

Original Research Paper

Hematological Biomarkers in Nellore Cows of Different Ages from the Bolivian Tropics

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Article history

Received: 21-09-2021

Revised: 20-01-2022

Accepted: 27-01-2022

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Abstract: The objective of the work was to evaluate if the multiparous adult cows presented any difference in the values of hematological biomarkers compared to young primiparous Nellore cows from the Bolivian tropics. During the month of February 2021, a study was carried out with 14 multiparous adult cows and 13 young primiparous cows. The cows used were: Adult cows of 4561±95 days and young cows of 1535±99 days ($p \leq 0.001$). Leukocytes and granulocytes were above the normal range, without significant differences between adult cows and young cows. Erythrocytes were within the normal range, although showing significant differences ($p \leq 0.05$) between adult cows and young cows. Hemoglobin for both groups was above normal values without showing significant differences between the two groups. The values of the mean corpuscular volume and the amount of hemoglobin in the red blood cell were within the normal range, although for both components the adult cows have a higher value with significant differences ($p \leq 0.0001$). The values of the erythrocyte distribution width and platelets are also within the normal ranges. Although in these cases with significant differences ($p \leq 0.05$), the highest values were the young cows. It is concluded that adult cows presented some difference in the values of hematological biomarkers compared to young Nellore cows from the Bolivian tropics, however, they were not outside the normal ranges.

Keywords: Erythrocytes, Ages, Leukocytes Multiparous Cows, Primiparous Cows

Introduction

The Nellore breed presents particular characteristics, high productive and reproductive indices in the different production conditions, as well as good adaptability and rusticity (Ferraz and de Felício, 2010). A factor that should be included in the search for a cow adapted to the system in which it is developed, is longevity. It includes from the first to the last parturition, having an economic impact of magnitude. Ikeda *et al.* (2020) reported that adult Nellore cows (those older than five years of life) proved to be the most productive, in terms of the amount of total kg of weaned calves and reproductive indicators, compared to Nellore cows less than five years of age. The study of veterinary hematology in recent years was based on the search for procedures related to clinical problems, the detection of pathological changes, and the factors that

cause their variations. Knowing the components of the blood is a necessary tool to assess the state of health and it could also be used routinely as indicators to learn about the changes that occur in cows at different ages (Bezerra *et al.*, 2008). Complete blood count values provide necessary diagnostic and prognostic information in different situations when compared to reference intervals. In adult cattle, there were changes between 1957 and 2006 in the reference values, where the neutrophil count increased, although a decrease in the concentration of hemoglobin and lymphocytes and the counts of monocytes and eosinophils. Few hematological studies are available in the literature on Nellore cows in different reproductive physiological stages (Oliveira *et al.*, 2019) and it is even greater in adult beef cows, the absence of studies referring to the state of hematological values. Trying to add elements

that justify the need to keep long-lived cows in the herd would reinforce the idea of the multiple benefits that a cow meeting life expectancy has for the system.

The objective of the study was to compare the values of hematological biomarkers between young primiparous cows and multiparous adult Nellore cows from the Bolivian.

Materials and Methods

A study was carried out with 27 multiparous and primiparous Nellore cows during the month of February 2021. They are part of a herd of 135 total cows that belongs to the Fundación Centro Tecnológico Agropecuario en Bolivia (Fundación CETABOL) in Colonia Okinawa. (17°13' 12" south latitude, 62°53' 39" west longitude) Santa Cruz, Bolivia. It is located at 286 meters above sea level, with a tropical climate, rains in eight months of the year, and a short dry season. There was a temperature of 26.0°C and 150 mm in the Okinawa Colony in February 2021.

Animals

This project has the approval of the Ethics and Animal Welfare Committee, CICUAL, and biosafety of the Faculty of Veterinary Sciences, of the National University of Rosario (Resol. CD 201/2019), Santa Fe-Argentina.

Thirteen young primiparous cows (Young Group: GJ) between three and four years of age and 14 multiparous adult cows (Adult Group: GA) between ten and fifteen years of age were used. The cows used in the trial at the time of taking the sample had calves at their feet and were pregnant.

Feeding

The cows during the month of February were in a pasture of *Brachiaria brizantha* cv. MG-5.

Sampling

A total of 10 mL of blood was collected from the coccygeal vein, half was distributed in a tube with EDTA anticoagulant solution at a concentration of 3.7 to 5.4 µm. Blood samples with EDTA solution were homogenized and kept until analysis.

Variables to Analyze

Age at time of sample collection: Date of sample collection-date of birth in days

Hemogram: Leukocytes ($10^9/L$), Lymphocytes ($10^9/L$), Monocytes ($10^9/L$), Granulocytes ($10^9/L$), Erythrocytes ($10^{12}/L$), Hemoglobin (g/l), Hematocrit (%), Mean Corpuscular Volume (fl), Mean cell (erythrocyte) hemoglobin (p.g.), Mean cell (Erythrocyte) Hemoglobin Concentration (p/l), Erythrocyte Distribution Width (%), Platelets ($10^9/L$), Mean Platelet Volume (fl).

Sample Analysis

The laboratory equipment BC-2800 Vet (Hematology Analyzer-Mindray BC-2800; Shenzhen

Mindray Bio-Medical Electronics Co., Ltd) is used. It is a compact and fully automatic three-part hematology analyzer with 19 parameters for the Complete Blood Count (CBC) tests and micro-sampling technology.

Statistical Analysis

The means and standard errors were obtained and it was tested whether there were significant differences between the groups (YG and GA) by applying a hypothesis test for continuous variables, according to Student's t-test ($P < 0.05$). Statistical analyzes were performed with the version Core Team (2013).

Results

The young cows had an average of 1535 ± 99 days of life and the adult cows had an average of 4561 ± 95 days of life at the time of blood extraction and measurement, presenting significant differences ($p \leq 0.001$). These results allowed us to assert that there are two different groups to compare. The young cows had a median of one calving and the adult cows of nine calvings.

In Table 1, it can be observed that the values of the leukocyte formula found, are above the normal ranges for bovines, leukocytes ($5-16 \times 10^9/L$), and granulocytes ($2.3-9.1 \times 10^9/L$). While monocytes ($0.3-1.6 \times 10^9/L$) and lymphocytes ($1.5-9.1 \times 10^9/L$) show that the values obtained are within the normal range, although the four components analyzed do coincide, it is that they do not show significant differences between adult cows and young cows.

Table 2, shows that Erythrocytes are within normal values ($5-10 \times 10^{12}/L$) although with significant differences ($p \leq 0.05$) between adult and young cows. Hemoglobin for both categories is above normal values ($90-139$ g/L) without showing significant differences between the categories and the Hematocrit of adult cows is at the upper limit (28-46%), while young cows presented values above this maximum value, although without showing significant differences between both categories. The values of the Mean corpuscular (erythrocyte) volume (38 -53 fl) and the value of the Mean cell (erythrocyte) hemoglobin volume (13-19 p.g.) are within normal values for both categories, although for both components the adult cows have a higher value with significant differences ($p \leq 0.0001$).

The values of Mean Cell hemoglobin concentration and the Mean platelet volume are within the normal ranges ($300-370$ p/L and $3.8-7.0$ fl) and without showing significant differences between adult and young cows. The values of Red Blood Cell (erythrocyte) distribution Width and platelet are also within the normal ranges ($14-19\%$ and $120-820 \times 10^9/L$), although in these cases with significant differences ($p \leq 0.05$), the young cows have the highest values (Table 3).

Table 1: Hemogram values of the components of the white series by a group

Groups	Leukocytes × 10 ⁹ /l	Lymphocytes × 10 ⁹ /l	Monocytes × 10 ⁹ /l	Granulocytes × 10 ⁹ /l
AG	25.8±3	1.3±0.2	0.9±0.1	23.6±3
YG	27.2±3	1.7±0.2	0.9±0.1	24.5±3
Significant	ns	ns	ns	ns

All values correspond to the arithmetic mean ± standard error.

Sample size: AG: 14 cows and YG: 13 cows.

ns (not significant)

Table 2: Hemogram values of the components of the red series by group

Groups	Erythrocyte x 10 ¹² /l	Hemoglobin g/l	Hematocrit %	MCV fl	MCH pg
AG	9.4±0.5	156.8±8	46.4±2	50.0±0.8	16.7±0.2
YG	11.2±0.6	171.1±9	50.72	45.5±0.8	15.2±0.2
Significant	*	ns	ns	***	***

All values correspond to the arithmetic mean ± standard error.

Sample size: AG: 14 cows and YG: 13 cows

Ns (not significant); * (p≤ 0.05); *** (p≤0.0001)

MCV: Mean corpuscular (erythrocyte) volume; MCH: Mean cell (erythrocyte) hemoglobin

Table 3: Hemogram values of the components of the red series by a group

Group	MCHC p/l	RDW%	Platelet × 10 ⁹ /L	MPVfl
AG	336.5±1.9	17.2±0.2	243±21	5.7±0.1
YG	337.0±2.0	17.8±0.2	298±23	5.6±0.1
Significance	ns	*	*	ns

All values correspond to the arithmetic mean ± standard error.

Sample size: AG: 14 cows and YG: 13 cows

ns (not significant); * (p≤0.05)

MCHC: Mean cell (erythrocyte) Hemoglobin concentration

RDW: Red Blood Cell (erythrocyte) distribution Width

MPV: Mean Platelet Volume

Discussion

The consequences of age on bovine hematological variables have been demonstrated, but in general, they refer mainly to changes produced in young animals (Mohri *et al.*, 2007). Confidence intervals for hematologic variables have varied in recent years. Therefore, it is important to generate this information, taking into account adequate environmental conditions, and representative physiological characteristics of the analyzed cows, using the same equipment, applying the same methodology, and with adequate statistical methods (Herman *et al.*, 2018). The values of the leukocyte formula found were above the normal ranges for bovines, leukocytes (5-16 × 10⁹/l), and granulocytes (2.3-9 × 10⁹/l) range (Kaneko, 1997; Calzada *et al.*, 2002, Underwood and Suttle, 2003; Suttle, 2010). These levels above the normal ranges could be explained by the stress caused by the rearing of their calves, climatic factors (temperature and rainfall), the enclosure for sampling, and some viruses. Leukocytes are influenced by physiological events, increasing in endometrial implantation, at the time of placentation, at birth, decreasing with the puerperal stage and in the final third of gestation (Oliveira *et al.*, 2019). While monocytes

(0.3-1.6 × 10⁹/l) and lymphocytes (1.5-9 × 10⁹/l) show that the values obtained are within the normal range (Calzada *et al.*, 2002; Kaneko, 1997; Suttle, 2010; Underwood and Suttle, 2003). Monocyte counts showed that these cells are little influenced by pregnancy, birth, and postpartum (Iriadam, 2007). Although, they do agree with Leukocytes, Lymphocytes, Monocytes, and Granulocytes in that they do not show significant differences between adult cows and young cows. A work by Vilela *et al.* (2016) reported that they observed significant differences when Guzerat and Nellore were compared in the profiles of leukocytes, lymphotoxin, eosinophils, and monocytes. Not with the age of the cows analyzed, in the latter coinciding with this study. Red blood plays a role in homeostatic and osmoregulatory systems (Merdana *et al.*, 2020). In cattle, the number of erythrocytes in the blood is from 7 to 10 × 10¹²/L; (Meyer and Harvey, 2007). Erythrocytes showed significant differences (p≤0.05) between adult and young cows. Hemoglobin and Hematocrit for both categories are above the values but without showing significant differences between the categories. Hematocrit and hemoglobin values are directly proportional to the number of erythrocytes (Adam *et al.*, 2015). This could be partly explained by suggested by Oliveira *et al.*

(2019) who stated that the erythrogram of the Nelore cow can be influenced by the reproductive stages. Another factor that intervenes is the level of dehydration of the animals at the time of sample collection (Thrall *et al.*, 2012). The values of the mean corpuscular volume (38 -53 fl) and Mean cell hemoglobin (13-19 p.g.) are within normal Ranges for both categories, although for both components the adult cows have a higher value with significant differences ($p \leq 0.0001$). The values of the Mean cell (Erythrocyte) hemoglobin concentration and the Mean platelet volume did not show significant differences between the adult and young cows. On the other hand, the values of the erythrocyte distribution width and platelets showed significant differences ($p \leq 0.05$) with the highest values in young cows. Although all four biomarkers are within normal ranges. A hematological analysis is not only relevant for diagnosing disorders of the hematological system but for the diagnosis of many systemic and organ diseases (Roland *et al.*, 2014). Parish (2010) stated that beef cattle production systems that have a higher proportion of adult cows obtain a higher percentage of weaned calves (kg of total calf), which makes it possible to reduce production costs and increase the sale of calves. What this study showed was that the longest-lived cows not only remained within the normal ranges in the values of hematological biomarkers but that several values were higher than the younger cows. In other words, it is necessary to have several concrete elements before deciding to eliminate an adult cow. In this case, the analysis of the hematological biomarkers helped not to be a reason for discarding the adult cows from the herd. This would help, having high percentages (close to 80%) of adult cows in the herd, from a zootechnical point of view would be ideal so that the traits associated with biological efficiency (longevity and reproduction) allow greater sustainability to the productive system (Ikeda *et al.*, 2020).

It is concluded that adult cows presented some difference in the values of hematological biomarkers compared to young Nelore cows from the Bolivian tropics, but they were not outside the normal ranges

Acknowledgment

This study was supported by the Technology Center on Agriculture and Livestock in Bolivia (FUNDACION CETABOL) Santa Cruz, Bolivia.

Author's Contributions

Atsuko Ikeda: Coordinated the work. Designed the research plan and organized the study.

Pablo Roberto Marini: Coordinated the data analysis and contributed to the writing of the manuscript.

Ethics

All authors declare no conflict of interest in this study. Moreover, the corresponding author declares that this study is the original work containing unpublished material. All authors appear read and approved the final version of this study

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