EFFECT OF SEASON ON SOME HAEMATOLOGICAL PARAMETERS OF THE ONE-HUMPED CAMEL *(Camelus dromedariues)*

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المستخلص

تمت دراسة آثار التغيرات الموسمية في البيئة الحرارية على بعض مكونات الدم لعدد 100 من الإبل وحيدة السنام خلال الصيف الجاف والممطر والشتاء لمدة عامين في دولة الإمارات العربية المتحدة, التى توجد بها تغيرات موسمية واضحة في درجة الحرارة والرطوبة النسبية. عدد الكريات الحمر فى الإبل تراوحت بين 3.7 و 9.1 × 10^6/مل ، نسبة الهيموغلوبين تراوحت بين 4.1 و 11.9 %، حجم الخلايا (PCV) تراوح بين 12% و 28% وإجمالي عدد خلايا الدم البيضاء (الكريات البيض) تراوح بين 5.5 و 15.9 × 10^3 / مل تبعاً للموسم. أشارت النتائج إلى تغييرات ملحوظة في معظم مكونات الدم نتيجة للتغيرات الموسمية. التباين الموسمي في عدد كريات الدم الحمراء، حجم الخلايا ، تركيز خضاب الدم وعدد الكريات البيضاء كانت كبيرة وتم الحصول على أعلى نتائج خلال فصل الشتاء. كما تمت دراسة التركيب النسيجي لخلايا الدم. وكان شكل كريات الدم الحمراء بيضاوية وعديمة النوئ. كريات الدم البيضاء تصنف إلى نوعين، المحببة وغير المحببة، استناداً إلى وجود أو عدم وجود حبيبات سايتوبلازمية نوعية. توجد ثلاثة أنواع من المحببات وهى العَدلات، الحمضات والقعدات وفقا لنوع صبغة الحبيبات النوعية. هناك نوعان من الخلايا غير المحببة هما الوحيدات واللمفاويات وهى خالية من الحبيبات السيتوبلازمية النوعية.

Abstract

The effects of seasonal changes in the thermal environment on some haematological values of 100 camels have been investigated during dry summer, wet summer and winter for two years in United Arab Emirates. There were marked seasonal changes in ambient temperature and relative humidity. The count of the RBCs of the camel ranged from 3.7 to 9.1x 10^6 /ml, Hb percentage ranged from 4.1 to 11.9 %, packed cell volume (PCV) ranged from 12 % to 28 % and total WBCs count ranged from 5.5 to 15.9 x10 ^{3} /ml depending on the season. The results indicated noticeable changes in most of the parameters investigated. The seasonal variation in RBCs count, PCV, Hb concentration and WBCs count were significant and the highest mean values of these parameters were obtained during winter. The histological structures of the blood cells were also studied. The shape of the RBCs was oval and non- nucleated. The WBCs are classified into two types, granulocytes and agranulocytes, based on the presence or absence of specific cytoplasmic granules. The three types of granulocytes (neutrophils, eosinophils and basophils) are named according to the staining reaction of their specific granules. The two types of agranulocytes (monocytes and lymphocytes) are devoid of specific cytoplasmic granules.

Introduction

The camel is the most famous animal of the desert and it can cross the scorching expanse of the Sahara. The extraordinary attributes of the camel as a riding and pack animal have been appreciated by many desert travelers (Schmidt- Nielsen, 1964). The camel is a useful animal in the tropics and subtropics as a source of milk, meat, hides, hair as well as for work (draft, transportation and racing). In United Arab Emirates, more attention is being paid to the camel as it is expected to play an important role as a source of food and for enjoyment of racing. In recent years, however, interest in camels

has increased considerably, and a good deal of information is coming out in various aspects. Nevertheless the anatomical details of many of its body parts are still not fully known. A survey of the existing literature reveals that very little attention was paid to the morphology of the blood cells (Banerjee, *et.al*, 1962; Barakat and Abdel-Fattah, 1971; Bokori, 1974; King, 1999; Leslie and James 2000 and Abubakar *et al*, 2011). Studies on the effect of season on haematological parameters and blood cell of the one-humped camel were very meagre. Therefore it is decided to study:

1/ the seasonal effect on some haematological parameters.

2/ the characteristic features of red blood cells and white blood cells.

Materials and Methods

100 young and adult Arabian camels of both sexes, aged between 2 to 10 years were used in this study. These camels were all apparently clinically healthy. Daily maximum, minimum and average temperature and relative humidity reading were obtained. These data were utilized in the computation of the mean monthly values of temperature and humidity over the three season. The blood samples for the haemogram were drawn from the jugular vein in clean vials containing EDTA as anticoagulant. The RBCS and WBCs counts were determined in Neubauer`s haemocytometer. The PCV was evaluated using Hawksely microhaemocrit centrifuge. Hb was determined by haemocytometer. The differential WBCs counts were made after staining the slides with Giemsa stain and 100 cells were counted on each slide. The mean corpuscular volume (MCV), the mean corpuscular haemoglobin (MCH) and the mean corpuscular haemoglobin concentration (MCHC) were calculated from the haemoglobin (Hb), PCV and RBCs values in accordance with the method of Jain (1986) and Mary, *et. al. (*1999). The study was conducted during two successive years. The experimental period covered 6 seasons (3 seasons in each year), dry summer, wet summer, and winter .The histological

structure of different blood cells was studied in blood smears prepared immediately after the collection of the blood sample. The blood smears were dried and then fixed by dipping the slides into absolute alcohol for 5 minutes. The blood films were then immersed in 5 % Giemsa stain in coupling jars for 20 minutes and rinsed well with distilled water and left to dry before being examined. The experimental data obtained during the two years from camels of different age groups has been subjected to statistical analysis using statistical Analysis system (SAS, 1988). The result was presented as means as $\pm$ SD.

Results

The seasonal variations in the Hb, PCV and RBCs values are shown in Fig. 1. The values showed wide range for Hb, RBCs count, PCV and other blood indices. The mean values for Hb, were 7.5, 8.4 and 9.7g/100 ml of blood, in dry summer, wet summer and winter respectively. The normal range in the number of RBCs varied from 4.2 million/mm to 12.5 million/mm^3. Mean values for RBCs in dry summer, wet summer and winter were 5.5, 6.5 and 10.5 million/mm^3 of blood cells respectively (Fig.1). The MCV of camel RBCs was relatively low. The MCH of camel RBCs was relatively low (15.3pg). The MCHC was much higher in camels reaching up to 54% (Fig 2). The PCV of the camel ranged from 28.5% to 30%. The dehydrated camel has showed either no change in PCV or even a decline (26%).

Average values for PCV were 17.8%, 24.8% and 28% in dry summer, wet summer and winter respectively (Fig. 1). There seemed to be no significant difference between the values in different seasons. The PCV was quite stable during summer with values of 24% (SD$\pm$1). In winter the average values were higher (28%) (SD$\pm$1.2). The Hb content, the PCV and the number of RBCS increased during winter (Fig. 1). The mean values for

WBCs were 7.8, 9.3 and 12.8 thousands/mm^3 in the three groups (Fig. 3). Comparison of cell count in these different groups revealed that there was little difference in the mean values.

Total WBCs count revealed little difference; the number was slightly higher in winter than in wet and dry summer, and the differential counts in winter reflected higher means of percentages for neutrophils than lymphocytes (Fig. 4). The total WBCs count of the camel did not differ significantly between dry summer and winter; showing total number of 8.360 and 9.660 respectively. The differential count of WBCs presented the following values for winter and summer: Lymphocytes: 51% and 46%, Neutrophils: 52% and 42%, Eosinophils: 4% and 2%, Basophiles: 2% and 1%, Monocytes: 3.5% and 1% respectively (Fig. 4). The diameter of the different cell types ranged as follows: Lymphocytes: 8 to 10 μm; Neutrophils: 9 to 12 μm; Monocytes: 12 to 15 μm; Eosinophils: 10 to 14μm and Basophiles: 8 to 10 μm. The results are presented as means ± SD (SAS 1988).

The camels RBCs, in the present study, are ovalocytes (elliptocytes) and non- nucleated (Fig. 5). The average dimensions: long axis varied between 7.5 and 10 μm; short axis varied between 3.9 and 6 μm. The average surface area of the cell is 50.6 μm^2.

The WBCs are classified into two types, granulocytes and agranulocytes, based on the presence or absence of specific cytoplasmic granules. The three types of granulocytes are named according to the staining reaction of their specific granules. Esinophils had definite acidophilic granules (stain red with eosin) (Fig. 6). Basophils possessed distinct basophilic (purple) granules (Fig. 7) and Neutrophils had granules that were neither acidophilic nor basophilic (Fig. 8). Neutrophils varied between 8.5 and 12 μm in diameter and displayed a light pink cytoplasm that housed many azurophilic and smaller specific granules. The specific granules did not

stain well with ordinary stains. The nucleus was dark blue, coarse and multilobed, generally showing three to five lobes with thin connecting strands of chromatin. The nuclear chromatin is dense. The granulocytes were characterized by lobulated nucleus and presence of granules. The two distinct types of agranulocytes, the lymphocytes (Fig. 9) and Monocytes (Fig. 10) were devoid of specific cytoplasmic granules but often contained non-specific azurophilic granules. Agranulocytes are further characterized by having a spherical, oval or indented nucleus.

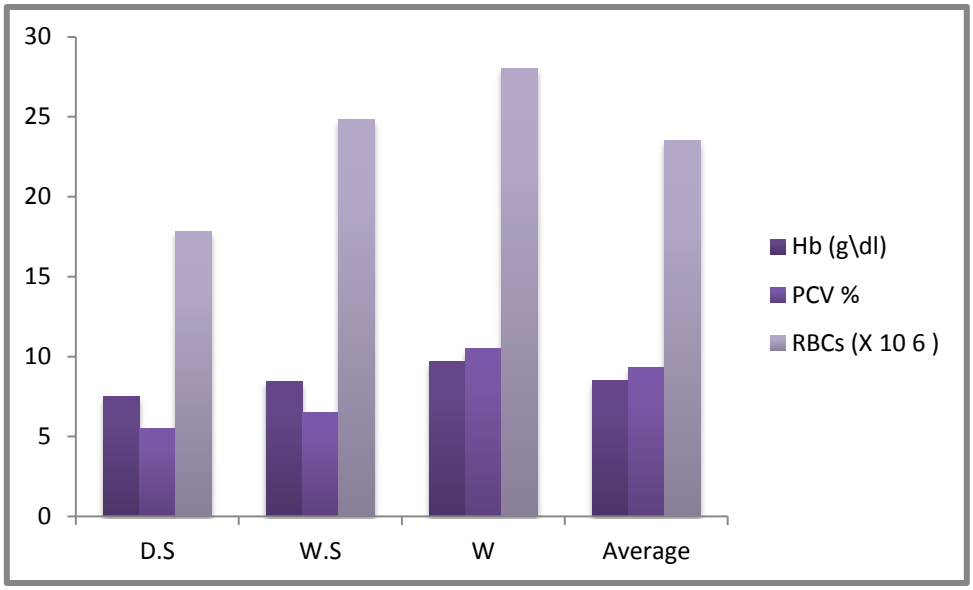

Fig. 1: Seasonal variations in Hb, PCV and RBCs values of the one - humped camel

D.S: Dry summer, W.S: wet summer, W: Winter. A: Average.

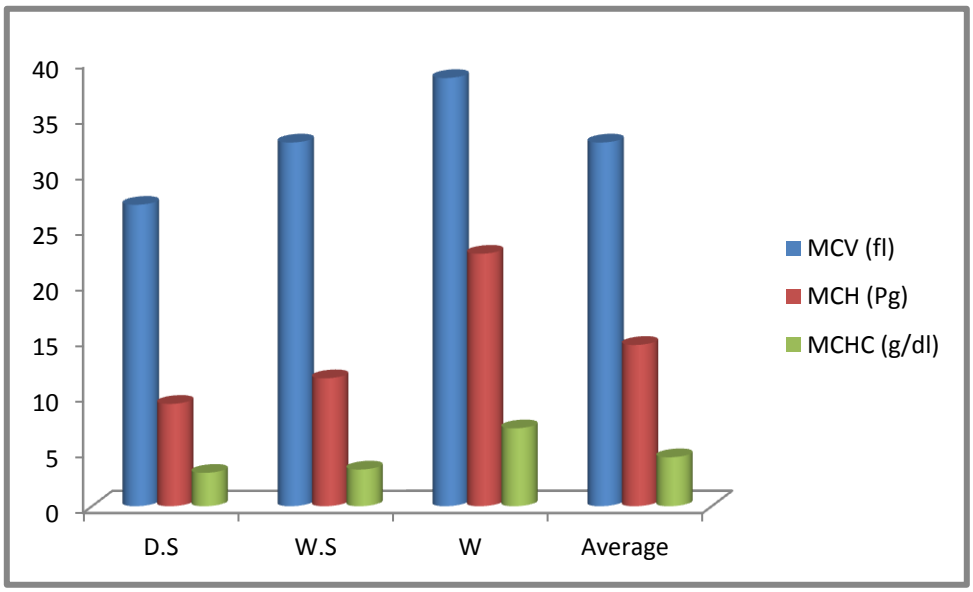

Fig. 2: Seasonal variations in MCV, MCH and MCHC values of the one-humped

Camel, D.S: Dry summer, W.S: wet summer, W: Winter. A: Average.

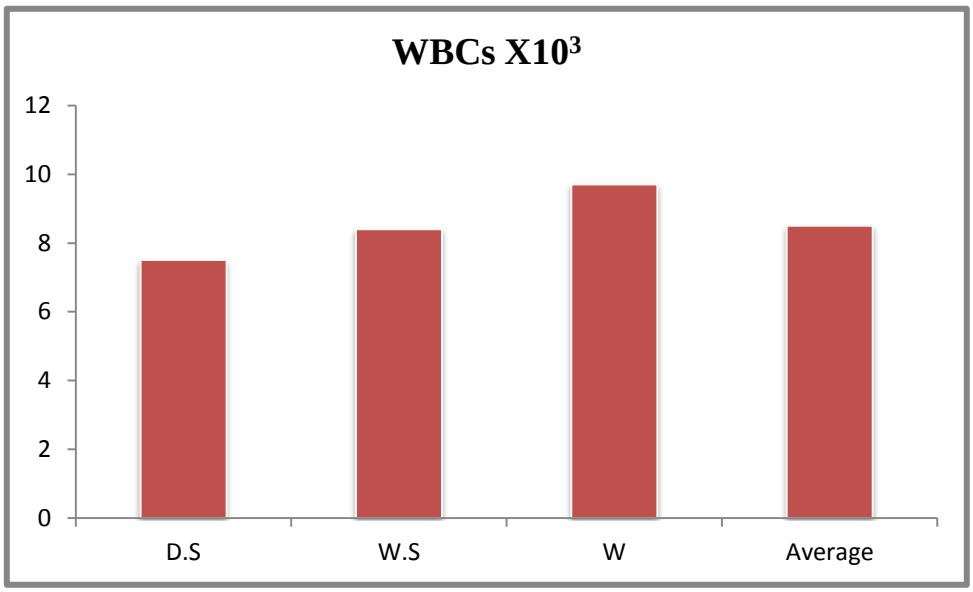

Fig.3: Seasonal variations in WBCs values of the one -humped camel, D.S: Dry summer, W.S: wet summer, W: Winter. A: Average.

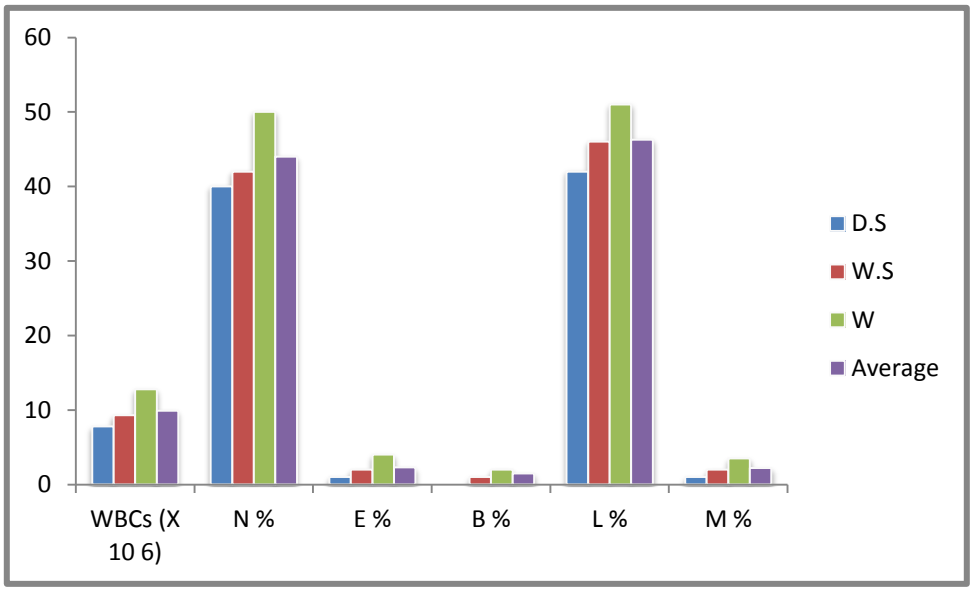

Fig. 4: Seasonal variations in WBCs differential count of the one- humped camel,

D.S: Dry summer, W.S: wet summer, W: Winter. A: Average.

Fig. 5: Photograph showing biconvex non nucleated Red blood cells. Giesma stain. X500.

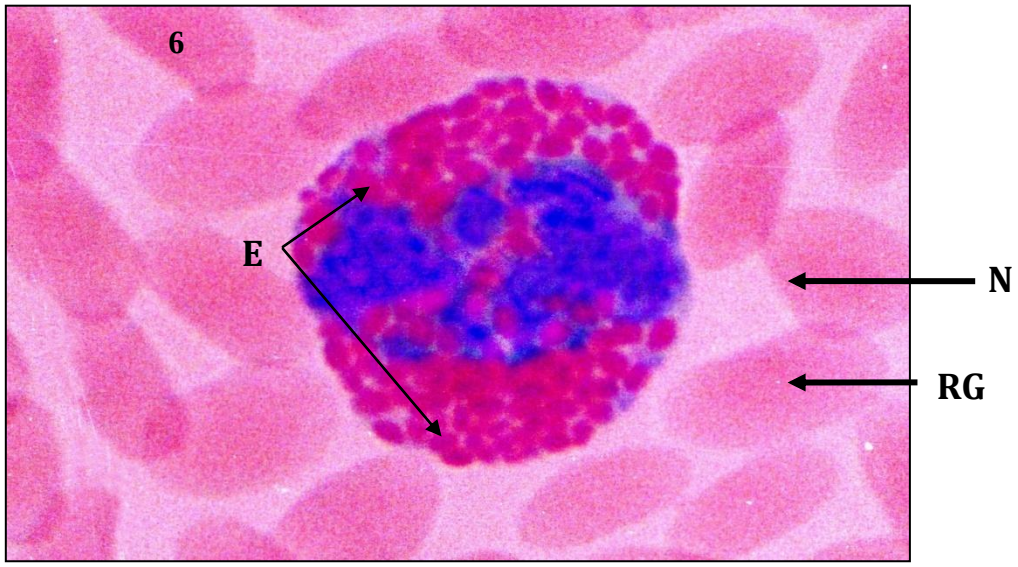

Fig. 6: Photograph of an Eosinophil. The granules are large and red in color. The Nucleus is blue in color, Giemsa stain. **E**: Erythrocytes **N**: Nucleus, **RG**: Red granules. X500.

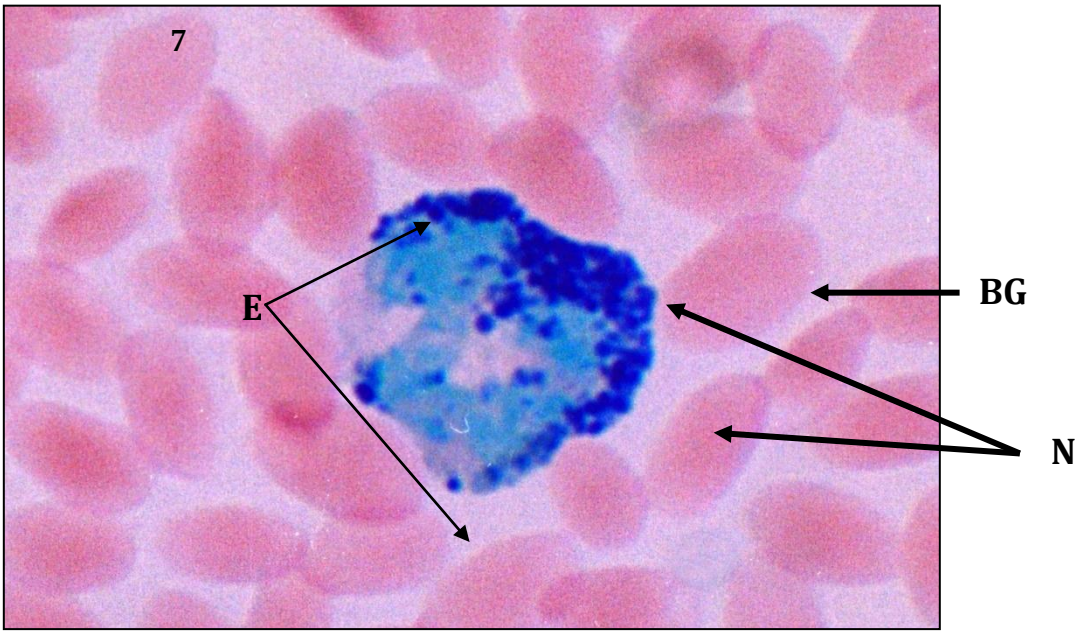

Fig. 7: Photograph of a Basophile with basophilic granules. Giemsa stain
E: Erythrocytes, **N**: nucleus, **BG**: blue granules. X500.

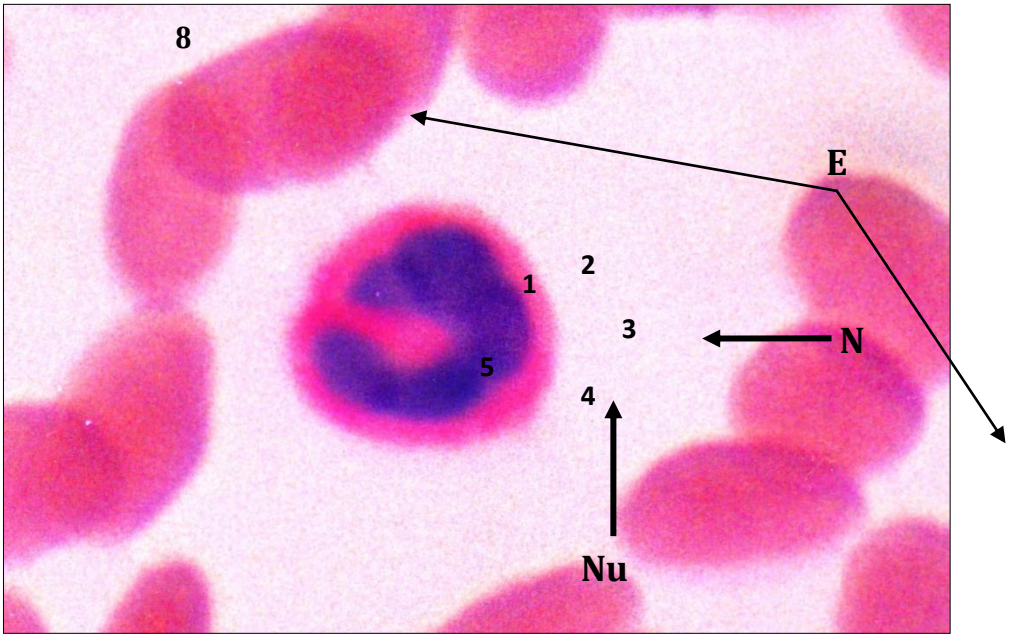

Fig. 8: A photograph showing several RBCs (arrows) and a neutrophil (Ne). Note that the nucleus of the Ne is lobulated into 5 segments 1, 2,3,4,5. Note also that the RBCs are non-nucleated May Grunewald and Giemsa stain. X500

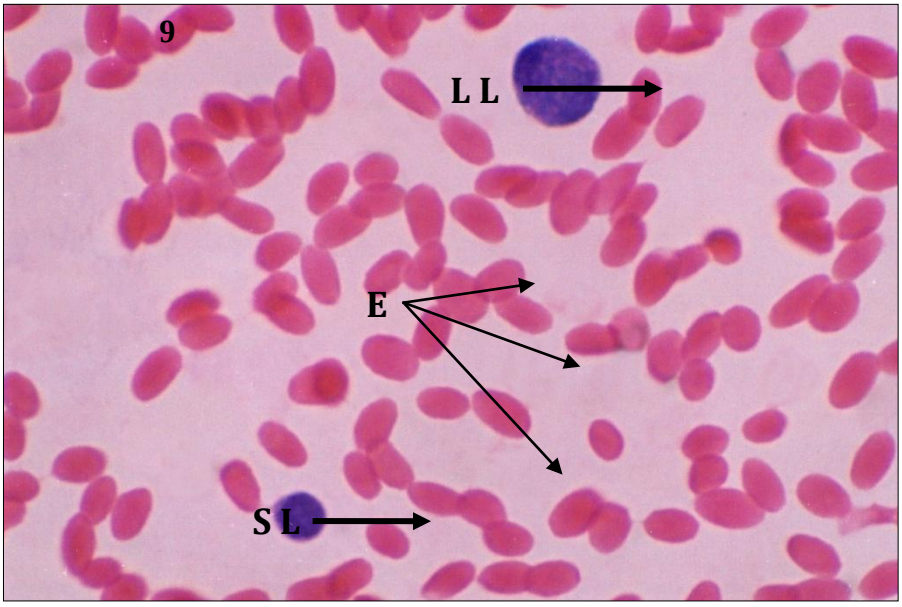

Fig. 9: Photograph of Lymphocytes. The nucleus is large and dark blue in color, it is surrounded by small amount of cytoplasm. May Grunewald and Giemsa stain. **LL**: Large lymphocyte, **SL**: Small lymphocyte, **E**: Erythrocytes. X500.

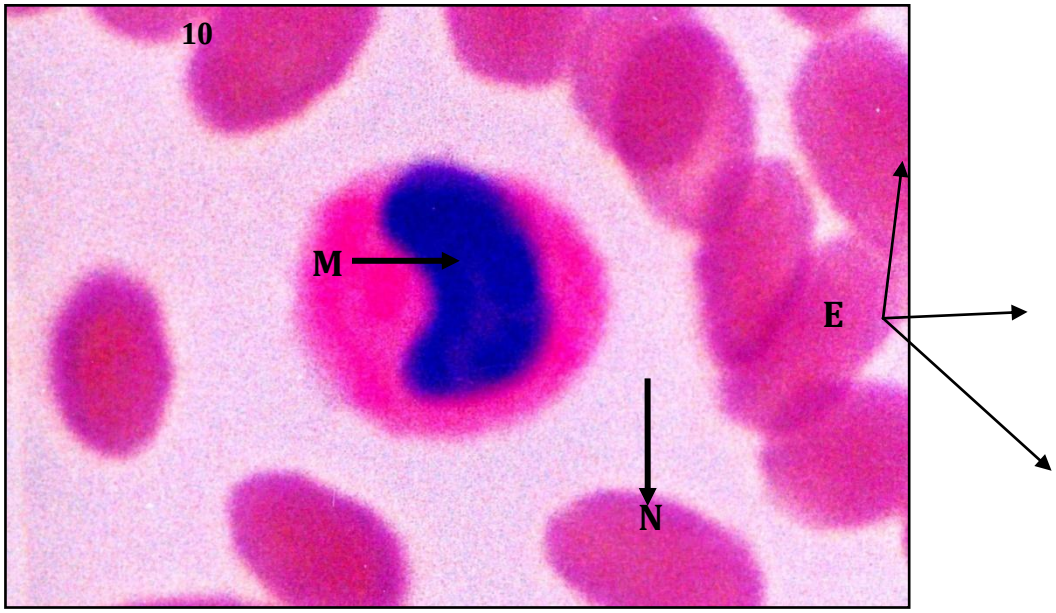

Fig. 10: Photograph of a Monocyte with a kidney –shaped nucleus and plenty of cytoplasm. May Grunewald and Giemsa stain. **E**: Erythrocytes, **M**: Monocyte, **N**: Nucleus, **C**: Cytoplasm. X500.

Discussion

The result of the present study showed that the normal ranges of some blood constituents and the structure of blood cells were generally similar to those of other domestic mammals (Fowler and Zinkl, 1989). The dromedary camel has more RBCs than many mammals, horse and pigs (Schalm, 1965; Musa and Mukhtar, 1982), sheep (Soliman and El-Amrousi, 1965) and buffalo (Mostapha, *et.al*. 1963); there are as many as $12.5X10^6$ $m/mm^{3.}$ This is nearly equal to that observed by Sharma, *et.al* (1973). However, Soliman and Shaker (1967) found that the number of RBCs in she-

camel is 7.2x 10^6 mm^3. Fowler and Zinkl (1989) recorded the haematological values of llama of all age groups and both sexes, and compared with values for horses and cattle. The mean values for Hb, were 7.5, 8.4 and 9.7g/100 ml of blood, in dry summer, wet summer and winter respectively. However these values are lower than those for the adult llama described by Soni and Aggrawala (1958) and Banerjee *et al*. (1962). The number of RBCs in healthy camel`s blood ranges between 4.2- 12.5 million/mm3. The wide range of RBCs count observed in camel`s blood is rather peculiar as compared as the buffalo (Mostapha *et al*. 1963), sheep (Soliman and El-Amrousi, 1965) and cow (Soliman, *et. al*., 1966). The total RBCs count is higher than the values reported by Lakhotia, *et al*. (1964) and (Bokori, 1974).

The WBCs count in camel ranged from 4X10^3/ml to 34 X 10^3/ ml with an average of 8.9 X 10^3/ml and the differential count reflected higher mean percentage for neutrophils than lymphocytes (Musa and Mukhtar, 1982). However, these values are lower than the values reported by Höller and Hassan (1966) and Abdelgadir, *et al*. (1979). These variations are probably a result of differences in breeds, age, season, and level of dehydration, nutrition, environmental condition and the technique used.

The values for Hb are in general agreement with the findings of other camel investigators (Goshal, *et.al.* 1973; Al-Ani, *et.al*. 1992; Salman and Afzal, 2004 and Getneth and Abebe, 2005) and are more or less similar to the values of cats, cows, sheep and goats (Schalm, 1965). In camels, the PCV % is higher than in other domestic animals during summer (Pal, *et al*. 1945; Pandy and Roy, 1969 and Yagoub, 1988). PCV% is similar to the findings of Ghodsian *et al*. (1978) but lower than the findings of Abdelgadir, *et. al*. (1979). The haematological values of apparently healthy camels were significantly greater during the hot season than in cold season. These findings are similar to those observed by Egbe - Nwiyi, *et.al*. (1995 and 2000). Since camels do not pant like other species, the limited availability of oxygen to the

tissue may stimulate haemopoiesis so that there is an increase in PCV%. Thus, an increase in PCV% in the camel in summer than in winter is also meant for better oxygen carrying capacity. The MCV of camel RBCs was relatively low and after dehydration it declined due to shrinkage of the cell. However, following rehydration it increased greatly due to swelling of the cells. The MCH of camel red cells was relatively low (15.3pg). In dehydration, the MCH declined to 12.1pg but returned to normal after rehydration. The MCHC was much higher in camels reaching up to 54% following dehydration and there was a decline in MCHC, due to shrinkage of the cells. There was a further decrease in MCHC following rehydration.

The percentage distribution of the neutrophils, esinophils, monocytes, lymphocytes and basophils in the present study is more or less similar to that reported by Holler and Hassan (1966) and Abdelgadir, *et. al*. (1979) in the camel and to that reported by Schalm (1965) in the cat. Mammalian erythrocytes are highly flexible biconcave discs (Dellmann and Brown, 1981; Banks, 1986; Daniel, 1995; Barbara and John, 2000 and Leslie and James, 2000).The camel RBCs, in the present study, are ovalocytes (elliptocytes) and non- nucleated. Similar results were also observed by Schalm (1967), Yagil, *e.t al*. (1974), Ernest, *et. al.* (1995) and Gurdial, *et al*. (1997). The structure of leukocytes in this study is similar to that reported by kessel (1998). The platelets of the camel in this study are small, round or oval biconvex, non- nucleated discs. This observation is similar to that in man and other domestic mammals (Dellmann and Brown, 1981; Banks, 1986 and Kurt, 1992). The platelets of the camel are flatter and smaller than those of most mammals, ranging from 2 to 4 μm. This is similar to the finding reported by Yagil, *et. al.* (1974) and Lewis (1976).

Musa and Mukhtar (1982) reported that rouleaux formation is not commonly observed in camel`s blood. The present work showed similar values to those observed by Dellmann and Brown (1981) and Banks (1986,

1993) in caprine, ovine, bovine and equine blood, but in feline and porcine blood, rouleaux formation is a characteristic feature.

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