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Haematological values of Pelibuey lambs under humid tropic conditions

Valores hematológicos de corderos Pelibuey en condiciones de trópico húmedo

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ABSTRACT

This article presents a determination of haematological parameters in Pelibuey lambs in the humid tropic of Mexico. A total of 80 blood samples were collected from clinically healthy male lambs of 3-4 months of age in with a live weight of 20.03 ± 7.50. The resulting data set was analyzed using Gaussian distribution and descriptive statistics. Confidence intervals of 95% were established. Haematological parameters in the Pelibuey lambs were haematocrit: 36.62 ± 3.80%; red blood cell: 11.71 ± 1.13 x106/µL; mean corpuscular volume: 31.28 ± 1.92 fl; haemoglobin: 12.01 ± 1.80 g/dL; mean corpuscular haemoglobin: 10.26 ± 1.30 pg; mean corpuscular haemoglobin concentration: 32.95 ± 4.46 g/dL; white blood cell: 11.55 ± 5.52 ×103/µL; and platelets: 509.98 ± 141.61 ×103/µL. Most haematological parameters in the Pelibuey lambs were similar to those reported for male lambs from other breeds in the humid tropic, although the red blood cells were upper. The mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration were slightly lower. The present study could help in realistic evaluation of the management practices and diagnosis of health condition of Pelibuey male lambs under humid tropic conditions.
Keywords: haematological profile, Pelibuey lambs, humid tropic.

RESUMEN

Este artículo presenta una determinación de parámetros hematológicos en corderos Pelibuey en el trópico húmedo de México. Se recogieron un total de 80 muestras de sangre de corderos machos clínicamente sanos de 3-4 meses de edad con un peso vivo de 20.03 ± 7.50. El conjunto de datos resultante se analizó mediante distribución Gaussiana y estadística descriptiva. Se establecieron intervalos de confianza del 95%. Los parámetros hematológicos en los corderos Pelibuey fueron hematocrito: 36.62 ± 3.80%; glóbulos rojos: 11.71 ± 1.13 x106/µL; volumen corpuscular medio: 31.28 ± 1.92 fl; hemoglobina: 12.01 ± 1.80 g/dL; hemoglobina corpuscular media: 10.26 ± 1.30 pg; concentración media de hemoglobina corpuscular: 32.95 ± 4.46 g/dL; leucocitos: 11.55 ± 5.52 ×103/µL; y plaquetas: 509.98 ± 141.61 ×103/µL. La mayoría de los parámetros hematológicos en los corderos Pelibuey fueron similares a los reportados para otras razas de corderos en el trópico húmedo, aunque los glóbulos rojos fueron superiores. La hemoglobina corpuscular

media y la concentración de hemoglobina corpuscular media fueron ligeramente inferiores. El presente estudio podría ayudar en la evaluación realista de las prácticas de manejo y diagnóstico del estado de salud de los corderos machos Pelibuey en condiciones de trópico húmedo.
Palabras clave: perfil hematológico, corderos Pelibuey, trópico húmedo.

Abbreviations

CI	confidence interval	Min	minimum
CIOS	Sheep Integration Center of the Southeastern	PLT	platelets
CV	coefficient of variation	Q_1	lower quartile
HCT	haematocrit	Q_3	upper quartile
HGB	haemoglobin	RBC	red blood cells
Max	maximum	SD	standard deviation
MCH	mean corpuscular haemoglobin	WBC	white blood cell
MCHC	mean corpuscular haemoglobin concentration	*x*	mean
MCV	mean corpuscular volume		

INTRODUCTION

Haematology is the study of morphology and physiology of the cellular elements of the blood – the red blood cells (**RBC**), white blood cell (**WBC**), haemoglobin (**HGB**), mean corpuscular volume (**MCV**), mean corpuscular haemoglobin (**MCH**), mean corpuscular haemoglobin concentration (**MCHC**), haematocrit (**HCT**), and platelets (**PLT**) (Harp *et al*., 2021). Haematological traits are essential parameters for evaluating the health and physiological status of animals and herds, for example Pelibuey, Awassi, Balami, Ouda, Dorper and their crosses (Muñoz-Osorio *et al.*, 2017). Currently, in Tabasco, the Pelibuey breed are raised in booth intensive or extensive production systems (Torres-Chablé *et al.*, 2020). However, the region's humid tropic conditions represent a metabolic and immunological challenge in Pelibuey male lambs throughout the year, compromising their health (Muñoz-Osorio *et al.*, 2017). Fortunately, the haematological values reflect the physiological responsiveness of the animal to its internal and external environments which include feed and feeding (Berda-Haddad *et al*., 2017). It also helps to distinguish normal state from state of stress (Sjors-Dahlman *et al.*, 2021; Thornton *et al.*, 2021). Scarcity of information on reference values for haematological parameters, particularly for sheep could make such comparisons difficult. Therefore, the present study was undertaken to establish the haematological values of Pelibuey lambs under humid tropic conditions.

MATERIALS AND METHODS

Animals

All experimental procedures were approved by the Committee of Ethical Review at Academic Division of Agricultural Science of Juarez Autonomous University of Tabasco (protocol approval number: 06/21; experimental period: May 2021). The animals belong to the Sheep Integration Center of the Southeastern (**CIOS**), located in the state of Tabasco, Mexico; between meridians 90°59'08" and 94°07'00" west of the Greenwich

meridian and parallels 17°15'00" and 18°38'45" north latitude. Climate is warm humid (Köppen Cfb) with abundant summer rains (Peel *et al.*, 2007). The average temperature is 22-27.5°C, with precipitation of the order of 2500 mm/year. The study was carried out with 80 male lambs with initial body weight (average ± SD) of 20.03 ± 7.50 kg and age between 3 and 4 months. At the time of sample collection, all the included animals apparently appeared asymptomatic. Lambs were placed in raised-slatted floor pens (6 × 4 m) with a feeding group (20 animals per pen) in a feedlot system and were fed *ad libitum*. The experimental diet was a total mixed ration (80:20 concentrate to forage ratio) comprising ground maize, soybean meal, star grass hay, vitamins, and minerals premix. The diet was formulated to meet the metabolizable energy, and metabolizable protein for growing sheep (250 g/d) according to the equations of the Agriculture and Food Research Council. Animals with FAMACHA© score of 2-3 were included as a method to rule out animals that presented anemia due to gastrointestinal parasites (Torres-Chablé *et al.*, 2020).

Blood sample collection

Blood was collected by jugular vein puncture, between 7:30 and 8:00 h, using 6 mL vacuum tubes with EDTA-K_2 (BD Vacutainer 367863; Becton-Dickinson Co., Franklin Lakes, United States), as described by Badawi & Al-Hadithy, (2014) and Njidda *et al.*, (2014). All blood samples were transported to a clinical laboratory at Academic Division of Agricultural Science, and analyses were performed on fresh samples.

Haematological analysis

The analysed haematological parameters were RBC, WBC, HGB, MCV, MCH, MCHC, HCT, and PLT using the blood analyzer (Medonic CA 620/530 Vet; Brand Boule Medical AB., Stockholm, Sweden).

Statistical analysis

The statistical procedure used to calculate 95% confidence intervals for the different haematological parameters followed the recommendation of the International Federation of Clinical Chemistry (Solberg, 1987). Data were first evaluated for the presence of outlier data for each haematological parameter. No samples were found with scores above the mean ± 3 SD. To assess the distribution of the sample, the resulting data set was analyzed using Gaussian distribution, and coefficient of variation, lower quartile and upper quartile were determined by SPSS Univariate Procedure (SPSS., 2013).

RESULTS

The reference value, descriptive statistics for RBC, WBC, HGB, MCV, MCH, MCHC, HCT, and PLT in Pelibuey lambs under tropic conditions are shown in Table 1.

Table 1. Mean (*x*), standard deviation (SD), reference value, minimum (Min), maximum, coefficient of variation (CV), confidence interval (CI), lower quartile (Q_1), and upper quartile (Q_3) for different haematological parameters in male Pelibuey lambs under humid tropic conditions (*n* = 80)

Value	*x* ± SD	Reference[1]	Min	Max	CV	CI[2]	Q_1	Q_3
RBC[a] ($\times 10^6$/µL)*	11.71 ± 1.13	7.72 ± 1.56	9.12	14.29	9.65	11.45 − 11.96	10.97	12.40
WBC[b] ($\times 10^3$/µL)	11.55 ± 5.52	9.13 ± 1.81	3.80	28.70	47.78	10.31 − 12.78	8.30	12.70
HGB[c] (g/dL)	12.01 ± 1.80	9.67 ± 1.47	8.90	19.50	15.05	11.61 − 12.42	11.00	12.50
MCV[d] (fl)	31.28 ± 1.92	33.99 ± 5.22	28.20	36.80	6.15	30.85 − 31.72	29.70	32.60
MCH[e] (pg)*	10.26 ± 1.30	10.56 ± 0.16	8.80	15.60	12.68	9.96 − 10.55	9.70	10.20
MCHC[f] (g/dL)*	32.95 ± 4.46	35.12 ± 2.70	28.00	54.10	13.53	31.95 − 33.95	30.60	33.30
HCT[g] (%)	36.62 ± 3.80	26.20 ± 3.87	27.10	47.00	10.40	35.77 − 37.47	34.40	39.40
PLT[h] ($\times 10^3$/µL)	509.9 ± 141.6	506.7 ± 110.9	248.00	816.00	27.76	478.2 − 541.7	427.00	597.00

[a]red blood cells; [b]white blood cell; [c]haemoglobin; [d]mean corpuscular volume; [e]mean corpuscular haemoglobin; [f]mean corpuscular haemoglobin concentration; [g]haematocrit; [h]platelets; [1]haematological values of Pelibuey lambs were compared to reference values of the most common goat breeds from humid tropical conditions (Badawi & Al-Hadithy, 2014; Njidda *et al.*, 2014); [2]confidence interval of 95%; *differences with the reference.

DISCUSSION

According to Slatinskaya *et al.* (2021), the extracellular excitation of Ca^{2+} increases the release of catecholamines (adrenaline and norepinephrine), causes an increase in blood pressure and consequently an increase in the number of circulating erythrocytes. Also, high RBC values may be associated with conditions of the bone marrow that produce more erythrocytes (polycythemia) or with impaired lung function (Carobbio *et al.*, 2019). Conversely, the destruction of erythrocytes can be produced by the depletion of intracellular enzymes, by their transit through very narrow capillaries, or even by phagocytosis (Johnstone *et al.*, 2017). Also, low RBC values may be associated with iron deficiency, internal bleeding, anemia or vitamin deficiency (Carobbio *et al.*, 2019). The observed value for RBC (Table 1) was similar to that observed for Awassi breed lambs (Badawi & Al-Hadithy, 2014), but higher than the values reported for lambs from the Yankasa (Adenowo *et al.*, 2004), Balami, Ouda (Njidda *et al.*, 2014), and Hamdani breeds (Khan, 2013). Therefore, the racial factor also determines different RBC values.

The determined value for WBC was similar with the reference values for Hamdani breed (Khan, 2013), but higher than those reported for Balami breed (Njidda *et al.*, 2014), and lower when compared to values of Yankasa and Ouda breeds (Adenowo *et al.*, 2004). Sheep have only lymphocytes with small-medium size (Polizopoulou, 2010). Lymphocytosis is unusual, but it can occur in chronic viral infections and autoimmune

disorders (Singh *et al.*, 2019). Lymphopenia is attributed to endogenous or exogenous corticosteroids, acute infections, and endotoxemia (Naylor *et al.*, 2020).

The HGB increases with intense training and its consequent dehydration (Atata *et al.*, 2019). Also, there are reports of its increase associated with resistance to infectious diseases (Geraci *et al.*, 2019). The HGB is reduced during hematopoiesis, prolonged stress, and severe infections (Huang *et al.*, 2018). Also, there are reports of its reduction associated with poor nutrition (Hamed *et al.*, 2021). However, the quantized value of HGB in male Pelibuey lambs is similar to the values reported for the Balami and Ouda breeds (Njidda *et al.*, 2014), Hamdani breed (Khan, 2013) and Awassi breed (Badawi & Al-Hadithy, 2014), and slightly lower compared to the Yankasa breed (Adenowo *et al.*, 2004).

The MCV value was similar with the Awassi breed (Badawi & Al-Hadithy, 2014). However, it was upper to the Hamdani breed (Khan, 2013), and was slightly lower in relation to the Yankasa, Balami and Ouda breeds (Adenowo *et al.*, 2004; Njidda *et al.*, 2014). Humid tropic conditions have been reported to influence MCV. This effect seems to be related to the organic need to reduce metabolic heating, by reducing the cellular oxygen requirement to compensate for environmental heat (Azeez *et al.*, 2009).

The observed value for MCH, was similar with the Awassi breed (Badawi & Al-Hadithy, 2014). However, it was slightly lower to the Yankasa breed (Adenowo *et al.*, 2004), to the Balami and Ouda breeds (Njidda *et al.*, 2014), and to the Hamdani breed (Khan, 2013). MCH does not provide a value individually, because its concentration depends on MCV and MCHC (Jiménez-Penago *et al.*, 2021), and usually, correlates with MCV except in animals with macrocytic and hypochromic erythrocytes (Adewoyin *et al.*, 2019).

The determined value for MCHC, was slightly lower in relation to the Yankasa, Balami, Ouda breeds (Adenowo *et al.*, 2004; Njidda *et al.*, 2014), and to the Hamdani and Awassi breeds (Khan, 2013; Badawi & Al-Hadithy, 2014). However, the RBC value is lower than the HGB (Table 1). Therefore, the concentration of erythrocytes is adequate for their storage in HGB (Atata *et al.*, 2019).

Different studies indicate factors such as high ambient temperature (Arieli *et al.*, 1986; Andrewartha *et al.*, 2011), food restriction (Bradley *et al.*, 2020), and hemorrhagic shock with blood loss (Egro *et al.*, 2020), as possible causes of variation in HCT. However, the determined value of this haematological parameter in male Pelibuey lambs (Table 1), is similar to the values reported for Awassi breed (Badawi & Al-Hadithy, 2014) and for Balami and Ouda breeds (Njidda *et al.*, 2014), and slightly lower compared to the Yankasa breed (Adenowo *et al.*, 2004). The HCT rises under stressful conditions, due to increased

erythrocythemia by stimulation of erythropoietin, or by splenic contraction with the release of stored erythrocytes (Wang *et al.*, 2021), but this was not the case.

Finally, the observed value for PLT, was similar with the Hamdani breed (Khan, 2013). However, it was upper to the Awassi breed (Badawi & Al-Hadithy, 2014). Prolonged bleeding and petechiae are common signs indicating thrombocytopenia or platelet dysfunction (Badawi & Al-Hadithy, 2014). Using heparin as an anticoagulant may decrease PLT (Polizopoulou, 2010). Different studies indicate factors such as age, sex, exercise, environmental temperature, altitude, temperature/humidity index, as possible causes of variation in PLT (Macías-Cruz *et al.*, 2013; Njidda *et al.*, 2014; Atata *et al.*, 2019).

CONCLUSIONS

The haematological values established in this study are one of the most comprehensive hematology datasets generated in male Pelibuey lambs under humid tropical conditions. Fluctuation exists in the hematological parameters of all breeds of lambs. However, the cause of the fluctuation can be undetected minor infections, weather extremities and genetic factors, so it is expected that there will be variations between populations/breeds. It is therefore necessary to establish reference ranges specific to a particular population instead of applying reference values for one population to another.

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Errata Erratum
https://abanicoacademico.mx/revistasabanico-version-nueva/index.php/abanico-veterinario/errata