Parámetros hemáticos en tres especies de peces (*Ictalurus punctatus, Morone saxatilis y Micropterus salmoides*) en condiciones de desnutrición

Hematological parameters in three species of fish (Ictalurus punctatus, Micropterus salmoides and Morone saxatilis) under conditions of malnutrition.

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Resumen

Se evaluó el efecto de la desnutrición sobre los parámetros hemáticos en tres especies de peces de agua dulce, *Ictalurus punctatus, Morone saxatilis y Micropterus salmoides*. Los parámetros hemáticos analizados fueron: Microhematocrito (Ht), Hemoglobina (Hb), Proteína Total del Plasma (PTP), y Recuento diferencial de leucocitos. Además se analizó el comportamiento del polígono de frecuencia de la longitud mayor de los eritrocitos. Se consideraron dos niveles de desnutrición: moderada (15 días) y severa (100 días). Para el Ht y el Recuento diferencial de leucocitos se realizó por el método estándar, la hemoglobina por medio de hemoglobinometro, y PTP por método gravimétrico con el uso de un refractómetro. Los resultados de Ht y Hb se incrementaron en la desnutrición moderada en *I. punctatus* y *M. salmoides*, mientras que en *M. saxatilis* decrecen, PTP decrece en *I. punctatus* y *M. salmoides* pero en *M. saxatilis* se incrementa, los trombocitos se incrementan y el tamaño de los eritrocitos decrece en las tres especies indicado por el polígono de frecuencia. En la desnutrición severa para *I. punctatus*, *M. saxatilis* y *M. salmoides*, Ht y Hb decrecen, PTP y trombocitos se incrementa, y la población de los eritrocito es heterogénea en tamaño en las tres especies. Concluyendo que los parámetros hematológicos más sensibles son Ht, Hb, PTP y Polígono de frecuencia que varían desde estadios temprano de la desnutrición y por su fácil interpretación es factible su aplicación tanto en la Acuacultura como para conocer el grado de desnutrición de los peces en el medio ambiente natural.

Palabras clave: Hematología, Ictalurus punctatus, Morone saxatilis, Micropterus salmoides.

Abstract

The effect of undernutrition on haematological parameters in three species of freshwater fish, Ictalurus punctatus, and Micropterus salmoides Morone saxatilis were evaluated. The hematological parameters were analyzed microhematocrit (Ht), hemoglobin (Hb), Total Plasma Protein (PTP) and differential leukocyte count. Furthermore the behavior of the polygon frequency the greater length of the erythrocytes were analyzed. Moderate (15 days) and severe (100 days): two levels of malnutrition were considered. For Ht and differential leukocyte count was performed by the standard method, using hemoglobin Hemoglobinometer and PTP by gravimetric method using a refractometer.

Key words: Hematology, Ictalurus punctatus, Morone saxatilis, Micropterus salmoides.

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Introduction

Malnutrition in wild fish under culture conditions is a factor in the growth and reproduction, as well as playing an important role in epizootic disease involving opportunistic pathogens. Some parameters of the blood tissue vary from starvation at an early time, as observed in man and domestic species. In the case of fish is of interest to detect incipient periods from malnutrition, and possibly the factor that is occurring. In this paper three fish species from different trophic levels, Ictalurus punctatus, and Micropterus salmoides Morone saxatilis were selected., And hematological parameters were analyzed Microhematocrit (Ht), hemoglobin (Hb), Total Plasma Protein (PTP), polygon frequency of the greater length of the erythrocytes and differential leukocyte count.

Background.

The most common types of condition indices are ranges between morphological and anatomical features, such as condition factor K, given by K = W x 105 / L3 equation, and a deterioration in this factor is usually interpreted as depletion of reserves energy, which leads to stress or malnutrition strictly (Goede and Barton, 1990).

For the diagnosis of diseased fish is necessary to know the anatomy and histology of normal fish for the confrontation of results. The need for blood for hematology and blood chemistry should be taken from live fish by different methods such as cardiac puncture, puncture of the tail vein or by severing the caudal peduncle and then use one of the methods of preservation (Post, 1987) .

Joshi (1980), a hematological study 33 fish species reported to Amblypharyngodon sp., A mean hemoglobin of 3.6 ± 0.9, and Heteropneustes sp., 16.2 ± 4.6 g / 100 ml in half Ompuk hematocrit 25.3 ± 3.8 and 40.4 ± 3.5 Anabas%, finding that Hb and Ht are usually high in fish plus size, assets, air breathing and preferably living in lentic habitats, while in smaller, less active fish without air breathing and preferably living in lotic habitats, the values are lower.

Scott (1981) evaluated the sublethal hypoxia prolonged subadult Channel Catfish (Ictaluru punctarus R.) using hematological parameters for assessing the physiological state, finding that the mean corpuscular hemoglobin, lactic acid in plasma and plasma glucose differ significantly from controls in periods of 24, 48 and 72 hr., whereas the hematocrit, plasma total protein, total count of erythrocytes, the total leukocyte count, mean corpuscular volume and differential leukocyte counts are not sensitive indicators to assess the state under this physiological condition.

Blaxhall (1973) analyzed the blood of brown trout (Salmo trutta L.), reporting for Hb = 6.83 ± 1.48 g / 100 ml (range 4.1-10.3), Ht = 34 ± 4.88% (range 20-43), counting RBC = 0.995 ± 0.16 million / mm 3 (range 0606-1320), ESR = 2.6 ± 0.7 mm / h (range 1.5), the total leukocyte count = 11536 ± 9061 / mm3 (range 2000-63000), differential count leukocytes, lymphocytes = 90 ± 8.9% (range 56,100), neutrophils = 6.6 ± 6.5% (range 0-25) = 1.6 ± 1.9 metamyelocytes% (range 0-8), blasts = 0.3 ± 0.7% (range 0-4), finding that the ranges of these tests are very broad, showing the need to set values for healthy fish, sick and several stress conditions in that order, to assist in the diagnostic evaluation.

Kawastu (1966) determined the hematological characteristics of anemia caused by malnutrition in rainbow trout by a twelve week period, such as the presence of microcytic erythrocytes, and disappearance of immature cell. The erythrocyte count dilution and hemoglobin increased in the early stages of malnutrition (2nd. Week), but decreased at the end of the 12th week with the appearance of anemia.

Kawatsu (1974) studied the hematological changes in rainbow trout over a period of 110 days malnutrition, examining at 2, 25, 80 and 110 days after their last food, suffering a decrease count by dilution of red cells, hemoglobin and hematocrit, erythrocytes characterized this hypochromic microcytic anemia, with no change in mean corpuscular hemoglobin, accompanied by absence of immature erythrocytes and low protein concentration of the plasma, neutrophils and elongated cells (spindle) decrease in number during development investigation but no significant change in the cell, determining that these behave like hematological changes in brown trout 2 years old and small fish.

Tisa (1983) determined the eight haematological values in 40 adult specimens of Morone saxatilis captured in natural freshwater reservoirs, finding haematological parameters within the following ranges: hematocrit 31-38%, hemoglobin 7-11 g / 100 ml; plasma osmolality 321-381 mOs; Plasma chlorine 129-156 meq / L; plasma glucose 77-118 mg / 100 ml, cortisol plasmic 0.77 -. 6.33 mgr / 100 ml, plasma total protein 4.3 -. 4.9 g / 100 ml, with values generally match striped sea bass apparently healthy saltwater reservoirs.

Grizzle and Rogers (1976), cited for channel catfish following blood parameters: hematocrit 29-47%; total erythrocyte count 2.44 x 106; Total leukocyte count × 103 164.0; 89.9 X 103 cells; 68.4 X 103 platelets; 5.2 X 103 neutrophils; hematopoietic 0.5 X 103; finding no eosinophils and macrophages, indicating that the absence of monocytes.

Breazile (1982) determined the following values for hematological parameters in the channel catfish: plasma protein 3.98 g / dl (1.34), a mean hemoglobin of 3.96gr / dl (1.85), Hematocrit 22.7% (7.2), count by diluting 1.61 X 106 red cells / mm 3 (5.8 X 105), VGM 138.8m3 (53.7) mgr HGM 21.5 (12.9), 16.5% CHGM (8.8) counted by diluting 2.81 X 105 white blood cells / mm 3 (1.4 X 105). For the differential white blood cell counts, neutrophils, 7% (5), thrombocytes 54.9% (17.2) and lymphocyte 37.5% (15.6).

Cannon (1980), determined with a light microscope, phase contrast and electron microscope, the following types of leukocytes to channel catfish: thrombocytes (54%) with a size of 6 to 13 microns, cell shape of the ovoid or round few azurophilic granules nonspecific, ovoid, round, or bilobed nucleus; small (20%) cell with a diameter of 5 microns, round cell cytoplasm blue sky, nonspecific azurophilic granules, round nucleus, occasionally 1 to 2 nucleoli; mature heterophils (1.5%) size of 7-13 microns, round or ovoid, grayish blue cytoplasm, abundant granules (60-200) specific, eccentric nucleus round, ovoid or lobed, absence of nucleoli; monocytes (8%) with a diameter between 7-17 microns, occasional cell pseudopodia round, blue-green cytoplasm few azurophilic granules, shaped cores brain, kidney-shaped or folded in itself nucleoli of 1 to 2; unidentified cell (3%) with a diameter of 5-16 microns, round, azurophilic granules usually round nucleus with 0-5 nucleoli, not found eosinophils and basophils.

Tomasso (1983) reported a decrease in leukocyte and increased concentration of corticosteroids in plasma of catfish stressed by confinement channel. Hematocrit not vary significantly over periods of 24 hours and the decrease of leukocyte is given by reducing the number of lymphocytes.

Klar et al. (1986), severe anemia determined for channel catfish and blue catfish farms in 39 of 166 west-central Alabama in 1983, associating with the diet, but not with bacteria, parasites or water chemistry. Induction of anemia in channel catfish diet of these farms is suggested as the cause and not the pond environment. The hematocrit value in moribund fish was 0-5%, pale or white gills, exophthalmos, extended abdomen, gray liver, kidney and spleen red brick rose, increasing fish mortality and reaching up to 5% per pond.

Plumb (1986) reported 70 cases of severe anemia and death in cultured Channel Catfish during 1983 in the states of Alabama and Georgia attributed to food, the fish had a hematocrit 1-9%, other apparently healthy fish ponds thereof had a lower hematocrit of 20%. When performing a bioassay to test food found that at 14, 21 and 28 days decreased from 9.1% hematocrit and hemoglobin concentration and erythrocyte count 1.36 x dilution 106 / mm3, whereas the dilution leukocyte count and bleeding time were unaffected significantly.

Noyes, et al. (1991) reported seven cases of severe idiopathic anemias in channel catfish, and found the following hematological parameters: Hematocrit of 1 to 10% by dilution of erythrocyte count in the range of 12,300 to 995,000 cells / ml, in a range of leukocyte 9200-133500 cels. / ml. Histopathology hematopoietic tissue Spleen, Head Kidney and Kidney necrotic trunk was found; Liver steatosis and desquamation, edema and necrosis in intestine. Suggesting causes malabsorption primarily Vitamin B12 deficiency and Ac. Folic.

Kawatsu and Ikeda (1988) determined the dose of menadione bisulfate Dimetilpirimidol (MPB) as anti-anemic agent in common carp by the effect of molinate which is a commonly used herbicide, indicating mortality data and hemoglobin levels. The MPB is effective to an estimate of 3.6 ppm in water at a concentration of 0.10 ppm molinate and 32.4 ppb molinate water when presented to 0.32 ppm. For the control group range hemoglobin of 13.0 was obtained 7.0 g / 100 ml.

Esch and Hazen (1980) studied the effect of prolonged hot water produced by a nuclear reactor on the Black Sea Bass and the frequency of red-ulcer disease caused by Aeromonas hydrofila. the sampled population into two groups, one condition coefficient K <2.0 and the other with K> 2.0, determining hematological parameters. For the group with K <2.0 found a hematocrit of 34.8% (0.7), a hemoglobin of 7.6 g / dl (0.2), cortisol 14.9 mg / dl (0.8), counts by dilution of erythrocytes 5.6 x 106 / mm3 (0.3), leukocyte counts by dilution of 22.0 x 103 / mm3 (1.1), granulocyte 7.1% (3.1), cells 52.8% (43.2) 3.3% monocytes (1.0), thrombocytes 1.9% (0.4); for the group with K> 2.0, hematocrit 42.0% (0.03), hemoglobin 9.2 g / dl (0.01), cortisol 12.4 mg / dl (0.4) by dilution of erythrocyte count 6.8 x 106 / mm3 (0.2), count by diluting 28.7 x 103 leukocytes / mm 3 (0.9), granulocyte 4.6% (0.9), lymphocytes 57.5% (30.0), monocytes 2.6% (0.5), thrombocytes 37.8% (16.5) and reticulocytes 2.5% (0.3). Finding that high temperature reduces water fish condition, increasing prevalence of ulcer disease-red due to the stimulation of the metabolic activity, decreasing the energy sources and reflected in blood parameters studied.

Garofano (1982) indicated that fish can be used as monitors water bodies contaminated with cadmium. In their study reveals that cadmium chloride in high concentrations produced a decrease of erythrocytes and leukocytes increased Ictalurus nebulosus. Prasad et al. (1987) study the effect of different concentrations of crude extracts of catfish (Heteropneustes fossilis), by hematology, finding low levels of hemoglobin, hematocrit increased, hyperglycemia, and increased concentration of ascorbic acid, showing that the effects are reversible upon return to the wild catfish.

Lohner et al. (2001), assessed in populations of bluegill (Lepomis sp.), Collected in the Ohio River and tributaries that receive discharges from coal ash, and the effect of low concentrations of Se. Finding that the concentration of Se, Cu and As were statistically higher in the tissues of fish sampled exposed fish compared to the reference. Leukopenia, neutropenia and lymphocytosis were evident in exposed fish. The values of the white blood cell count and the percentage dilution of lymphocytes was significantly correlated with the concentration of Se in the liver. Protein levels in the plasma were significantly lower in fish exposed indicating that there may be a nutritional stress. The condition factor and growth range no significant differences between exposed fish and reference, considering haematological parameters and analysis of the concentration of Se in the liver as diagnostic tools.

Silveire-Coffigny et al. (2004), Oreochromis aureus studied the effect of different conditions of stress, bacterial infection, nitrite poisoning, overdose of malachite green, its effect on haematological indices and their relation to health status. The fish showed microcytic anemia in the experimental bacterial infection by Corynebacterium sp .; anemia, erythrocyte deformation neutrofiolia and nitrite intoxication medication overdose and malachite green.

Beker et al. (2005) compared the hematological parameters, Hematocrit, Hemoglobin, the Concerntración Media Hemoglobin, ionic composition, concentration of metabolites and protein Total Plasma under stress conditions in Acipenser oxyrinchus and Acipenser brevirostrum, finding differences in osmolaidad plasma concentration of Na +, Cl, lactate, cortisol, and total protein, the other parameters do not show significant difference.

Jamalzadeh and Ghomi (2009) conducted a study with hematologic caspius Salmon trutta, finding that the winter increase in monocytes, eosinophils and neutrophils compared to other seasons. The hematocrit, leukocyte count dilution, lymphocytes and large lymphocytes are higher in small bodies than adults.

Adeyeno et al. (2009) reported hematologic changes in the African catfish (Clarias garipinus) under simulated conditions of handling and transportation, finding an increase in lymphocytes, but no significant difference in micro-hematocrit, hemoglobin, leukocytes and eosinophils.

Galeano et al. (2010) reported haematological values porosissimus midshipman, sampled in Bahia Blanca, Argentina, place down by urban and industrial pollution. Erythrocyte values were 1.32 ± 0.32 x 106 / ml, 3314.8 ± 2058.8 leukocytes / uL, hemoglobin 8.13 ± 1.18g / dl, 36.17 ± 6.03% hematocrit, mean corpuscular volume (MCV) 295.14 ± 90.02fl, corpuscular hemoglobin medium (HCM) 65.68 ± 22.32pg, and mean corpuscular hemoglobin concentration (MCHC) 23 ± 4.92%. The fall in plasma protein was 4.059 ± 0.971 g / dl, and decreased by 2.477 ± 0.369g spring / dl. Six types of blood cells, erythrocytes, lymphocytes, eosinophils, neutrophils, platelets and monocytes are described.

Akinrotimi et al. (2010) analyzed 60 adult fish Tilapia guineensis reporting the following hematological parameters, 22.67 ± 2.14% hematocrit, hemoglobin 7.72 ± 1.20g / dl, I leucocrito 7.81 ± 1.14%, leukocyte counts by dilution 30.02 ± 2.50 cells x109 g / l, erythrocyte counts by dilution x109 2.58 ± 0.69 g / l cells, thrombocytes 40.65 ± 3.14% 20.45 ± 2.21% neutrophils, lymphocytes and 35.46 ± 4.7% 3.12 ± 1.00% monocytes.

MATERIAL AND METHOD

This study was conducted with specimens of the following species: channel catfish (Ictalurus punctatus Rafinesque, 1818), largemouth bass (Micropterus Lacepede salmooides 1802) and Striped Sea Bass (Morone saxatilis Walbaum, 1792). Provided by Uvalde National Fish Hatchery, Fish and Wildlife Service. Uv. Tx.

The number of individuals sampled for the Channel Catfish and Black Sea Bass was 45 for each species and for Striped Robalo 42 Bearing a total of 132 fish under study, divided into batches control moderate and severe malnutrition (Table 1) the fish were removed from grow-out ponds and placed in pools (8X1X1 mts.) or water tanks (1000 liters). To set the anemic syndrome caused by malnutrition in fish, they retreat completely food from confinement until the day the blood sample was obtained for analysis.

Table No. 1 shows the complete list of the species studied is indicated, the time of malnutrition and the number of fish subject to hematology.

ESPECIE	CONTROL		DESNUTRICIÓN MODERARA		DESNUTRICIÓN SEVERA	
	TIEMPO (días)	No. De ejemplares	TIEMPO (días)	No. De ejemplares	Tiempo (días)	No. De ejemplares
Ictalurus punctatus	0	15	18	15	101	15
Micropterus salmoides	0	15	18	15	110	15
Morone saxatilis	0	15	15	15	70	12

Before removing the fish blood for analysis, the overall length and weight of each of the specimens was recorded to determine the condition coefficient K.

Fish tail vein was punctured for the blood sample, disposable syringe and needle 22 x 32 mm., Previously moistened with heparin (10,000 IU). The collected blood volume was 0.3 ml. to 1 ml.

The microhematocrit heparinized capillary filling was made from half to three quarters, blood was taken directly from the syringe with the fact that the collection was being sealed by the end where the filling was performed Critoseal. The capillaries were centrifuged at 11000 rpm for 5 minutes (Clay Adams, Div. Of Becton, Dickenson and Company, model 0200, No. 113038). Using a reader to the corresponding microhematocrit determination (Blaxhall and Daisley, 1973) was performed.

To determine total plasma protein, capillaries centrifuged microhematocrit for testing were used, which were sectioned, taking only the portion of the plasma, which was placed in a refractometer (Model 100 / B, National Instrument Company, Inc.) to gravimetrically determine plasma protein, causing the scale reading in g / dl units. (Ikeda and Ozaki, 1982).

One Hemoglobinometer (BMS model AO) placing a drop of blood (0.1 ml.) Was used to measure the amount of hemoglobin in the camera compartment, observing through the eyepiece, sliding scale markers to match the colors of the screen, the reading is taken on the outer scale where the indicator is parked.

The differential count was determined by performing a blood smear stained with Giemsa. The smear was observed under the microscope (Carl Zeiss Standard K-4), with immersion lens (100X), running the smear to check different areas, to one hundred white cell count including platelets, to determine the proportion of each (Blaxhall and Daisley, 1973).

To determine the frequency polygon of the greater length of an ocular micrometer erythrocytes (CPL W 10X / 18, Carl Zeiss), and oil immersion (100X) was used, the observation was conducted in 100 erythrocytes for each sampled fish.

Results.

The mean condition factor K decreased in the lots under malnutrition to control the three species, lots of largemouth bass only a slight increase from moderate malnutrition with respect to severe (Table 2) was detected.

Table 2 Relationship of condition factor K in different species, under conditions of moderate and severe malnutrition.

Especie	Factor de condición K		
	Testigo	Desnutrición moderada	Desnutrición severa
Ictalurus punctatus	3.2	0.9	0.4
Micropterus salmoides	1	0.2	0.4
Morone saxatilis	3.5	1.3	0.04

Microhematocrit parameter increased by moderate malnutrition in channel catfish and largemouth bass, but decreased in the striped bass, whereas in severe malnutrition decreases in the first two species and the striped bass increases. In severe malnutrition microhematocrit decreases in channel catfish and largemouth bass, while the striped bass increases (Table 3).

Table 3 the mean (± SD) microhaematocrit, the result of the ANOVA for control, moderate malnutrition and severe malnutrition, and multiple comparison Tukey are presented.

Especie	Microhematocrito (%)			
	Testigo	Desnutrición moderada	Desnutrición severa	
Ictalurus puntatus	30.64(±0.44) a	37.36(±0.14) b	31.04(±0.10) a	F=5574.94 p< 0.05
Micrpoterus salmoides	28.26(±0.56) a	33.99(±0.79) b	22(±0.62) c	F=46.20 p< 0.01

Morone saxatilis	31.19(±0.67) a	26.4(±0.48) b	31. 72(±0.48) a	F=83.59 P< 0.05

Hemoglobin increase in moderate malnutrition in channel catfish and largemouth bass, but decreased in the striped bass, and severe malnutrition declined in the first two species but increased in the last species (Table 4).

Table 4 the mean (± SD) hemoglobin resulting from the ANOVA for control, moderate malnutrition and severe malnutrition, and multiple comparison Tukey are presented.

Especie	Hemoglobina gr/ 100ml			
	Testigo	Desnutrición moderada	Desnutrición severa	
Ictalurus puntatus	7.08(±0.09) a	9.78(±0.26) b	6.64(±0.06) c	F=330.92 p< 0.01
Micrpoterus salmoides	5.10(±0.20) a	7.76(±0.25) b	4.35(±0.10) c	F=256.79 P< 0.01
Morone saxatilis	7.6(±0.29) a	6.74(±0.05) b	7.21(±0.11) a	F=17.29 p< 0.01

The PTP is increased in moderate malnutrition in largemouth bass and striped bass but decreased in the channel catfish, while severe malnutrition decreases in the first two species, and channel catfish is slightly increased (Table 5).

Table 5 the mean (± SD) plasma total protein, the result of the ANOVA for control, moderate malnutrition and severe malnutrition, and multiple comparison Tukey are presented.

Especie	Proteína Total del Plasma (gr/dl)			
	Testigo	Desnutrición moderada	Desnutrición severa	
Ictalurus puntatus	4.14(±0.08) a	3.35(±0.1)	3.62(±0.03)	F=88.51

		b	c	p< 0.01
Micrpoterus salmoides	4.31(±0.08) a	4.56(±0.07) a	3.72(±0.34) b	F=13.20 p< 0.01
Morone saxatilis	3.07(±0.08) a	4.61(±0.006) b	3.56(±0.02) c	F=902.58 p< 0.01

The differential leukocyte count, the cell increases in both moderate and severe malnutrition are thrombocytes, for the three species although other cells show changes are inconstant presence.

The behavior of the frequency polygon of the greater length of the erythrocytes for the three species studied showed a shift to the left in moderate malnutrition and severe malnutrition in a more proportional distribution of the different classes is observed.

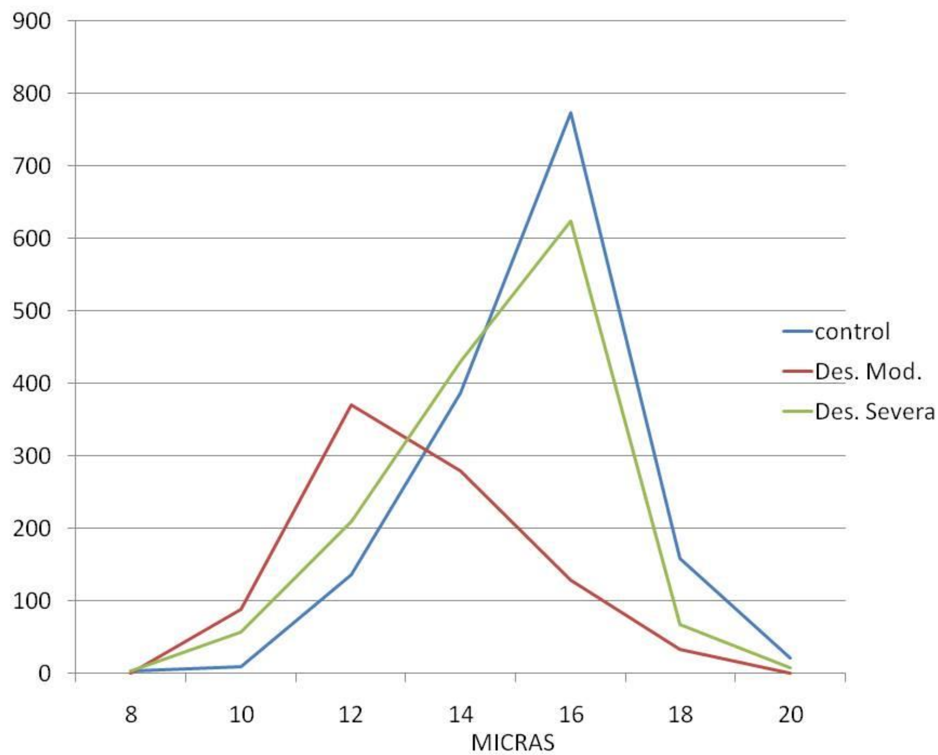

Figure 1 Frequency Polygon for Ictalurus punctatus.

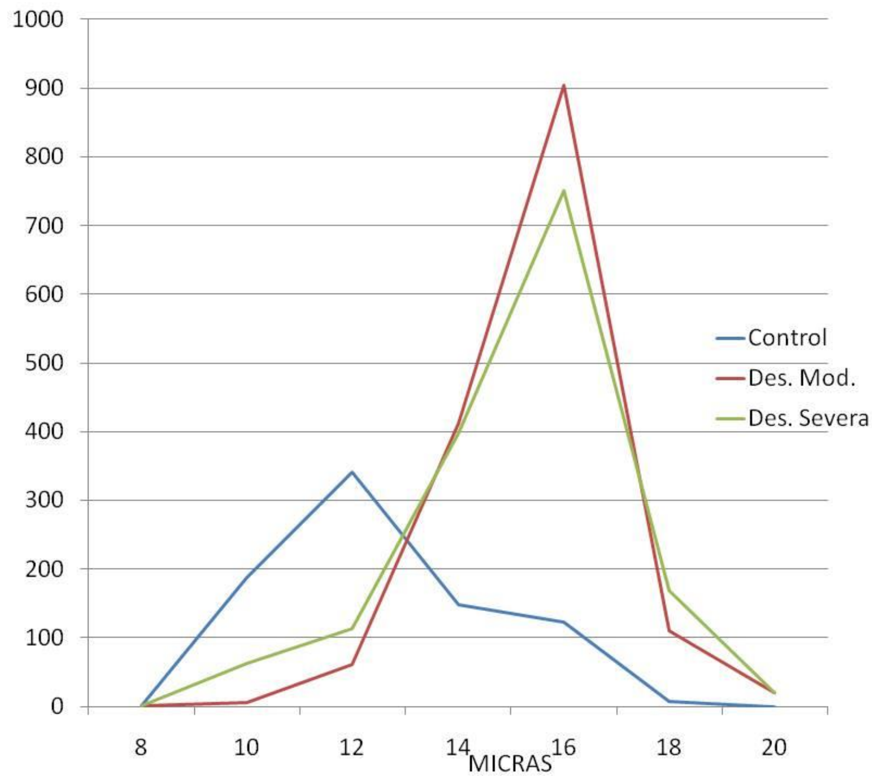

Figure 2 Frequency Polygon for Micropterus salmoides.

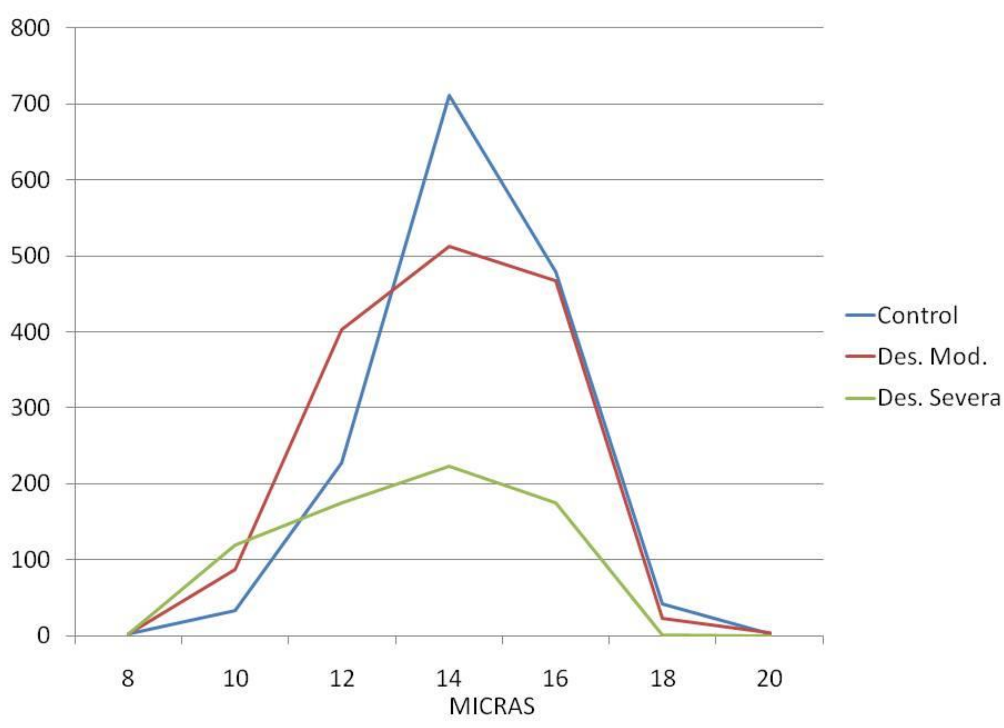

Figure 3 Frequency Polygon for Morone saxatilis.

Conclusion

Hematocrit values obtained for channel catfish in both the control group and in conditions of malnutrition are higher than those reported by Grizzle and Rogers, 1976 and 1982 Brazile, not values as low as those reported in catfish were found malnourished (klar et al, 1986;. Plumb 1986 Noyes et al, 1991).. Hemoglobin values reported in this work for lots under malnutrition Channel catfish are higher than those reported by Brazile (1982), in healthy fish, but found in the reported for other species (Tisa 1983 range; Kawatsu and Ikeda, 1988; Galeano, 2010; Akinrotimi 2010). The total plasma protein malnutrition in the lots under Channel catfish are similar to those reported by Brazile (1982) and Galeano (2010).

The microhematocrit reported lots of largemouth bass under malnutrition is similar to those reported by Esch and Hazen (1980) and for other species (Kawatsu, 1974; Akinrotimi, 2010). The hemoglobin levels of bass are treated the same as those reported by Esch and Hazen (1980) and lower than those reported for other species (Galeano, 2010; Akinrotimi, 2010). The values of total plasma protein malnourished bass are within the range of other species (Brazile, 1982; Galeano 2010).

The striped bass microhematocrit and hemoglobin is lower in the lot under moderate malnutrition, while severe is similar to that reported by Tisa (1983). The total plasma protein in the lots under malnutrition is within the ranges reported for other species (Brazile, 1982; Galeano, 2010).

The differential leukocyte count, the cells present in the three species are the platelets and increase as malnutrition takes the rest of the cells are varied and inconsistent.

The frequency polygon in the three species studied in incipient stages of malnutrition slides to the right and if malnutrition is prolonged slides left or is heterogeneous. Microhematocrit parameters, Hemoglobin and Plasma Protein analysis and frequency polygon of length greater erythrocytes are sensitive to the different periods of malnutrition. Depending on the species and the physicochemical parameters of the water, malnutrition is reflected in more early in the hematological parameters mentioned above. Increased platelet along with analysis of other blood parameters we can diagnose a process of malnutrition.

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