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Hematological parameters in female Pelibuey lambs clinically healthy raised in the humid tropic of Mexico

Parámetros hematológicos en corderas Pelibuey clínicamente sanas criadas en el trópico húmedo de México



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Abstract

Hematological parameters are used to evaluate the health of sheep. However, these parameters can be affected by different factors such as the physiological stage, breed, age, gender and management conditions. The purpose of this study was to determine the hematological parameters in female Pelibuey lambs raised in the humid tropics of Mexico. A total of 97 Pelibuey lambs ranging from two to four months of age were sampled and the blood used to determine the hematological parameters in automated analyzer. The obtained data were grouped to determine the average, minimum range, maximum range, median, mode, variance, standard deviation and variation coefficient. Results were compared with previous studies in males of the same age, adult Pelibuey ewes and veterinary books used as reference. Diverse variations were found between this study and previous reports. Hematological parameters established in this study will aid to evaluate the health of female Pelibuey lambs aged two to four months under the humid tropical conditions of Mexico.

Keywords: erythrogram, blood parameters, ewes, hair sheep, hemogram.

Resumen

Los parámetros hematológicos son usados para evaluar la salud de las ovejas. Sin embargo, estos parámetros pueden ser afectados por diferentes factores tales como el estado fisiológico, la raza, la edad, el género y las condiciones de manejo. El propósito de este estudio fue determinar los parámetros hematológicos en corderas Pelibuey criadas en el trópico húmedo de México. Un total de 97 corderas con edades entre dos y cuatro meses de edad fueron muestreadas y su sangre usada para determinar sus parámetros hematológicos mediante un analizador automático. Los datos obtenidos fueron agrupados para determinar el promedio, rango mínimo y máximo, mediana, moda, varianza, desviación estándar y coeficiente de variación. Los resultados fueron comparados con estudios previos en machos de la misma edad, ovejas Pelibuey adultas y libros de veterinaria usados como referencias. Diversas variaciones fueron encontradas entre el presente estudio y reportes previos. Los parámetros hematológicos establecidos en este estudio ayudarán a evaluar la salud de corderas Pelibuey con edades de entre dos y cuatro meses de edad, bajo condiciones de trópico húmedo de México.

Palabras clave: eritrograma, parámetros hematológicos, ovejas, ovejas de pelo, hemograma.



INTRODUCTION

The sheep production in Mexico has increased from 56,546 tons in 2011 to 65,891 tons in 2021 according with Mexican Meat Advice. However, humid tropical zone contributing only a small percentage (0.5%) to the national production ([Compendio Estadístico del Consejo Mexicano de la Carne, 2023](#)). Despite the fact that the humid tropical zone of the country has extensive areas of grazing, factors such as low nutritional quality of the pasture, climatic conditions of high heat and humidity and mainly parasitic infections negatively affect the sheep production.

Hematological parameters are commonly used to evaluate the health of the animals including sheep ([Matanović *et al.*, 2007](#)). Parameters such as red blood cell (RBC) count, hemoglobin (HGB), hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) has been used to classify the anemia ([Badawi & Al-Hadithy, 2014](#)), including that caused by gastrointestinal parasites such as *Haemonchus contortus* ([Corrêa *et al.*, 2021](#); [Jiménez-Penago *et al.*, 2021](#); [Zaragoza-Vera *et al.*, 2022](#)).

Non-infectious factors and physiological stages also lead to alterations in the hematological parameters of sheep. Breed and physiological stages has been studied as factors that influence in hematological parameters in Morada Nova and Santa Inês ewes ([Bezerra *et al.*, 2017](#)). A study performed in Chios sheep showed that HCT, HGB, RBC, leukocytes, neutrophils, lymphocytes, eosinophils and platelets were significantly affected by the age; while monocytes and eosinophil counts by the reproductive stage of the animals ([Panousis *et al.*, 2017](#)). Results in adult Pelibuey ewes showed that there are variations in the hematological parameters of this breed compared to Churra-da-Terra-Quente, Santa Ines, and Bergamasca ([Torres-Chable *et al.*, 2020](#)).

The variations observed in hematological parameters in sheep according to breed, body condition score, gender, age and physiological stages, lead to the determination of reference parameters considering all these factors. Therefore, the objective of this study was determine the hematological parameters in female Pelibuey lambs raised in the humid tropics of Mexico.

MATERIALS AND METHODS

Study area

The animals belonged to the Centro de Integración Ovina del Sureste (CIOS), located in the state of Tabasco, Mexico; between the coordinates 90°59'08" N and 94°07'00" W. The climatic conditions corresponded to those of the humid tropics, with an average temperature of 26°C and over 2000 mm of annual precipitation ([INEGI, 2023](#)).



Animals and biological samples collection

A total of 97 Pelibuey lambs ranging from two to four months of age, clinically healthy, and raised in floor pens to prevent contamination with gastrointestinal parasites, were sampled. Their diet was based on 300 g of commercial feed with 12% crude protein, along with dry Taiwan grass forage and water ad libitum. Animals exhibiting growth retardation, respiratory symptoms, or diarrhea were excluded from the study. Blood samples were obtained from the jugular vein using Vacutainer™ catheters with a #21 needle and tubes containing EDTA as an anticoagulant (Vacutainer™; BD Biosciences, Franklin Lakes, NJ, USA). The blood samples were placed on wet ice in an insulated container and transported to the laboratory for processing. Finally, stool samples were collected directly from the rectum of the animals in plastic bags and analyzed using the McMaster technique (Rodriguez Vivas & Cob-Galera, 2005) to confirm the absence of gastrointestinal parasites.

Hematological parameters evaluated

The hematological parameters were measured using an automated analyzer (VetAutoread™, IDEXX Laboratories, Westbrook, ME). The analyzed hematological parameters were hematocrit (HCT), red blood cell count (RBC), mean corpuscular volume (MCV), red cell distribution width-standard deviation (RDW-SD), red cell distribution width-coefficient variation (RDW-CV), hemoglobin (HGB), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), platelets (PLT), plateletcrit (PCT), mean platelet volume (MPV), platelet distribution width (PDW), white blood cell count (WBC), lymphocytes (LYM), percentage of lymphocytes (LYM%), granulocytes (GRAN), and percentage of granulocytes (GRAN%). Blood smears were prepared and stained with Diff-Quick™ (Hycel, Jalisco, Mexico) to observe the morphology of erythrocytes and discard the presence of hemoparasites.

Ethical considerations

The animals used in this study, biological samples and residues were treated and handled in accordance with federal regulations in Mexico (NOM-046-zoo-1995, NOM-087-ECOLSSA1-2002). The owner of female lambs received informed consent and approved the obtaining of biological samples.

RESULTS

Data obtained from automated analyzer were grouped, and the average, minimum, maximum, median, mode, variance, standard deviation and variation coefficient were determined (Table 1). None of the selected animals presented gastrointestinal parasites or signs of disease throughout the study. Similarly, blood smears showed no red blood cell abnormalities or hemoparasites. Therefore, the data described in this study correspond to the erythrogram of clinically healthy Pelibuey lambs aged between two and four months.



Table 1.- Reference parameters and descriptive data of hematological variables evaluated in female Pelibuey lambs raised in the humid tropics of Mexico

Variable	Mean	Min range	Max range	Median	Mode	Variance	Standard deviation	Variance coefficient
HCT (%)	39.44	28.60	50.40	39.80	42.20	4.12	4.12	10.44
RBC (x10 ¹² L)	12.53	8.07	15.25	12.81	13.05	1.20	1.20	9.57
MCV (fL)	31.47	28.20	36.60	31.50	31.50	1.89	1.89	6.00
RDW-CV (%)	17.49	13.90	19.40	17.60	17.70	0.85	0.85	4.86
RDW-SD (fL)	21.46	18.80	25.10	21.50	21.60	1.46	1.46	6.80
HGB (g/dL)	12.97	8.40	19.80	12.50	13.00	2.03	2.03	15.62
MCH (pg)	10.32	9.00	15.40	10.00	10.10	1.38	1.38	13.38
MCHC (g/d)	32.99	28.30	52.90	32.10	31.90	4.66	4.66	14.12
PLT (x10 ⁹ L)	547.02	223.00	977.00	531.00	352.00	145.82	145.82	26.66
PCT (%)	0.41	0.17	0.71	0.40	0.37	0.11	0.11	26.62
MPV (fL)	7.32	6.50	7.80	7.30	7.40	0.24	0.24	3.27
PDW (fL)	8.85	7.90	9.10	8.90	9.00	0.20	0.20	2.31
WBC (x10 ⁹ L)	12.19	3.90	39.10	10.20	9.60	6.14	6.14	50.36
LYM (x10 ⁹ L)	8.12	2.60	34.40	6.20	5.80	5.34	5.34	65.71
LYM (%)	63.08	0.68	87.90	63.50	68.10	12.80	12.80	20.29
GRAN (x10 ⁹ L)	2.48	0.60	5.80	2.20	2.10	1.08	1.08	43.74
GRAN (%)	21.47	0.20	42.50	20.80	20.80	6.91	6.91	32.17

Min: Minimum, Max: Maximum, HCT: Hematocrit, RBC: Red blood cell, MCV: Mean corpuscular volume, RDW-CV: Red blood cell distribution width-coefficient of variation, RDW-SD: Red blood cell distribution width-standard deviation, HGB: Hemoglobin, MCH: Mean corpuscular haemoglobin, MCHC: Mean corpuscular hemoglobin concentration, PLT: Platelets count, PCT: Plateletcrit, MPV: Medium platelet volume, PDW: Platelet distribution width, WBC: White blood cells, LYM: Lymphocytes, LYM (%): Percentage of lymphocytes, GRAN: Granulocytes, GRAN (%): Percentage of granulocytes.

DISCUSSION

Hematological parameters used as reference must closely match the characteristics of the individuals being compared. Breed, age, zootechnical purpose, gender, and production system are considered the main factors that affect the hematological parameters in sheep. In this study, we present the hematological parameters for female Pelibuey lambs raised in the tropic humid conditions of Mexico, but kept in floor pens to prevent contamination with gastrointestinal parasites.

The erythrogram consists of HCT, RBC, MCV, MCH, and MCHC, and these parameters are used to classify types of anemia, identify hemolysis, dehydration or hypovolemia, and contribute to the identification of erythrocyte abnormalities abnormalities (Nuñez & Bouda, 2007; Byers & Kramer, 2010). The hematological parameters evaluated in this study were compared with previous publications conducted in Mexico, where Pelibuey sheep were studied. Additionally, a clinical pathology book commonly used for veterinary students in Mexico, as well as a veterinary hematology book with worldwide distribution, were used for making comparisons (Table 2).



Table 2.- Comparison of hematological parameters in Pelibuey sheep raised in the humid tropics of Mexico and two veterinary books

Variable	References				
	This study	Méndez-Aguilar <i>et al.</i> (2022)	Torres-Chable <i>et al.</i> (2020)	Nuñez & Bouda (2007)	Byers & Kramer (2010)
Breed	Pelibuey	Pelibuey	Pelibuey	Non- specific	Non- specific
Age	(2-4 months)	(2 – 4 months)	(2- 3 years)	Non- specific	Non- specific
Country	Mexico	Mexico	Mexico	Mexico	Non- specific
RBCx10 ¹² μL	12.53 (8-15)	11.71 (9-14)	6.68	(9-15)	12 (9-15)
HGB (dL)	12.97 (8-20)	12.01 (9-20)	10.85	(9-15)	11.5 (9-15)
HCT (%)	39.44 (28-50)	36.62 (27-47)	31.39	(27-45)	35 (27-45)
MCV, fL	31.47 (28-37)	31.28 (28-37)	47.44	(23-48)	34 (28-40)
MCH, pg	10.32 (9-15)	10.26 (9-16)	16.36	(8-12)	10 (8 – 12)
MCHC (%)	32.99 (28-53)	32.95 (28-54)	35.05	(31-34)	32.5 (31-34)

RBC: Red blood cell, HGB: Hemoglobin, HCT: Hematocrit, MCV: Mean corpuscular volume, MCH: Mean corpuscular haemoglobin, MCHC: Mean corpuscular hemoglobin concentration.

The mean RBC count in female Pelibuey lambs in this study was similar to that in males of the same age, as reported [Méndez-Aguilar *et al.* \(2022\)](#). However, this value was higher than the count reported in adult Pelibuey ewes aged two to three years old ([Torres-Chable *et al.*, 2020](#)). The minimum range of RBC count was slightly lower in female Pelibuey lambs than in males, as well as the ranges reported by [Nuñez & Bouda \(2007\)](#), and [Byers & Kramer, 2010](#)). The minimum range of HGB was also slightly lower in female Pelibuey lambs than in males with the same age, according to the data reported by [Méndez-Aguilar *et al.* \(2022\)](#). The minimum and maximum ranges of the HGB in female Pelibuey lambs in this study were practically similar to those reported in males ([Méndez-Aguilar *et al.*, 2022](#)), but both ranges were wider than those reported by [Nuñez & Bouda \(2007\)](#), and [Byers & Kramer, 2010](#)). The HCT is the parameter most easily measured, and therefore, it is the most commonly used to evaluate various conditions associated to anemia in animals. In this study, the HCT in female Pelibuey lambs was higher than that reported in males of the same age and in adult Pelibuey ewes raised in Tabasco, Mexico (39.44 vs 36.62 and 31.39%, respectively). The minimum and maximum ranges were wider than those reported in previous studies in Tabasco ([Torres-Chable *et al.*, 2020](#); [Méndez-Aguilar *et al.*, 2022](#)) and the data reported in veterinary books ([Nuñez & Bouda, 2007](#); [Byers & Kramer, 2010](#)). Parameters such as MCV, MCH and MCHC in female Pelibuey lambs were similar to the data reported in males by [Méndez-Aguilar *et al.* \(2022\)](#). However, the MCV in Pelibuey lambs (males and females) was lower than in adult Pelibuey ewes, as reported by [Torres-Chable *et al.* \(2020\)](#). This means that while adult Pelibuey ewes have a lower number of erythrocytes (12.53 vs 6.68x10¹²μL), they compensate for this by increasing the size of erythrocytes and their haemoglobin content. This fact can be



observed in the MCH (10.32 vs 16.36 pg) and MCHC (32.99 vs 35.05) of the female lambs in this study and adult Pelibuey ewes studied by [Torres-Chable et al. \(2020\)](#).

The previously discussed data suggests that Pelibuey sheep are well-adapted to the conditions of the humid tropics of Mexico, especially the heat, humidity, and altitude (with an average of 20 masl) in the Centro region, where the studied sheep reside. As a result, the haematological parameters reported in this study can significantly contribute to evaluating this sheep breed with greater precision than using didactic veterinary books or making comparisons with data from other breeds, latitudes or breeding conditions. Additionally, this study emphasizes the importance of considering age when comparing hematological parameters of Pelibuey sheep.

CONCLUSIONS

The hematological parameters established in this study contribute to enhancing erythrogram evaluations in female Pelibuey lambs aged two to four months under the humid tropical conditions of Mexico.

CONFLICT OF INTERESTS

Authors declare have no conflict of interests.

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