**ABSTRACT:** Blood samples were collected from 30 (15 male and female) apparently healthy Sudanese desert goats ranging under the same field conditions from North Kordofan State, Sudan. This study had analyzed the hematological profile of goats and the influence of sex on the hematological and some biochemical values. On the Erythrocyte parameters sex had any influence: The mean of red blood cell (RBCs) [(12.10 ± 0.53) (×10⁶ /μL)] and the mean corpuscular hemoglobin concentration (MCHC) (35.69 ± 2.94) in males were higher than females [(12.27 ± 0.74) (×10⁶ /μL), 36.45 ± 2.49%], while the hemoglobin (HB), packed cell volume (PCV), mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH), were high in males than females. In leukocytary series: T Lymphocytes (%) and Eosinophils (%) were higher in females, while Lymphocytes (%) and Eosinophils (%) high in males. Neutrophils (%) average was smaller than normal (23.67 ± 1.96) % and mean of Monocytes (%) was higher, which may be interpreted as a potential infection or hermetic aggression. In biochemical: Glucose was elevated in females goats, while total protein and urea higher in male animals. Ever Since the animals are apparently healthy, any value may be regarded as possible infection or metabolic and nutritional disorder.

**Key words:** Haematological Profile, Biochemical Indices, Blood, Desert Goat.

**INTRODUCTION**

In Sudan goats are estimated to be about 42.5 million head which is a very large population compared to other African countries (Yousif and Fadl El-Moula, 2006). This population composed of four major local breeds, Nubian, Desert, Nilotic and the Dwarf, distributed throughout the country (Wilson, 1991). The Desert goat is characterized by the long drooping (lop) ears, as in the Zaraibi of Egypt and Nubian of the Sudan. Similar types of goats are heavily represented in the atlas region of north Africa, western Mediterranean region as well as in Syria, Iraq and India. At present their major breeding area is considered to be in India. However, no traces of this type of goats (Zaraibi, Damascus, Jamnapari, etc.) have been found in the Indus valley or west of it. The ancestral stock might have evolved either in India subsequent to the Indus valley civilization, or west of India, possibly Iran, from where it spread to Syria and Egypt in the west. It also appears from the occasional occurrence of homonymous screw-like horns in Zaraibi and Jamnapari bucks, that this goat type was evolved from the screw-horned goats common throughout the ancient world from India in the east to Libya in the west. The so-called Nubian goat probably does not in fact originate from Nubia (the area of southern Egypt and northern Sudan), and certainly not from Ethiopia, and the convex profile is a common characteristic of goats in the Middle East and India (General breed information from Mason, 1984).

Despite the social and economic values of goats as source of meat, milk and hides, with a great production potential, the research effected on goats in our country were neglected for long time. The goats revaluation depends on various factors, including the great prevalence of diseases, poor management practices and extensive production systems. The diseases action is the most aggressive on animals. From this point view, clinic and Para clinic exams are essential to sanitary strategies (control, prevention or treatment). The hematological tests served as information base for animal health assistance. It has been reported that regardless of age, sex and climate, goats reared under traditional husbandry system have low hematological values compared to those reared under modern husbandry (Coles, 1980; Schalm et al, 1975). Low nutritional grassland pasture, stress, parturition and climatic factors greatly alter the blood values of goats (Anosa and Isoun, 1978, Radostits et al 1994). Blood is an important and reliable medium for assessing the health status of individual animals (Oduye, 1976). Determination of the main haematological and biochemical parameters of animals helps veterinarians to confirm clinical
diagnoses, estimate the severity of cases, administer appropriate treatment, and evaluate outcomes (Roubies et al., 2006). To interpret data correctly, the results obtained in the laboratory must be compared with values corresponding to the reference values of clinically healthy animals, which serve as a guide to the clinician in evaluating parameters (Yokus, et al., 2006). It is unequivocal that a large number of factors, such as species status, breed, sex, age, nutrition, illness, and seasonal variations, can affect the pattern of these values (Swanson, et al., 2004; Nazifi, et al., 2003). The significance of determining haematological and biochemical indices in animals is well documented (Oduye and Adadevoh, 1976; Obi and Anosa, 1980), and changes in these parameters have been studied in cattle (Ghergariu, et al., 1984), sheep (Kaushish, and Arora, 1977), and goats (Tschuor, 2008; Tibbo, 2008). There is great variation in the haematological and biochemical parameters observed between goat breeds (Azab and Abdel-maksoud, 1999; Tambuwal et al., 2002; Daramola, et al., 2005).

These differences have underscored the need to establish an appropriate physiological baseline values for various breeds of livestock including the desert goat which could be used in the realistic evaluation of the management practice, nutrition and diagnosis of health condition, furthermore, this paper focused on the hematological and some biochemical values of apparently healthy Desert goats as influenced by sex and attempt has been made to provides references ranges for these variables of Sudanese Desert goats.

MATERIALS AND METHODS

Survey background
This study was carried out in North Kordofan State, Sudan (Latitudes 13° and 29° North, Longitudes 21° and 33° East). It was conducted in July 2011 ranging under the same field conditions (at El Obied Animal market). Blood samples were collected from thirty Desert goats (15 male and female) apparently healthy goats of adult age. The goats herds were naturally ranging and had no feed supplementation, water was available ad labium.

Blood analysis
Samples of blood were collected from goats by jugular vein puncture. Five milliliters blood samples were collected from each goat using 5 mL plastic disposable syringes. Tow milliliters of the blood sample were immediately transferred to capped and heparinized tubes (Medical Disposable Industrial Complex MDIC). These samples were used for the hematological analyses and the determination of plasma glucose concentration. The rest of the samples were allowed to clot for 2h at room temperature, the sera were then separated by centrifugation at 3000 rpm for 15 min and stored frozen at -20C for further analysis. Erythrocytic indices were determined according to the methods described in Schalm’s Veterinary Hematology (Jain, 1986). The packed cell volume of erythrocytes was determined by the micro-haematocrit method using a special centrifuge. Haemoglobin concentration was determined by the cyano- methaemoglobin method as described by Van kampen and ziljstra (1961). Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC) and Mean Corpuscular Volume (MCV) calculated from the following formula (Simon. et al, 2001):

\[
\begin{align*}
MCH \text{ pg (picogram) } &= \frac{\text{Hemoglobin (in gm/dL) \times 10} \times 100}{\text{RBCs count (in million /uL)}} \\
MCHC \text{ (g/dL) } &= \frac{\text{Hemoglobin (in gm/dL) } \times 100}{\text{PCV (in %) }} \\
MCV \text{ fl (femtoliter) } &= \frac{\text{PCV % } \times 10}{\text{RBCs count (in million /uL)}} \\
\end{align*}
\]

Differential leukocyte count (DLC) was determined microscopically from a count of 100 leukocytes in thin May-Giemsa stained blood smears (Kelly, 1984). Serum total protein was determined by the Biuret reagent method according to King and Wooton (1965), Plasma glucose level was determined by the enzymatic colorimetric method using a kit (Plasmatec Laboratory at Products Ltd Germany). The concentration of serum urea was determined by the colorimetric method according to Harold (1988).

Statistical analysis
The data obtained from the blood samples collected from the goats have been subjected to standard methods of statistical analysis was performed using windows based SPSS (Version 10.0, 1999). The analysis of student t-test was used to evaluate the effects of sex on haematological and biochemical parameters in Sudanese desert goats.

RESULTS AND DISCUSSION

The hematological and biochemical values obtained in this study in Tables 1-3 in both sexes in goats were in reference range and comparable to those previously reported concerning the influence of sex and values of Sudanese goats (Holman and Dew, 1965; Schalm et al, 1975; Oduye, 1976; Azab and Abdel-maksoud, 1999; Egbe-Nwiyi et al., 2000; Tibbo et al., 2004; Daramola, et al., 2005; Kamal, 2008; Tschuor, 2008; Waziri et al., 2010 Addass et al., 2010).

Erythrocyte Indices of Sudanese desert goats
Mean Erythrocyte values (± Std) of adult male and female goats are presented in Table 1 and Figure 1 indicating the influence of Sex along with Mean values of all the 30 animals. In erythrocytes indices: Except R.B.Cs count and MCHC all Erythrocyte indices were slightly higher in males than females animals. The R.B.Cs mean on adult male and female was (12.10 ± 0.53) and (12.27 ± 0.74), respectively. The coefficients of variance permits the use
of mean as statistic interpretation. This means are closed to the normal mean of R.B.Cs (8 – 18) (Table 1). In both, males and females the coefficient of variance is less than 30% which revealed that the mean of erythrocytes and eryctocrit constants are representative for this category of goats. The eryctocrit parameters HB, PCV, MCV, MCH and MCHC were analyzed in both sexes. HB mean was (8.47 ± 0.86) g/dl in females and (8.67 ± 0.85) g/dl in males. PCV had the following values: (25.60 ± 1.38)% in males and (23.80 ± 1.41)% in females. MCV, MCHC and MCHC were slightly higher in females compared with males animals. Coefficient of variance did not exceed the limit of 35%, which can be used in statistically interpretation. The RBC values in the ruminants in this study may, among other things, be due to excitement or strenuous exercise during handling (Gartner et al., 1969). This leads to the release of adrenaline and hence spleen contracts and therefore causes the release of more RBC into circulation. The mean of MCV was (21.52 ± 1.33)% in males and (19.96 ± 1.37)% in females, in MCHC the mean was (36.45 ± 2.49)% in females and (35.69 ± 2.94) in males animals. These values of MCV and MCHC in both sexes had been fluctuated and their values are dependent upon RBC, HB and PCV values. The fluctuation of this values are represented in figure 1, where we observed the vaguely differences between females and males.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sex</th>
<th>N</th>
<th>Mean</th>
<th>Std</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
<th>Median</th>
<th>CV</th>
<th>Reference values*</th>
</tr>
</thead>
<tbody>
<tr>
<td>R.B.Cs (x10(^6)/μL)</td>
<td>Male</td>
<td>15</td>
<td>12.10</td>
<td>0.53</td>
<td>2.07</td>
<td>10</td>
<td>18.7</td>
<td>11.8</td>
<td>17%</td>
<td>8 - 18</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>15</td>
<td>12.27</td>
<td>0.74</td>
<td>2.88</td>
<td>10.8</td>
<td>22.3</td>
<td>11.4</td>
<td>23%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>30</td>
<td>12.18</td>
<td>0.45</td>
<td>2.47</td>
<td>10.0</td>
<td>22.3</td>
<td>11.55</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>HB (g/dl)</td>
<td>Male</td>
<td>15</td>
<td>8.67</td>
<td>0.85</td>
<td>3.31</td>
<td>3</td>
<td>13</td>
<td>10</td>
<td>38%</td>
<td>8 - 12</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>15</td>
<td>8.47</td>
<td>0.86</td>
<td>3.44</td>
<td>3</td>
<td>14</td>
<td>10</td>
<td>39%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>30</td>
<td>8.57</td>
<td>0.60</td>
<td>3.27</td>
<td>3</td>
<td>14</td>
<td>10</td>
<td>38%</td>
<td></td>
</tr>
<tr>
<td>PCV (%)</td>
<td>Male</td>
<td>15</td>
<td>25.60</td>
<td>1.98</td>
<td>5.34</td>
<td>3</td>
<td>13</td>
<td>24</td>
<td>21%</td>
<td>22 - 38</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>15</td>
<td>23.80</td>
<td>1.41</td>
<td>5.47</td>
<td>3</td>
<td>13</td>
<td>24</td>
<td>23%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>30</td>
<td>24.70</td>
<td>0.98</td>
<td>5.39</td>
<td>3</td>
<td>13</td>
<td>24</td>
<td>22%</td>
<td></td>
</tr>
<tr>
<td>MCV (fl)</td>
<td>Male</td>
<td>15</td>
<td>7.28</td>
<td>0.76</td>
<td>2.92</td>
<td>2.38</td>
<td>11.54</td>
<td>8.20</td>
<td>40%</td>
<td>16 - 25</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>15</td>
<td>7.04</td>
<td>0.75</td>
<td>2.91</td>
<td>2.63</td>
<td>12.61</td>
<td>7.19</td>
<td>41%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>30</td>
<td>7.16</td>
<td>0.52</td>
<td>2.87</td>
<td>2.38</td>
<td>12.61</td>
<td>7.34</td>
<td>40%</td>
<td>5.2 - 8</td>
</tr>
<tr>
<td>MCH (pg)</td>
<td>Male</td>
<td>15</td>
<td>35.69</td>
<td>2.94</td>
<td>17.09</td>
<td>11.43</td>
<td>30.48</td>
<td>19.49</td>
<td>24%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>15</td>
<td>36.45</td>
<td>2.94</td>
<td>11.38</td>
<td>14.29</td>
<td>52.38</td>
<td>37.04</td>
<td>34%</td>
<td>30 - 36</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>30</td>
<td>35.57</td>
<td>2.60</td>
<td>14.27</td>
<td>11.43</td>
<td>35.9</td>
<td>35.91</td>
<td>40%</td>
<td></td>
</tr>
</tbody>
</table>

N= Number of animals, Std= Standard error of mean, SD= Standard Deviation, Min= Minimum value, Max= Maximum value and CV= Coefficients of Variance. *Reference values Adapted from Merck Sharp & Dohme Corp., a subsidiary of Merck & Co., Inc. Whitehouse Station, NJ USA; © 2011, from Duncan J.R. and Prasse K.W., Veterinary Laboratory Medicine, 2nd ed., Iowa State University Press, 1986.
In leucocytes indices

Total W.B.Cs, Monocytes (%) and Neutrophils (%) were faintly higher in females, while Lymphocytes (%) and Eosinophils (%) elevated in males are shown in Table (2) and Figure (2). The total W.B.Cs mean in males and females is between (3.50 ± 0.60) with a minimum of 0.8 and a maximum of 8.9 and (5.38 ± 1.06) with a minimum of 1.1 and a maximum of 19.2, respectively. The male category of goats had faintly lower values than normal (4 - 13) and can be attributed to immune response to different environmental factors and physiological status (Table 2). In leukocytary series: the mean of lymphocytes was (61.33 ± 2.16)% in male and (56.47 ± 2.15)% in females, respecting the normal rapport (50 – 70)%. The Eosinophils are in the same normal limit (1 - 8)% and their means are (7.07 ± 0.81)% for females and (7.93 ± 1.29)% in males. Neutrophils (%) average was smaller than normal (30 - 48)% as follows: (23.67 ± 1.96)% in males and (27.40 ± 2.27)% in females, can be attributed to occurrence of some viral infection or have been long term bone marrow damage as designated of the low neutrophils numbers (neutrophenia). The (7.20 ± 0.94)% value of Monocytes in males and (7.47 ± 1.12)% in females were higher than normal (0 - 4)% in both sexes, this could be due to chronic infections, carcinomas, leukemia (monocytic) or lymphomas. The white blood cells (WBCs) are the soldiers of the body and their high counts may also be due to the increase of the complement in the immune systems of the animals. It may also be attributed to physiological phenomena i.e. excitement or strenuous exercise during handling.

Biochemical parameters in Sudanese Desert goats

Glucose was diminutive higher in females goats, while total protein and urea higher in male animals, Table (3) and Figure (3). The overall value of glucose, total protein and urea were (65. 20 ± 3.24) mg/L, (6.90 ± 0.12) mg/dl and (15.60 ± 0.89) mg/dl, respectively. The coefficients of variance permits the use of mean as statistic interpretation, this means are closed to the normal mean of glucose (80 - 100) mg/L, total protein (6.4 – 7.8) mg/dl and urea(10 - 27) mg/dl.

Table 3 - Some biochemical indices (mean ± Std) of Sudanese desert goats

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sex</th>
<th>N</th>
<th>Mean</th>
<th>Std</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
<th>Median</th>
<th>CV</th>
<th>Reference values*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose</td>
<td>Male</td>
<td>15</td>
<td>65.20</td>
<td>3.24</td>
<td>12.54</td>
<td>48</td>
<td>81</td>
<td>63</td>
<td>19%</td>
<td>60 - 100</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>15</td>
<td>65.67</td>
<td>2.44</td>
<td>9.44</td>
<td>50</td>
<td>79</td>
<td>66</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>30</td>
<td>65.43</td>
<td>1.99</td>
<td>10.91</td>
<td>48</td>
<td>81</td>
<td>65.5</td>
<td>17%</td>
<td></td>
</tr>
<tr>
<td>Total protein</td>
<td>Male</td>
<td>15</td>
<td>6.95</td>
<td>0.20</td>
<td>0.76</td>
<td>5.9</td>
<td>8.0</td>
<td>7</td>
<td>11%</td>
<td>6.4 - 7.8</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>15</td>
<td>6.85</td>
<td>0.14</td>
<td>0.53</td>
<td>6.0</td>
<td>8.1</td>
<td>6.8</td>
<td>8%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>30</td>
<td>6.90</td>
<td>0.12</td>
<td>0.65</td>
<td>5.9</td>
<td>8.1</td>
<td>6.85</td>
<td>9%</td>
<td></td>
</tr>
<tr>
<td>Urea</td>
<td>Male</td>
<td>15</td>
<td>15.73</td>
<td>1.19</td>
<td>4.60</td>
<td>10.0</td>
<td>26</td>
<td>14</td>
<td>29%</td>
<td>10 - 27</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>15</td>
<td>15.47</td>
<td>1.38</td>
<td>5.33</td>
<td>8.0</td>
<td>26</td>
<td>16</td>
<td>34%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>30</td>
<td>15.60</td>
<td>0.89</td>
<td>4.9</td>
<td>6</td>
<td>26</td>
<td>14.5</td>
<td>31%</td>
<td></td>
</tr>
</tbody>
</table>

N= Number of animals, Std= Standard error of mean, SD= Standard Deviation, Min= Minimum value, Max= Maximum value and CV= Coefficients of Variance. * Reference values Adapted from Veterinary Drug Handbook, D.C. Plumb, Iowa State University Press, 1999.

Figure 1 - Representation of erythrocytic indices in male and female of Sudanese desert goat
CONCLUSIONS

Sex showed relatively influence on the haematological and biochemical values of the goat studied, existing fluctuations in all the hematological and biochemical parameters of both sexes. In this study the MCV and MCHC values in both sexes fluctuated and their values are dependent upon RBC, Hb and PCV values. The low neutrophils ratio in the animals in this study might be attributed to occurrence of some viral infection; the Monocytes values can translate to an infection or hermetic aggression. The fluctuation in various parameters may be undetected minor infections, weather extremities and poor management.

REFERENCES


