Haematological and protein profile of goat rodeo in extensive productions of different regions in the province of Salta, Argentina

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ABSTRACT
The proposal of this study was to determine the haematological and protein parameters of goats raised extensively in three regions of different orography and climate in the province of Salta. Haematological parameters were determined: haematocrit (Hct), red blood cell (RBC), mean corpuscular volume (MCV), haemoglobin (Hb), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), white blood cell (WBC), lymphocyte (L), neutrophil (N), eosinophil (E), basophil (B) and monocyte (M), and serological parameters: proteins, albumin and A/G ratio. Blood samples were taken by the jugular puncture from 61 animals of the mountain range region, 253 from the region of the valleys and Sub-Andean Mountain and 299 from the Chaco region. In general, the values obtained are within the reference parameters of the goat species. The study of one-way analysis of variance (ANOVA) showed there was a significant effect of altitude on the following parameters: Hct, Hg, being higher in the animals from the mountain range environment. The values determined contribute to the knowledge of the reference range of haematological and protein values for goat raised in Salta, and can be used as health control.

1. Introduction
The determinations of the blood parameters are used for individual health assessment and monitor the nutritional and metabolic conditions of the animals. However, the levels of blood parameters are influenced by several factors, such as sex, breed, age, stress, diet, milk production levels, management, weather and physiological state (lactation, pregnancy, and reproductive status) because they modify homeostasis and the metabolic response of the organism (Arfuso et al. 2016; Fazio et al. 2016). For the correct interpretation of the metabolic profile, it is necessary to compare with regional values and population reference values in particular (da Silva et al. 2008). Nevertheless, reference to climate zones values and similar groups can be used (Piccione et al. 2010; Carlos et al. 2015). In Salta province, goat breeding is a subsistence economy and represents an ancestral activity (Suárez et al. 2017).

The predominant production system is extensive, which predisposes the animals to inadequate temperature and humidity conditions at certain times of the year (Suárez et al. 2016). The goat is a markedly rustic animal, adapts to high mountains, to different climates and pastures. During this process, animals acquired unique adaptive traits such as disease resistance and tolerance to hot and cold (Silanikove 2000; Ribeiro NLet al. 2018).

Haematocrit (Hct) is an estimate of the mass of erythrocytes (RBC) relative to blood volume. It can be increased by loss of liquid through evaporation (Nunes et al. 2002), and can be decreased due to anaemia, haemolysis, advances pregnancy and long-term heat stress (Paes et al. 2000). The diameter of the erythrocytes of the goat is smaller than the rest of the domestic animals, averaging 3.5 microns. This is compensated by a high number, which is much higher than the rest of the domestic animals, being the average from 8 to 18 million/ul being able to reach 20 million in young animals. This could be related to the adaptation of goats to live on the mountains summits where more efficient oxygen exchange is required (Abraham et al. 1984). There was a seasonal effect on erythrocytes (RBC), haematocrit (Hct), haemoglobin (Hb), mean corpuscular volume (MCV), and mean corpuscular haemoglobin concentration (CHCM). The animals alter haematological parameters to maintain a stable body temperature. These changes are likely adaptive and have been acquired over the years as a result of the environmental conditions of the studied region. The haematological values most likely reflect the adaptive capacity of the animals, as they have acquired this characteristic trait by adapting to the local climate over several generations (Ribeiro NLet al. 2018).

Piccione et al. (2011) demonstrated seasonal rhythms of albumin and albumin/globulins both in sheep and goats. The total proteins and globulin levels were significantly higher in the dry season. Difference in the globulin values is related to physiological and genetic factors of animal adaptation (Ribeiro NLet al. 2018). In the goats that suffer from long-term heat stress, there is a drop in total proteins, albumin and
globulins, Ribeiro María N et al, 2018). In animals serum proteins change with age and in the very old, this age is an important consideration in the interpretation of serum protein. The effect of age was significant only on the γ-globulins increased in its relative amount and a significant decrease in the albumin/globulin’s ratio in adult’s native goat (Piccione et al. 2010).

As in others parts of the world, the breeding of goats in Argentina is known as the poor man’s cow. It is predominant in family production systems having a key role in the development of rural marginal areas. Given the adaptability and resistance of these little ruminants, they contribute to improving the quality of life, to fight poverty and hungers of hundreds of families in the region (Ribeiro Neila et al. 2015; Habibu et al. 2017).

The aim of this study, given that there are no previous data, was to determine the haematological and protein parameters of native goats raised extensively in three different regions of Salta province, and to analyse the influence of endogenous variables, such as sex and age, and of some exogenous variables, such as climate and altitude. This will allow us to improve the productive and economic results of the place.

2. Materials and methods

2.1. Study area

This study was conducted in the northwest Argentina province of Salta located between 22° and 26° latitude S and 62° and 68° longitudes O, with a surface of 155,488 km². It has an orographic and climatic heterogeneity that allows us to distinguish three regions, from the cold of the Andes and the Puna, to the subtropical of the jungles, passing through fertile template valleys.

(a) Mountain range environment. Dry Puna climate. Formed by the Puna and the Pre-Puna mountain range, Andean altiplano, ranging from 2000 to 6000 meters above the sea level. An area of 31,000 km². The altitude and the lack of humidity mean that there is a great variation in temperature, −10°C at night and 25°C during the day. It is a dry, arid and inclement region, punished by the wind and snow blizzards. The sparse vegetation is of the xophilic type and between the mountains there are immense plains.

(b) Subtropical climate with dry season environment: sub-Andean valleys and mountains. The mountains are from 1200 to 200 m above the sea level. An area of 45,000 km². It is the region of the sub-Andean valleys (Lerma, Sianca, San Andres and Calchaquies).

(c) Chaco environment: subtropical climate with dry season. The temperature are very high, the annual average is 30°C. It can reach 49°C. It rains 750 mm in the spring and the summer (from November to March). It has an area of 79,000 Km². The departments visited of these regions were Anta and Rivadavia Banda Sur (RBS).

2.2. Animals

Between April 2016 and October 2019, 9 departments (small towns) with 33 Production Family Unite (PFU) with a total of 613 goats were studied. The distributions of sampling points by regions are shown in Figure 1. If we group the regions by altitude intervals the above sea level, the numbers of goats analysed in the regions of different altitudes are as follows:

(a) From 2000 to 4000 m: 61 goats
(b) From 1000 to 1999 m: 253 goats
(c) Less than 999 m: 299 goats

In all the Production Family Unite (PFU) visited the number of goats did not exceed 30 animals, so the sampling went to all the animals clinically healthy. The study included native goats, with extensive raising production system. Only in La Viña department (small town), the raising system is intensive and the goats are of Saanen breed. The visiting period was during the dry season in all the regions, i.e. when the rain ceases and before the summer. The sex and age of each animal were recorded. The animals were separated in age groups of up to 6 years old and older than 6 years old.

2.3. Data collection

All the data and the blood samples were collected during visits to the Family Production Unite, after the owners had signed a consent form.

2.4. Collection of blood

All goats were sampled once blood samples were collected from each animal by the jugular vein puncture into tubes: 1 tube contained ethylene diamine tetra-acetic acid (EDTA) for haematological analyses and the other tubes for protein analyses did not contain anticoagulants. The vials containing the blood and the anticoagulant were inverted several times to ensure proper mixing.

2.5. Haematological profile

The micro-haematocrit technique was used. The number of red blood cells (RBCs) and the numbers of white blood cells (WBC) were determined in the Neubauer chamber. Blood whit EDTA was diluted at 1:200 for RBC counts with a saline solution, while for WBC counts were diluted at 1:20 with a Turck solution. For the haematological technique the indications of Juste de Santa Ana and Carretón Gomez (2015) were followed.

The amount of haemoglobin (Hb) in the blood was determined from the Haemoglobin-Cyanide method, according to the technique described by Drabkin and Austin (1935) and Van Kampen and Zijlstra (1965) and the Homocyan B (Brizuela-Lab) reagent was used.

Different leucocyte counts (TLCs) were determined using blood smear, coloured with Giemsa and examined under the immersion microscope (100×). Neutrophils, eosinophils, basophils, lymphocytes and monocytes were distinguished.

For the determination of the Red Blood Cell Indices, the Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC) were calculated. The MCV indicates the average size
of each red blood cells and is calculated using the following formula: 

$$MCH (pg) = \frac{Hb (g/dl) \times 10}{N}\text{ red blood cells/ul}.$$  

The MCHC indicates the weight of haemoglobin in 100 ml of red blood cell; it is calculated by: 

$$MCHC (%) = \frac{Hb (g/dl) \times 100}{HTO}.$$  

**2.6. Serum protein**

Blood samples collected in anticoagulant-free tubes were allowed to clot, followed by centrifugation at 2000 g for 15 min. The serum samples were frozen individually at −20°C until further use for protein analysis. The serum levels of total protein and albumin were performed using specific commercially available kits (Proti 2, Wiener Lab, Santa Fe Argentina). The results of total protein and albumin levels were used for calculating globulin and the albumin/globulin (AG) ratio (Carlos et al. 2015).

**2.7. Data analysis**

The values were expressed as mean ± standard deviation (±SDM). The obtained data were grouped by climatic regions, sex and age. The age groups were: up to 6 years old, and older than 6 years old. One-way ANOVA was used to assess the statistical differences between groups of goats living in different altitudes (GraphPad Prism v.4). The level of significance was set at $p < 0.05$.

**3. Results**

**3.1. Haematological values**

The red cells indices found are presented by department (small towns), grouped by age and sex. Due to technical problems, (the distances between the location and the laboratory), not all the samples were analysed for the same determination, so the $(n)$ changes for the different determinations. The statistical mean ± one standard deviation is expressed.

In Table 1, we can observe the average of the haematological parameters of goats from the mountains’ range and the sub-Andean valleys with the reference values from the species.

The values of the blood parameters in relation to the age and sex of the los Andes, La Caldera and Capital department of Salta are presented in Table 2.

Table 3 shows the main goat parameters of the Chaco environment. In Anta and Rivadavia Banda Sur (RBS) small towns, the presence of ticks was observed above 20%. However, this percentage could have been higher in the days prior to our visits, since several owners had spayed external deworm. Since the percentage of infestation in goats could influence the haematocrit value, we present the parameters found in each FPU. The comparison of blood values between males and young females is observed in Table 4.

The white blood cell differential was determined in goats from the FPU visited during September 2017, which had a 47% infestation by ticks. These values were found in 6 (six)
female goats: N: 30.8 ± 14.0; E: 5.3 ± 4.2; B: 0.6 ± 0.5; M: 55.8 ± 10.2; M: 7.3 ± 5.9 and in 5 (five) male goats: N: 30.2 ± 5.5; E: 9.7 ± 6.4; B: 1.1 ± 0.5; M: 2.3 ± 2.3 ± 0.7; M: 53.0 ± 9.0 * 0

3.2. Serum protein values

The mean ± SEM values of the serum proteins are presented in Tables 5–7.

Effects of altitude and climatic variable are shown in Figures 2–4.

4. Discussion

From Table 1, it can be seen that the haematological values are within the parameters of the species (El Manual Merck de 1988). In the Capital city located in a sub-Andean valley 1220 metres above the sea level, the values of the haematocrit (Hct) and haemoglobin (Hg) are registered slightly below average. This can be attributed to the helminthiasis, a worm infection that affects the correct absorption of nutrients (Obi and Anosa 1980). In 2013, Ribeiro NL et al. (2018), analysing goats in a semi-arid region in Brazil during the dry season, found an average of Hæmatocrit of 23.0 ± 6.4 with a minimum of 12.0 and a maximum of 34.0 for which our values would be in agreement. The same happened with the values obtained by Piccione et al. (2010) of 34.0 for which our values would be in agreement. The same happened with the values obtained by Souza in 2011 (10.45 g/dl, for the haematocrit value of 29.83%), However, the haematocrit value of 26. 0 ± 3.4 is within the average for the species and higher that determined by Nunes and close to the MCH value of 5.4 ± 1.3 determined by Azab et al. (1999) in Baladi goats.

In La Caldera department (small town) the Hct and Hb values are at the lower limit and a higher count of eosinophil is observed that is above the reference range. This can be attributed to the helminthiasis, a worm infection that affects the correct absorption of nutrients (Obi and Anosa 1980). In 2013, Guzman and Custodio, also found an increase of eosinophil in goats from Peru, and they attributed it to a pro-inflammatory response.

In the Chaco environment, the haematocrit values are mostly low. These animals have a very poor sanitary level, tick parasitism exceeding 20% on average, so there is the possibility of anaemia. Obi and Anosa (1980) determined that a very mild anaemia was produced by A. marginali in cow. Nevertheless, Ribeiro NL et al. (2018), analysing goats in a semi-arid region in Brazil during the dry season, found an average of Haemocrit of 23.0 ± 6.4 with a minimum of 12.0 and a maximum of 34.0 for which our values would be in agreement. The same happened with the values obtained by Piccione et al. (2010) of 34.0 for which our values would be in agreement. The same happened with the values obtained by Souza in 2011 (10.45 g/dl, for the haematocrit value of 29.83%). However, the haematocrit value of 26. 0 ± 3.4 is within the average for the species and higher that determined by Nunes and close to the MCH value of 5.4 ± 1.3 determined by Azab et al. (1999) in Baladi goats.

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Table 3. Haematological values of young female goats and old female goats in the Chaco environment.

| Date          | Anta F | RBS F | RBS M | Anta M | RBS F | RBS M | RBS F | RBS M | RBS F | RBS M | RBS F | RBS M | RBS F | RBS M | RBS F | RBS M |
|---------------|--------|-------|-------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| % ticks       | 42.8   | 43.8  | 35    | 57.1   | 36.4  | 6.7   | 47.0  | 53.8  | 20    | 13.3  | 23.8  | 23.8  | 0     | 13.3  | 23.8  | 0     |
| Hct%          | 26.7 ± 5.0 | 19.7 ± 4.7 | 20.6 ± 2.5 | 4.7   | 15.8 ± 4.3 | 17.0 ± 3.2 | 24.3 ± 4.4 | 23.3 ± 3.8 | 26.5 ± 1.0 | 24.6 ± 1.7 | 24.1 ± 1.7 | 15.9 ± 3.0 | 21.0 ± 7.1 | 18.0 ± 3.0 | 7.1   |
| WBC x10³/ul  | 8.0 ± 2.5 | 73.6 ± 3.2 | 56.2 ± 2.0 | 2.5   | 6.2 ± 2.7 | 6.2 ± 1.2 | 6.0 ± 1.0 | 5.6 ± 1.4 | 8.1 ± 2.6 | 5.7 ± 1.7 | 5.7 ± 1.7 | 5.0 ± 1.8 | 4.2 ± 1.5 | 4.3 ± 1.9 |

Notes: (n): number of goats, X ± SD, Hct (haematocrit), WBC (white blood cell).

Table 4. Overall mean and SEM values for blood parameters of female and male goats from the Chaco environment.

| Date          | Anta F | Anta M | RBS F | RBS M | RBS F | RBS M | RBS F | RBS M | RBS F | RBS M | RBS F | RBS M | RBS F | RBS M | RBS F | RBS M |
|---------------|--------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Ticks (%)     | 4/19   | 4/19   | 6/19  | 6/19  | 9/17  | 9/17  | 10/19 | 10/19 | 10/19 | 10/19 | 10/19 | 10/19 | 10/19 | 10/19 | 10/19 | 10/19 |
| Hct%          | 42.8   | 42.8   | 43.8  | 43.8  | 43.8  | 47.0  | 53.8  | 53.8  | 20    | 20    | 13.3  | 13.3  | 23.8  | 23.8  | 13.3  | 23.8  |
| WBC x10³/ul  | 8.0 ± 2.5 | 73.6 ± 3.2 | 56.2 ± 2.0 | 2.5   | 6.2 ± 2.7 | 6.2 ± 1.2 | 6.0 ± 1.0 | 5.6 ± 1.4 | 8.1 ± 2.6 | 5.7 ± 1.7 | 5.7 ± 1.7 | 5.0 ± 1.8 | 4.2 ± 1.5 | 4.3 ± 1.9 |

Notes: (n): number of goats, X ± SD, Hct (haematocrit), WBC (white blood cell), F (Female), M (Male).

Table 5. Proteins values of young female goats from the mountain range and valleys of Salta.

| Los Andes | Rosario de Lerma | San Carlos | La Viña | La Caldera F < 6 years old | La Caldera F > 6 years old | Cerrillos | Capital | Merck RV |
|-----------|------------------|------------|---------|-----------------------------|-----------------------------|-----------|---------|----------|
| Total Proteins (g/dl) | 17.1 ± 0.8 | 35.6 ± 0.6 | 36.7 ± 0.6 | 67.6 ± 1.1 | 57.6 ± 1.1 | 66.0 ± 1.0 | 67.1 ± 1.1 | 61.1 ± 1.1 |
| Albúmin (g/dl) | 17.2 ± 0.4 | 35.0 ± 0.6 | 36.7 ± 0.6 | 67.6 ± 1.1 | 57.6 ± 1.1 | 66.0 ± 1.0 | 67.1 ± 1.1 | 61.1 ± 1.1 |
| Globulin (g/dl) | 17.3 ± 0.5 | 35.2 ± 0.6 | 36.7 ± 0.6 | 67.6 ± 1.1 | 57.6 ± 1.1 | 66.0 ± 1.0 | 67.1 ± 1.1 | 61.1 ± 1.1 |
| A/G ratio | 17.4 ± 0.1 | 35.1 ± 0.6 | 36.7 ± 0.6 | 67.6 ± 1.1 | 57.6 ± 1.1 | 66.0 ± 1.0 | 67.1 ± 1.1 | 61.1 ± 1.1 |

Notes: (n): number of goats, X ± SD, RV: reference value.
of haematocrit (27.25 ± 0.59) are similar to ours in Anta (26.7 ± 5) and RBS (26.0 ± 3.3) goats.

The study of one-way (ANOVA) showed that there was a significant effect of altitude on the following parameters: haematocrit, haemoglobin, and white blood cell. The second figure presents the effect of altitude on Hct and Hg, shows a highly significant difference (p < 0.0001, α = 0.05) between the averages of the animals in the three climatic zones, the highest values being for animals living in the mountain ranges from 2000 to 4000 m above sea level. The same happens with the average values of haemoglobin, being significantly much higher in animals living in mountain range environment than the others. Because the function of the haemoglobin is the oxygen transport of the lungs for different tissues and that at higher altitude the lower environmental oxygen pressure, the higher the number of red blood cells, the greater the oxygenation capacity of the tissues through oxyhaemoglobin to then release its oxygen into the tissues. (Silva et al. 2008; Blanco et al. 2016; Souza et al. 2011). But, a reduction in the red blood cells has been reported in animals exposed to extreme cold, and has been associated with a reduction in the average life of erythrocytes. Habibu et al. (2017) observed both reduction and rise in the value of erythrocyte parameters depending on breed. In Los Andes and Rosario de Lerma zones, temperature below 0 (cero) degrees has been reported, with permanent snowfall thought the year, so we can assume that these goats are adapted to this climate.

A significant difference was found in the white blood cells count between goats living in the valleys and sub-Andean region being the value: 7.5 ± 0.25, is slightly different from the goats living at higher altitude (p = 0.02) and differs significantly with those living at a lower altitude. (p = 0.0001). (Figure 3) This may be because this area is the richest in the province, meanwhile in the mountain range the extreme cold limits the presence of pathogens. The increase in WBC seems to have the protective system, providing a rapid and potent defence against any infectious agent and this is probably the physiological basis for the adaptation of this species to this eco-zone characterised with high prevalence of disease and suggestive of well-developed immune system with such number of immune cells to proffer good health (Daramola et al. 2005).

When analysing the altitude and climate effects over the proteins, we notice that the proteins form the Chaco environment are significantly higher (p < 0.0001) compared to the other regions and the same happens with the globulin values. (p = 0.02) (Figure 4). This may be due to the presence

| Table 6. Proteins values from male goats from the mountain range and valleys of Salta. |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Los Andes | La Caldera | Capital | Anta | RBS 6/19 | RBS 9/17 | RBS X/19 |
| (n) Total Proteins (g/dl) | 9 | 5.8 ± 0.8 | 2 | 7.2 ± 0.0 | 5 | 6.0 ± 0.3 | 1 | 5.4 | (1) | 7.6 ± 1.1 | (1) | 9.5 ± 1.8 | (1) | 7.8 | 6.1–7.4 |
| (n) Albumin (g/dl) | 9 | 2.7 ± 0.1 | 2 | 2.2 ± 0.7 | 5 | 3.0 ± 0.1 | 1 | 1.4 | (5) | 3.8 ± 0.5 | (11) | 4.8 ± 0.8 | (3) | 3.9 ± 0.3 | 2.3–3.6 |
| (n) Globulins (g/dl) | 9 | 3.1 ± 0.5 | 2 | 5.2 ± 0.8 | 5 | 2.8 ± 0.4 | 1 | 4.0 | (4) | 3.7 ± 1.3 | (11) | 4.7 ± 1.3 | (2) | 3.4 ± 0.7 | 2.7–4.4 |
| (n) A/G ratio | 9 | 1.0 ± 0.36 | 2 | 0.4 ± 0.4 | 5 | 1.0 ± 0.22 | 1 | 0.3 | (1) | 1.1 ± 0.4 | (11) | 1.0 ± 0.2 | (2) | 1.1 ± 0.07 | 0.6–1.1 |

Notes: (n): number of goats, X ± SD, RV: reference value.

| Table 7. Proteins values of female goats from Chaco environment. |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Anta | RBS | RBS | RBS | RBS < 6 años | RBS > 6 años | Merck RV |
| Date | 4/17 | 6/19 | 8/19 | 9/17 | 10/19 | 10/19 |
| (n) Total Proteins (g/dl) | 19 | 6.0 ± 1.0 | (77) | 7.3 ± 0.9 | (62) | 6.5 ± 0.8 | (18) | 8.5 ± 0.1 | (31) | 6.7 ± 0.7 | (4) | 7.7 ± 0.8 | 6.1–7.4 |
| (n) Albumin (g/dl) | 19 | 3.1 ± 0.7 | (32) | 3.7 ± 0.6 | (60) | 3.8 ± 0.6 | (18) | 4.1 ± 0.6 | (53) | 3.5 ± 0.5 | (10) | 3.5 ± 0.5 | 2.3–3.6 |
| (n) Globulins (g/dl) | 19 | 2.8 ± 0.8 | (32) | 3.6 ± 0.8 | (59) | 2.8 ± 0.78 | (18) | 4.4 ± 1.1 | (31) | 3.3 ± 0.9 | (4) | 4.3 ± 1.1 | 2.7–4.4 |
| (n) A/G ratio | 19 | 1.1 ± 0.45 | (32) | 1.0 ± 0.3 | (59) | 1.4 ± 0.5 | (18) | 0.97 ± 0.3 | (31) | 1.0 ± 0.4 | (4) | 0.8 ± 0.4 | 0.6–1.1 |

Notes: (n): number of goats, X ± SD, RV: reference value.

Figure 2. (a) ***The values are significantly different at P < 0.0001; (b) ***, the values are significantly different at P<0.0001.
of gamma globulin that increases in response to chronic infections. Ribeiro NL et al. (2018) found total protein and globulin values with higher values during dry season, matching our results. Grilli et al. (2007) determined an average of Total Protein value of 6.28 ± 0.81 in a goat rodeo at a hyper dry region of Mendoza, Argentina. Differences in the globulin values are related to physiological and genetic factors of animal adaptation. These changes are likely adaptive and have been acquired over the years as a result of the environmental conditions of the studied region. The haematological values most likely reflect the adaptive capacity of the animals, as they have acquired this characteristic trait by adapting to the local climate over several generations (Ribeiro NL et al. 2018).

4.1. Effect of age on haematological and biochemical parameters

The female goats from La Caldera have lower values at HCT, RCB, Hh, WBC, (with neutrophil predominance) and also lower values on proteins. Daramola et al. (2005) compared adult goats with kid goats, where the haematocrit is higher in adults but not by a big difference, also the Hb and RBC were higher in adult goats \(p < 0.05\) compared to values obtained for young West African Dwarf (WAD) goats. So age has a significance on these parameters.

4.2. Effect of sex on haematological and biochemical parameters

Roberto et al. (2010) determined the haematological parameters of full male F1 Boer x SRD, from the semi-arid paraibano, which presents a maximum average annual temperature of 32.9°C and a minimum of 20.8°C and relative humidity of 61%, determining the Hct values in 29.83%. In Los Andes department, we determined Hct of 30.8% and in La Caldera and the Capital 23%. The determination in the males of the Chaco environment varies in relation to the tick infestation, but the same remains within the limits determined by the species and greater than the females.

The blood parameters tested in the male have higher values: young males presented larger globular volumes than the young females, contrary to what was published by de Alvarado (1991), in Venezuela.

5. Conclusions

Although factors, such as breed, sex, age, and regions, influence the haematological and protein parameters, all of the animals presented averages inside the normal limits for the species, demonstrating to be well adapted to the climatic conditions.

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