAL AND METHODS

Twenty-four red snappers, *L. analis*, were caught by fisherman using baited traps in coastal areas of Lagoa da Conceição, Florianópolis, SC (27°35'00.27"S; 48°26'30.51"W). The fish were placed in two floating net cages of 8 m³ each with stocking density of 1.5 fish m⁻³, located in open circulation ponds in the Laboratory of Marine Fish Culture (LAPMAR) of the Federal University of Santa Catarina (UFSC) in Florianópolis.

At the beginning of the experiment, all fish were anesthetized in a benzocaine solution (50 mg L⁻¹) (according to the Ethic Committee PP 00861, CEUA/UFSC) and approximately 1.0 mL of blood was collected by puncturing the caudal vessel with syringes containing EDTA 10% (GHIRALDELLI *et al.*, 2006). After that, fish were measured (cm) and weighed (g) individually using a digital electronic weighing scale (accuracy of 0.01 g). An aliquot of collected blood was used to determine the hematocrit percentage according to GOLDENFARB *et al.* (1971). Subsequently, blood smears were made in duplicates and stained with May-Grunwald/Giemsa by ROSENFELD (1947) method for total count of leukocytes and thrombocytes as well as differential count of white blood cells. The red blood cells count was performed using a hemocytometer after 1:200 dilution in sodium chloride solution (0.65%). The total numbers of thrombocytes and white blood cells were

calculated by the indirect method from blood smears, as suggested by ISHIKAWA *et al.* (2008).

After blood collection, the fish were replaced in the floating net cages. During the experimental period, the fish were fed once a day with eviscerated trash fish, at a rate of 3% body weight. Temperature and dissolved oxygen concentration in the water was monitored daily (YSI model 51 Oximeter - Yellow Springs Instrument Company, Yellow Springs, Ohio, USA) and presented mean values of 21.0 ± 1.9 °C and 4.5 ± 1.1 mg L⁻¹, respectively. The salinity (32.5 ± 2.0 ‰) was also measured daily using an optical refractometer F 3000 (Bernauer Aquaculture, Blumenau, Brazil).

At the end of the culture adaptation period (30 days), a new biometric and blood sampling, following the same methodology, was made in order to compare the hematological parameters of fish.

Hematocrit percentage data were transformed into arc sine root of x and the other data were transformed into root of x . Then, the results were subjected to analysis of variance (ANOVA) and, when significant, the "t" test was used to

detect differences between treatments ($p < 0.05$) (ZAR, 1999).

RESULTS

At the beginning of the experimental period, the mean weight of the fish was 364.8 ± 63.7 g and total length 28.7 ± 1.8 cm; after 30 days of daily feeding with trash fish, the mean weight was 417.4 ± 86.5 g and total length 30.3 ± 0.7 cm.

In relation to the hematological parameters, specimens of red snapper cultured for 30 days showed a significant increase in the hematocrit percentage even though no increase in the number of circulating red blood cells was observed (Table 1). A significant increase of total white blood cells after 30 days culture was also observed (Table 1).

No significant difference was found in the values of thrombocytes, lymphocytes and neutrophils between the two sampling periods. On the other hand, monocytes number was higher in fish after culture than that observed at the beginning of the experiment (Table 1).

Table 1. Hematological parameters and standard deviation of *Lutjanus analis* before and after 30 days of culture in floating net cages. Different letters indicate significant differences between the periods ($p < 0.05$) by "t" test.

Hematological parameters	Before culture	After culture
Hematocrit (%)	31.73 ± 8.16^a	40.81 ± 9.22^b
Red blood cells ($\times 10^6 \mu\text{l}^{-1}$)	2.99 ± 0.87^a	2.42 ± 0.73^a
White blood cells ($\times 10^3 \mu\text{l}^{-1}$)	30.25 ± 16.23^a	42.44 ± 14.13^b
Thrombocytes ($\times 10^3 \mu\text{l}^{-1}$)	23.21 ± 12.37^a	16.38 ± 8.75^a
Lymphocytes ($\times 10^3 \mu\text{l}^{-1}$)	18.04 ± 10.01^a	20.58 ± 6.55^a
Neutrophils ($\times 10^3 \mu\text{l}^{-1}$)	10.75 ± 8.07^a	16.77 ± 7.96^a
Monocytes ($\times 10^3 \mu\text{l}^{-1}$)	1.47 ± 2.10^a	5.08 ± 1.94^b

DISCUSSION

In farmed fish, chronic stress is mainly caused by incorrect fish management such as inadequate husbandry, high stocking density and unbalanced diet (MORAES and MARTINS, 2004). In the present study, all of the items mentioned above have been observed and controlled during the experimental period, particularly with respect to food. SANCHES (2011) proved the feasibility of using trash fish in the culture of red snapper,

highlighting the significant weight gain of the species similarly to the studies of CABRERA *et al.* (1997) and CASTILLO-VARGASMACHUCA *et al.* (2007).

Farmed fish can present changes in the hematological parameters when compared to wild specimens, which may be related to the health status or imbalance fish homeostasis (RANZANI-PAIVA and ISHIKAWA, 1996). According to TAVARES-DIAS *et al.* (2008), the assessment of

blood parameters enables rapid detection of stress that the culture environment can impose on fish. As observed in the present study, an increase in the hematocrit percentage can occur after a culture period, corroborating the results found in mullet *M. platanus* (RANZANI-PAIVA and ISHIKAWA, 1996), in gilt-head bream *Sparus aurata* (MONTERO *et al.*, 1999), in giant trevally *Caranx ignobilis* and yellow spotted trevally *Carangoides fulvoguttatus* (WELLS and BALDWIN, 1990). MONTERO *et al.* (1999) have related chronic stress, increased hematocrit percentage and cortisol in *S. aurata* kept in high stocking densities. WELLS and BALDWIN (1990) observed similar values of hematocrit percentage in *C. ignobilis* and *C. fulvoguttatus* when compared to the end of the experimental period in the present study. In contrast, lower values in the hematocrit percentage were observed in *Lethrinus nebulosus*, *Epinephelus merra*, *Lutjanus carponotatus*, *Choerodon albigena* and *Echeneis naucrates* (WELLS and BALDWIN, 1990) when compared to both sampling periods evaluated in this study. Increased hematocrit percentage can be related to an increased demand for circulating red blood cells (RANZANI-PAIVA and SILVA-SOUZA, 2004), even though no increase in the number of circulating red blood cells was observed in this study.

The number of red blood cells found in this study was similar to that observed in *L. carponotatus* (WELLS and BALDWIN, 1990). This fact confirms the findings of WILHELM FILHO *et al.* (1992), that in the marine fishes of Cyclostoma, Chondrichthyes and Osteichthyes classes, variations in the number and volume of red blood cells may occur and, in general, there is an increase on its number as the degree of fish specialization increases.

As supported by ACEVES *et al.* (2010), erythropoiesis in fish is a result of decreased dissolved oxygen in water. In cultured red snapper, BOTERO and OSPINA (2003) highlighted the strong resistance of fish in relation to changes in the water quality parameters, an important feature for species in intensive culture system. Water temperature, dissolved oxygen and salinity in the present study were considered inside the ideal parameters for snapper, described by BENETTI *et al.* (2002). According to

RANZANI-PAIVA and ISHIKAWA (1996), hematological alterations might be related to different conditions of fish maintenance as reported in this study.

Increased number of white blood cells, as observed in this study after 30 days culture, is associated with inflammatory processes, infections by different pathogens and in certain circumstances, to physiological processes such as extreme stress (HOKAMA and MACHADO, 1997). According to MARTINS *et al.* (2004), white blood cells are directly involved in the defense response of the organism when exposed to stressful conditions.

Aside from the white blood cells, thrombocytes may be involved in the defense response as supported by MARTINS *et al.* (2008b) and DEL RIO-ZARAGOZA *et al.* (2010). In this study, the differential count of the white blood cells was composed by lymphocytes in high number, followed by neutrophils and monocytes, similar to that reported in fat snook *Centropomus paralellus* (RANZANI-PAIVA *et al.*, 2008) and common snook *Centropomus undecimalis* (FUJIMOTO *et al.*, 2009).

According to MAGNADOTTIR (2006), besides the lymphocytes, one of the most important cells involved in the innate immune system are the monocytes, which have the ability to migrate from the circulation to tissues. Monocytes are precursors of macrophages (THOMPSON, 1983). Increased number of monocytes in culture conditions could be associated with the confinement environment in floating net cages, favoring the defense response when compared to wild fish. According to FERREIRA and GIL BARCELOS (2008), fish not adapted to culture can present health and welfare problems often related to a state of chronic stress, which is reflected mainly on its normal behavior. In this study, no abnormal behavior was found in fish from floating net cages.

CONCLUSIONS

This study showed that *L. analis* cultured for 30 days showed changes in the hematological parameters that might be related to adaptive physiological mechanisms of this species to farming conditions.

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