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Serum Metabolites, Haematological Indices and Physiological Parameters of Free Grazing Camels (Camelus dromedaries) as Affected by Different Seasons

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***Abstract*—**This study was carried out in Eastern Gezira State, Sudan for a period of one year, and was designed to investigate the effect of seasons on the body thermoregulatory (rectal temperature, respiratory rate and pulse rate) and blood constituents of dromedary she camel (*Camelus dromedarius*). Fifteen healthy free grazing she-camels were included in the study. Blood samples were drawn in July, august and September (Rainy autumn), November, December and January (Dry winter) and April, May and July (Dry hot summer). The effect of season on some blood haematology and metabolites was studied. Effect of season on body thermoregulatory (rectal temperature, respiratory rate and pulse rate), RBCs, Hb, MCH, MCHC, total protein, albumin and cholesterol were significant affected by autumn season. Moreover, TLC, globulin triglyceride and glucose were decreased significantly during summer season. It was concluded that, Seasons had significant ($p<0.05$) affect on some of the contestants of blood of she-camel in free grazing system

***Keywords*—**Season; haematological values; free-grazing; she-camel; Sudan.

I. INTRODUCTION

Investigation of blood constituents can provide valuable benefit and indication about the general health of animals. Observation of a deviation of certain blood parameters from their normal limits could be an indication for diagnosis or differential diagnosis of a diseased condition [1].
The pasture quality and quantity are influenced by the seasonal changes in rainfall [2], [3], which in turn could influence the nutritional status and consequently the blood constituents of camels and comparison of blood values under different management systems. The concentration of blood metabolites are sensitive to seasonal changes in nutrient supply. Therefore, they could be used as indicators of nutrientional status [4]. Red blood cells count, lymphocytes and basophiles percentages increased significantly during the dry season, while the MCV, MCH and neutrophils percentage increased significantly during the green season [5].
The objective of this study was to investigate the effect of season on some haematological and physiological parameter of she-camel in Sudan.

II. MATERIALS AND METHODS

A. Study Area

This study was done in Butana area, Sudan, which it lays approximately between latitude 14º-16º N and longitude33º-36º E, between March (2013) and February (2014).

B. Animals

The study was carried out on fifteen one-humped non pregnant she-camels. Clinically healthy camels were grazed free in Butana pasture.

C. Meteorological Data

Meteorological data, including ambient temperature (Ta) and relative humidity (RH) were collocated from the Meteorological Unit, Wad-Medani.

D. Physiological Parameters

The rectal temperature (Tr) (C0) was taken in the rectum by a digital thermometer. Respiratory rate (Rr) (breath/min) was determined by counting the frequency of flank movement. Pulse rate (beat/min) was determined by feeling the frequency of the jugular vein with hand.

E. Blood Analysis

Blood samples were collected from the jugular vein of camels, (7.0 ml) of blood from each animal using 10 ml sterile plastic disposable syringes. Two ml of the blood samples were immediately transferred into heparinzed tubes (Medical Disposable Industrial Complex MDIC). They were used immediately for the determination of plasma glucose concentrations and then for the hematological parameters. The remainder of the samples which were kept into plain plastic tubes allowed clotting for 2h at room temperature; the sera were then separated by centrifugation at 3000 rpm for 15 min and stored in sealed plastic containers at -20C^0 until analyzed.
Erythrocytic indices were determined according to the methods described in Schalm's Veterinary Hematology [6]. The packed cell volume (PCV) of erythrocytes was determined by the micro-haematocrit method using haematocrit centrifuge. Haemoglobin (Hb) concentration was determined by the cyano- methaemoglobin method as described by [7]. Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC) and

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Mean Corpuscular Volume (MCV) calculated according to formulae of Jain [6]. Differential leukocyte count (DLC) was determined microscopically from a count of 100 leukocytes in thin May-Giemsa stained blood smears [8]. Colorimetric method was used for the determination of blood concentration of total protein, albumin, cholesterol, triglycerides and glucose using commercial kits (Spain).

F. Statistical Analysis

One-Way analysis of variance (ANOVA) test was used to determine the effect of seasons on the parameters investigated using SPSS version 15 computer programs. Mean separation was performed using Duncan Multiple Range Test.

III. RESULTS

A. Body Thermoregulatory Parameters

Figure 1 shows the seasonal variation of ambient temperature and relative humidity during the experimental period.The ambient temperature registered in the study area during the experiment ranged between 15.7C0 and 41.63C0 while relative humidity fluctuated between 21% and 70%. Table I shows the effect of seasons on physiological parameters of free grazing dromedary's camels. It was observed that rectal temperature and pulse rate were increased during summer while respiratory rate was varied significantly with seasons.

B. RBC and its Related Parameters

Seasonal changes in erythrocytes indices of grazing dromedary's camels are shows in table II. RBCs count, Hb concentration, MCH and MCHC were increased during autumn while MCV was decreased. PCV did not affected by eseason.

C. Total and Differential WBC count

Seasonal changes in leukocytic indices of free grazing dromedary's camels are shows in Table III. The mean value of TLC measured during summer season was the lowest one. neutophils were increased during summer while lymphocytes increased during autumn. There was on significantly effect of season on eosionophils, basophils and monocytes.

D. Blood Metabolites

Seasonal changes in the concentration of blood metabolites of free grazing camels are shows in Table IV. Albumin, total protein, and cholesterol were increased during autumn. Globulin observed during summer was increased while triglyceride decreased. Glucose concentration was varied significantly with season

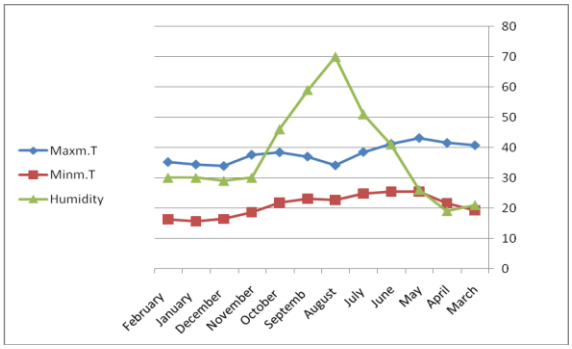

Fig. 1. Meteorological data during the study period at Butana area.

TABLE I. The effect of season on physiological parameters of free grazing camels.

Parameters	Seasons (mean ± SD)			Overallmean± SD	LS
	Summer	Autumn	Winter		
Rectal temperature (C^0)	37.82^a+0.46	37.67^b+0.48	37.62^b+0.53	37.71+0.49	*
Respiratory rate (breaths/min)	14.56^b+ 1.69	15.18^a+1.75	13.9^c+0.79	14.54+2.08	***
Pulse (beats/min)	42.98^a+2.76	$41.91a^b$+7.78	39.75^b+4.25	41.55+5.49	*

TABLE II. The effect of seasons on erthrothytic indices of grazing camels.

Parameters	Seasons (mean ± SD)			Overallmean± SD	LS
	Summer	Autumn	Winter		
RBCs ($X10^6/mm^3$)	6.86^b+0.99	7.40^a+1.06	6.88^b+1.18	7.05+1.10	*
PCV (%)	28.13+3.40	28.20+3.31	28.16+3.93	28.16+3.53	NS
Hb (g/dl)	10.24^b+1.46	11.16^a+1.51	10.15^b+1.97	10.51+1.71	**
MCV (fl)	41.25^a+3.56	38.30^b+2.56	41.29^a+3.63	40.28+3.55	***
MCH (pg)	15.11^b +0.84	18.08^a +2.06	14.68^b +1.14	15.96+1.53	***
MCHC (g/dl)	36.44^b+3.27	39.58^a+3.28	35.89^b+4.29	37.30+3.97	***

Table III. The effect of season on leukocytic indices of grazing camels.

Parameters	Seasons (mean ± SD)			Overallmean±SD	LS
	Summer	Autumn	Winter		
TWBCs ($X10^3/mm^3$)	15.94^b+3.14	21.08^a+4.48	19.08^a+3.25	18.70+3.62	***
Neutrophil (%)	55.02^a+4.97	42.10^b+3.23	47.38^b+3.88	48.17+5.36	**
Lymphocytes (%)	37.88^b+3.58	51.51^a+4.41	45.62^{ab}+3.33	45.01+4.44	**
Eosinophil (%)	4.78+1.32	4.62+0.81	4.62+0.0.82	4.67+1.01	NS
Basophil (%)	0.33+0.48	0.20+0.41	0.42+0.50	0.32+0.47	NS
Monocytes (%)	2.01+0.66	1.87+0.72	2.03+0.55	1.97+0.64	NS

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TABLE IV. The effect of season on concentration of blood metabolites of grazing camels.

Parameters	Seasons (mean ± SD)			Overallmean±SD	LS
	Summer	Autumn	Winter		
Albumin (g/dl)	2.41^{c} +0.41	3.73^{a}+0.59	2.71^{b} +0.52	2.95+0.76	***
Total protein (g/dl)	6.11^{b} + 0.48	7.06^{a}+0.96	5.96^{b} +0.89	6.37+0.93	***
Globulin (g/dl)	3.7^{a} +0.47	3.33^{b} +0.89	3.24^{b}+0.74	3.43+0.79	*
Cholesterol (mg/dl)	20.2^{b} +5.56	57.53^{a} +6.83	23.64^{b} +5.2	33.79+7.63	***
Triglyceride(mg/dl)	26.6^{b} +3.37	33.8^{a} +6.31	34.9^{a} +5.17	31.76+6. 91	*
Glucose (mg/dl)	106.11^{b}+8.94	116.91^{a} +8.1	124.93^{a}+7.75	115.01+9.18	*

a, b and c means values within the same row having different superscripts, differ significantly
NS: not significant, *: P<0.05, **: P<0.01, ***: P<0.001

IV. DISCUSSION

Results showed that, the rectal temperature was increased during summer season, this agrees with that noted in the camels [9-11]. This increasing in rectal temperature most probably minimizes the temperature gradient between the body and the environment. The overall mean of rectal temperature recorded in this work was support the findings of Mohammed [10] and El-Harairy [11]. Respiratory rate (Rr) was shown to be affected by seasons. The mean value of respiratory rate (Rr) measured during autumn was the highest one while that during winter was lowest one. The respiratory rate was increased during summer season [10], [11]. The present result showed that mean value of plus rate was increased significantly during summer season compared to winter season similar to results found that the pulse rate increases during summer season [10], [11].

Red blood cells count (RBCs), haemoglobin concentration (Hb), MCH and MCHC measured during autumn increased significantly compared with winter and summer seasons. This may be due to nutritional conditions of camels which it were improved during autumn season. Amin [5] and Babeker [12] recorded that the RBCs was increase during summer season. The overall mean of RBC count observed in this work was similar to the previous studies [12-15]. The overall mean of Hb concentration in this study was in line with that recorded by Amin [5], Barakat [17], Omer [16], El- Harairy [11] and Faroog [15]. PCV in this study support the findings of Amin [5] who reported that season had no significant effect on PCV. This result of PCV was similar to values reported in camels [18-20]. The mean value of MCV during autumn season was decreased significantly compared with values obtained in winter and summer, this decreases might be due to the negative correlation between MCV and RBCs which was increases in autumn season. The result of this study was not in line with the findings that MCV was increase in the autumn season [5, 12]. In this result the overall mean of MCV in the range which was reported by Amin [5] and Omer [16]. The result of the overall mean of MCH was in line with the results reported many researchers [5], [12-15], lower than that obtained by Babeker [12], and higher than that obtained by Rezakhani [19].The overall mean of MCHC was in line with that found by Faroog [15] and Babeker [12], not highly lower to that obtained by Rezakhani [19], Amin [5], Barakat [17] and Omer [14]. The overall mean of MCHC very low compared with that found by AL-Busadah [13].

TLC was decrease during summer season, there was no significant different between autumn and winter seasons. The results of this study were not in line with the findings that TLC increases during summer season [12]. The overall mean of TLC in this study was in line with the finding by Sarwar [21] and AL-Busadah [13] but higher than that found by Barakat [17], El-Harairy [11] and Babeker [12]. The mean value of neutrophils on this study was increased during summer season similar to that found by Babeker [12] but disagree with Amin [5] who reported that the neutrophils were increased in autumn season. In this result the overall mean of neutrophil was highest to that reported by AL-Busadah [13], Amin [5] and Babeker [12]. Result showed that lymphocyte was increased during autumn season this in line with that found by Babeker [12] but disagree with that found by Amin [5] who reported that the lymphocytes were decreased during autumn season. In this result the overall mean of Lymphocyte was in line with that reported by Rezakhani [19], Amin [5] and Babeker [12] but lower than that was obtained by AL-Busadah [13]. There was no significant seasonal variation in eosinophils, basophils and monocytes in this study, similar to the results has found by Amin [5] in eosinophils and monocytes but they found that basophil was increased during summer season. In this result the overall mean of eosinophil was similar to the result has found by Sarwar [21], Rezakhani [19] and AL-Busadah [13], lower compared to that reported by Amin [5] and Babeker [12]. The overall mean of basophil in this study was in line with that obtained in camels [5], [13], [19], [21]. The overall mean of monocyte was similar to that reported by Rezakhani [19] but it was lower compared to that found by AL-Busadah [13], Amin [5] and Babeker [12].

The mean value of albumin, total protein and cholesterol concentration determined during autumn increase significantly compared to winter and summer seasons. This may be due to nutritional conditions of camels which it were improved during autumn season. Mohammed [22] found that the albumin was increase during autumn season. Amin [5] recorded that the total protein was increase during summer season. Ahmed (2013) recorded that the cholesterol concentration determined during summer was increase significantly compared with winter season. The overall mean of total protein and albumin observed in this work were in line with the result had found by previous researchers [5], [13], [14], [16], [23-28]. The overall mean of cholesterol was in line with the result reported by AL-Sultan [23], Lower than that obtained by Salah El Din [24] and Salah [25].The mean value of triglyceride and glucose determined during summer were

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decreased significantly compared to winter and autumn seasons, this is a disagree with Amin [5] who was found that the triglyceride increased significantly during summer season compared with autumn season, while it was agree with Mohammed [22] and Ahmed [29] who were found that the glucose increased significantly during winter season compared with summer season. The result of the overall mean of triglyceride was in line with that result reported by AL-Sultan [23], Amin [5] and Salah [25]. The overall mean of glucose was in line with that result reported by Salah [25], higher than that was obtained by AL-Sultan [23].

V. CONCLUSION

RBCs count, Hb concentration, MCV, MCH, MCHC, total WBC and blood metabolites were affected by season.

No change in PCV, eosionophil, basophil and monocytes observed in different season.

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