

Original Article

Hematology in ornamental discus fish *Symphysodon discus* from Amazonian, Brazil

Hematologia em peixes-disco ornamentais *Symphysodon discus* da Amazônia

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Abstract

Symphysodon discus is known in the world of aquariums for its market value, beauty, and behavior. However, more substantial information about its physiology and biology must be available, which can hinder its development and maintenance in breeding systems. The study evaluated the blood biochemistry and erythrogram of 20 specimens of *S. discus* captured in the municipality of Barcelos, Amazonas, with an average weight of 89.80 ± 7.13 g and an average length of 13.48 ± 0.55 cm. The erythrogram evaluated variables such as hematocrit (Ht), hemoglobin (Hb), red blood cell count (RBC), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC). Blood biochemistry was analyzed, including cholesterol levels, total proteins, triglycerides, glucose, urea, and chlorides. Intra-specific variations were observed between the surveyed individuals about the Hb, MCV, and MCH values. The values of triglycerides, cholesterol, and chlorides were elevated compared to other cichlids. This study may be useful to serve as a parameter to indicate the normal health conditions of this Amazonian cichlid. It can be applied in studies for ornamental fish farming and actions for managing and conserving the species.

Keywords: physiology, blood, wild specimens, cichlid.

Resumo

Symphysodon discus é conhecido no mundo dos aquários por seu valor de mercado, beleza e comportamento. Informações substanciais sobre a sua fisiologia e biologia devem estar disponíveis, o que pode dificultar seu desenvolvimento e manutenção em sistemas de reprodução. O estudo avaliou a bioquímica sanguínea e o eritrograma de 20 exemplares de *S. discus* capturados no município de Barcelos, Amazonas, com peso médio de $89,80 \pm 7,13$ g e comprimento médio de $13,48 \pm 0,55$ cm. O eritrograma avaliou variáveis como hematócrito (Ht), hemoglobina (Hb), contagem de hemácias (hemácias), volume corpuscular médio (VCM), hemoglobina corpuscular média (HCM) e concentração de hemoglobina corpuscular média (CHCM). A bioquímica sanguínea foi analisada, incluindo níveis de colesterol, proteínas totais, triglicérides, glicose, uréia e cloretos. Foram observadas variações intraespecíficas entre os indivíduos pesquisados quanto aos valores de Hb, VCM e HCM. Os valores de triglicérides, colesterol e cloretos foram elevados em comparação com outros ciclídeos. Este estudo pode ser útil para servir de parâmetro para indicar as condições normais de saúde desse ciclídeo amazônico. Pode ser aplicado em estudos para piscicultura ornamental e ações de manejo e conservação da espécie.

Palavras-chave: fisiologia, sangue, espécimes selvagens, ciclídeos.

1. Introduction

The main drivers of the ornamental fish trade are the aquarium consumers, who determine the species to be produced in aquacultures or caught in the wild (Din et al., 2002; Ribeiro et al., 2023). In general, characteristics such as striking colors, the rarity of the species, and behavioral peculiarities make the species attractive to aquarists (Jesus et al., 2022; Lemos et al., 2015; Santos et al., 2012).

The Amazonian species that comprise the genus *Symphysodon* (*S. aequifaciatus*, *S. discus*, and *S. tarzoo*)

attract aquarists worldwide due to their body coloration pattern and behavioral characteristics (Rossoni et al., 2014; Yang et al., 2021). These cichlids have disk-shaped bodies, and small mouths, inhabit igarapés, lakes, and riverbanks with water temperatures ranging between 26 and 30 °C, and have good resistance to thermal variability (Rossoni et al., 2014).

The discus fish *Symphysodon discus* is economically significant in the national and international ornamental

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fish market (Tribuzy-Neto et al., 2021). However, scientific information on its physiology, health, and adaptation in aquaculture is scarce. The high mortality when out of the natural environment, due to stress and low immunity, problematizes the production of *S. discus* (Tavares-Dias and Moraes, 2004).

Among the tools used to understand animal physiology and health, the analysis of the hematological profile, which includes erythrogram and blood biochemistry, stands out. Hematology allows practical and helpful identification of the stress level, enabling the correction in management and ensuring animal welfare (Magro et al., 2016; Oliveira et al., 2021; Santos et al., 2024; Ranzani-Paiva et al., 2013). In addition to stress, factors such as life stage, type of environment, population genetics, and diet can influence the responses of hematological analyses (Tavares-Dias and Moraes, 2004). The current study verified the hematology of wild specimens of discus fish *S. discus* captured in the natural environment in the municipality of Barcelos, Amazonas, Brazil.

2. Material and Methods

Specimens of discus fish of *S. discus* (N= 20) were captured with “rapiché” (hand net) in flooded areas of the Daracua community and Mariuá Archipelago, located in the municipality of Barcelos, Amazonas, Brazil (Figure 1). The experimental procedures adopted during these animals’ capture and blood analysis were registered and approved by the Brazilian Institute of the Environment and Renewable Natural Resources-IBAMA under Process No. 15116-1. The research was developed and approved by the Ethics Commission on the Use of Animals (ECUA)

of the Federal University of Amazonas under Process No. 2015/010.02.0905. All experiments were conducted according to local and ARRIVE guidelines (Percie du Sert et al., 2020).

The collected fish were stocked in “curries” (pens) (wooden tanks) until they were transported in canoes with “caçapas” (plastic containers with about 20 L⁻¹ of water) to the city of Barcelos, Amazonas. After that, the animals were anesthetized with eugenol (0.2 g.L⁻¹) for blood collection by caudal puncture, using disposable syringes previously moistened with the anticoagulants heparin 2500 IU. After blood withdrawal, standard length (cm) and weight (g) were determined using tape and portable scales, respectively.

The collected blood was divided into two aliquots: one for determining red blood parameters and the other for obtaining plasma and performing assays on biochemical constituents. Erythrocyte counts (RBC) were conducted in a Neubauer chamber after dilution in formalin-citrate solution; hematocrit (Ht) was determined using the microhematocrit method; and the hemoglobin (Hb) concentration was found using the cyanmethemoglobin method. Through these data, the following red cell indexes were calculated: mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) (Anselmo et al., 2021; Bussons et al., 2021; Oliveira et al., 2017; Aride et al., 2021).

Plasma was obtained after centrifugation and frozen in liquid nitrogen (-86 °C) until the biochemical analyses. Glucose, triglycerides, total cholesterol, total protein, urea, and chloride (Cl⁻) concentrations were determined using enzyme-colorimetric methods, with quantification using commercial kits (Labtest®, Brazil) (Oliveira et al., 2016; Castro et al., 2021). The data were tabulated, and descriptive

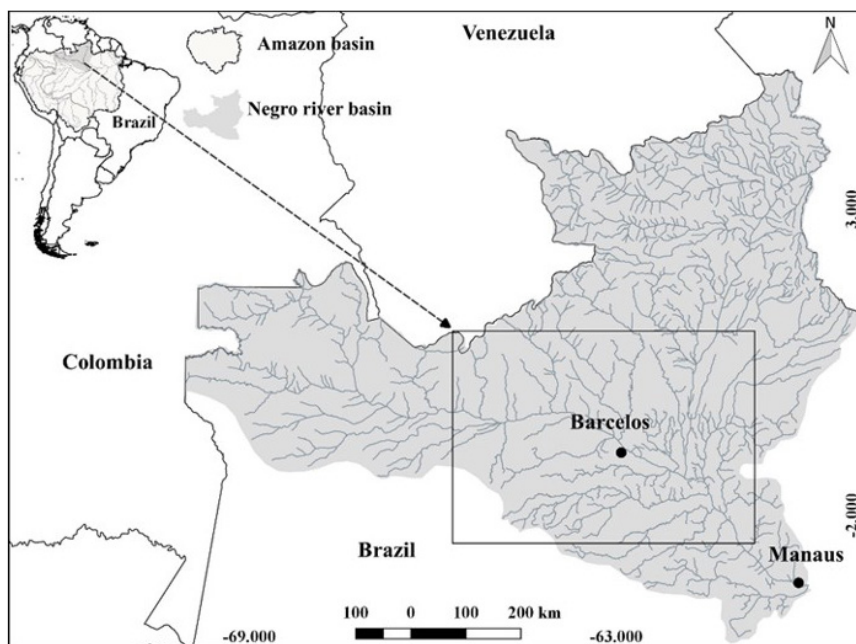


Figure 1. Location of the study area Barcelos, Amazonas, Brazil.

statistics were used, using mean, standard deviation (SD), and maximum and minimum values.

3. Results

In the biometric variables of the fish analyzed, a little intra-specific alteration was observed in total length (TC) and body weight (BW), with TC varying between 12.40 and 14.00 cm and BW varying between 77.00 and 104.00g (Table 1).

The erythrogram of the acará disco (Table 2) showed wide variation in the values of Hb (Hemoglobin; minimum of 2.51 and a maximum of 21.11 g.dL⁻¹), MCV (Mean corpuscular volume; minimum of 101.82 and a maximum of 718.31 fL), and HCM (Mean Corpuscular Hemoglobin; minimum of 9.98 and maximum of 91.64 pg). The levels of cholesterol, total proteins, triglyceride, glucose urea and chloride are demonstrated in Table 3.

4. Discussion

According to Rossoni et al. (2014), the adult *S. discus* has a body measuring between 12.00 and 20.00 cm. Thus, the data in Table 1 (total length: 13.48 ± 0.55 cm) show that the

S. discus captured for the current study is in the adult phase. The fishes analyzed presented high hematocrit (Ht: 34.11 ± 10.23%) and mean corpuscular volume (MCV: 245.37 ± 164.9 fL) about the cichlids *S. aequifasciatus* (blue Discus; MCV: 121.80 ± 45.67 fL and Ht: 17.11%) and *Geophagus brasiliensis* (papa terra acará; MCV: 121.80 ± 45.67 fL and Ht: 5.68 ± 0.87%) reared outside the natural environment and studied by Paixão et al. (2017) and Romão et al. (2006), respectively. However, when compared to the cichlids *Cichla monoculus* (yellow tucunaré), *Cichla temensis* (tucunaré açu), and *Cichla vazzoleri*, in the natural environment, verified by Castro et al. (2021) regarding Ht (between 40.37 ± 1.17% and 40.40 ± 1.06%) and MCV (between 222.94 ± 25.94 fL and 246.11 ± 20.46 fL), the data of the present study are shown to be lower. Lower hematological values show that the animal has lentic behavior (Tavares-Dias and Moraes, 2004). While high values can be attributed to the constant movement of the animal for foraging or escape from predators. The comparison between the cichlids shows the possible influence of the natural environment and the aquaculture production environment on the hematological parameters of *S. discus*.

The mean corpuscular hemoglobin (44.78 pg) and the corpuscular mean hemoglobin concentration (21.45 g.dL⁻¹) of *S. discus* (Table 2) showed lower values than those of tucunarés *C. monoculus*, *C. temensis*, and *C. vazzoleri*

Table 1. Biometric variables of specimens of *Symphysodon discus* captured in Barcelos, Amazonas, Brazil.

Variables	Mean	Standard Deviation	Minimum	Maximum
Standard length (cm)	13.48	0.55	12.40	14.00
Weight (g)	89.80	7.13	77.00	104.00

Table 2. Erythrogram of specimens of *Symphysodon discus* captured in Barcelos, Amazonas, Brazil.

Variables	Mean	Standard Deviation	Minimum	Maximum
Ht (%)	34.11	10.23	20.00	51.00
Hb (g.dL ⁻¹)	7.08	4.27	2.51	21.11
RBC (millions.µL ⁻¹)	1.80	0.76	0.56	2.99
MCV (fL)	245.37	164.9	101.82	718.31
MCH (pg)	44.78	23.73	9.98	91.64
MCHC (g.dL ⁻¹)	21.45	11.59	9.80	49.10

Table 3. Plasma metabolites of specimens of *Symphysodon discus* captured in Barcelos, Amazonas, Brazil.

Variables	Mean	Standard Deviation	Minimum	Maximum
Cholesterol (mg.dL ⁻¹)	298.97	81.32	95.71	442.57
Total Proteins (g.dL ⁻¹)	2.08	1.14	0.63	4.51
Triglyceride (mg.dL ⁻¹)	119.28	44.82	33.33	213.07
Glucose (mg.dL ⁻¹)	53.98	34.80	11.74	140.41
Urea (mg.dL ⁻¹)	31.85	7.20	6.96	43.01
Chloride (mEq.L ⁻¹)	141.68	18.12	81.21	169.07

(Castro et al., 2021). Although both are cichlids in the natural environment, this difference can be attributed to factors that influence hematological parameters such as temperature, dissolved oxygen, seasonal cycle, stress, poor nutrition, and the sex of individuals (Castro et al., 2021).

In the plasma biochemistry analysis, *S. discus* showed high values for triglycerides, cholesterol, and chlorides about other Amazonian cichlids, such as *Cichla* spp. (Castro et al., 2021). Those above may be related to the type of feeding of *S. discus* in the natural environment, which is based on protein- and lipid-rich foods such as small fish, live worms, nauplii of microcrustaceans and periphyton, and the availability and nutritional composition of these foods in the localities where the fish were collected (Rossoni et al., 2014).

The high glucose and urea levels (53.98 mg.dL⁻¹ and 31.85 mg.dL⁻¹, respectively; Table 3) suggest that the animals were stressed, which can be attributed to the traditional processes of capture, stocking in pens and pens, and transport to the distribution center in Manaus city (Erdal et al., 1991; Ranzani-Paiva et al., 1999). The stocking process can be long and without control over the ideal water quality levels (up to 48 hours without aeration in caçapas), which provides hypoxia and contributes to high values of plasma metabolites (Rossoni et al., 2014; Ramos et al., 2015; Ladislau et al., 2021).

5. Conclusion

In conclusion, the hematological responses obtained in this study with *S. discus* suggest that the species is sensitive to stress caused by environmental disturbances. Standardized hematological studies with *S. discus* in different environments are needed to confirm this. This understanding is fundamental to providing adequate acclimatization of animals under production, and maintaining animal welfare and health, since *S. discus* naturally presents low immunity, and stressful conditions can worsen this condition and lead to mortality. The current study profiles the hematological variables of *S. discus* under the described conditions and serves as a parameter for further physiological studies with the species.

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