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Influence of Thermal Environment Change on Blood Metabolites, Leukocytic and Erthrocytic Indices and Clinical Parameters of In-Door Camel (*Camelus dromedaries*)

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Abstract

The present study was performed to investigate the influence of the season on some clinical and haematological parameters of Sudanese camels kept in-door. It was carried out from March 2013 to February 2014 in Tambol Camel Research Center - Gezira State- Sudan. Blood was collected aseptically, from 15clinically healthy non pregnant and not lactating she camels, monthly throughout the experimental period. Red blood cells count, haemoglobin concentration (Hb), packed-cell volume (PCV), total leukocytes count (TLC), differential leukocytes count, glucose, total protein, albumin, globulin cholesterol and triglyceride were determined using the standard laboratory methods. It was found that, rectal temperature increased significantly during summer (37.87^0c) compared to winter (37.63^0c). Respiration rate was not affected significantly by the season. Significantly lower pulse rate was registered during autumn than that found in summer and winter. The effect of the season on red blood cells count, haemoglobin concentration (Hb) and (MCH) were not insignificant. Significantly lower values of PCV (27.13) and MCV (40.85) were obtained during autumn season and no significant differences were observed between summer (29, 44.09) and winter values. The highest value of (MCHC) was recorded during autumn (39.24) and the lowest value was recorded during winter (35.5). The highest value of the total leukocytes count (TLC) was recorded during autumn (12.56) while the lowest value was recorded during summer (10.3). The lowest neutrophils percentage was observed during winter (44.97) and no variation was found between summer (55.05) and autumn (57.56). The highest values of lymphocytes were recorded during winter season (48.11) but there was a not significant difference between the values of summer (37.4) and autumn seasons (35.67). The seasonal variation of eosinophils, basophils and moncytes were not significant. Serum albumin, total protein, cholesterol and triglyceride were increased during autumn (3.77, 6.54, 53.38, 37.89) compare to summer (2.82, 5.34, 30.42, 27) and winter (3.2, 5.77, 25.27, 34.04). These results were compared and discussed with the findings of previous studies conducted by other researchers.

Key words: *Season, Clinical parameters, In-door, Camel.*

Introduction

One-humped camel was domesticated 5,000 years ago in Arabian Peninsula (Al-Harbi, 2012). Camels are now transformed from the position of subsistence to one of production; this leads camel to be an important animal in Arabian culture (FAO, 1995). The one humped camel or Arabian camel is an essential source of food and milk in many parts of the world and especially in developing countries in Africa and Asia (Ouajd *et al*., 2009). The camel population in Sudan is estimated at 3.3 millions (Anon, 2004). The methods of camel keeping are now fast changing due to the shrinkage of grazing land and camel farms are now growing in Sudan very rapidly.

Animal's performance is a bear by interaction between the environment and genotype. The capacity of the dromedary to live under desert conditions and to survive in the incredibly hard environment of the Sahara is due to its biological and physiological particularities. All the functions of the dromedary organism are conceived to be physiologically adapted to "water and food restrictions" and to a very hot climate (Ouajd *et al*., 2009).

The study of blood constituents can provide valuable information about the general health of an animal (Omer *et al*., 2007) and how to manage camel's farms and keep them camels in a stable physiological status.

The present study was performed to contribute to the knowledge in the influence of the seasonal changes on some hematological and clinical parameters of indoor kept Sudanese she-camels.

Materials and Methods

Study area and Duration

This study was conducted at Tambol Camel Research Center, Butana Area, Sudan, between March 2013and February 2014.

Animals and Housing and Feed

The animals were housed in open shades at that center throughout the experimental period. Fifteen adult non-pregnant and non lactating she-camels were used in this study. All of them were clinically healthy and free from physical abnormalities.

The feed, housing and management were kept constant throughout the experimental period. The animals were fed twice daily, sorghum straw and a concentrate composed of molasses 30%, bagasse 20%, sorghum grain 15%, groundnut cake 17%, wheat bran 15%, urea 2% and salt 1%. Camels had free access to water.

Meteorological data

Meteorological data during the study period, that is ambient temperature (Ta) and relative humidity (RH), were provided monthly by the Meteorological Unit, Wad-Medani.

Clinical parameters

The Rectal temperature (Tr) was obtained gently by a digital thermometer. Respiratory rate (Rr) (breath/min) was determined by counting the frequency of flank movement per minute. Pulse rate (beat/min) was determined by feeling the jugular vein with hand per minute.

Blood collection and analysis

Blood was obtained by jugular veni-puncture into vacutainers containing di-sodium ethylene diamine-tetra-acetic acid (EDTA), this was used immediately for the determination of the hematological parameters, RBC,PCV, Hb, WBC were performed according to those described in Schalm's Veterinary Haematology (Jain, 1986). (MCV), (MCH) (MCHC), were calculated from the erythrocytic series values according to the method of Dacie and Lewis (1992).

Two ml were collected into vacutainers, containing sodium fluoride as an anti-coagulant, for serum glucose determination immediately after sera separation. More 5 ml of blood were drawn into plain, clean dry test tubes for determination of serum total protein, albumin, cholesterol and triglycerides. Sera were separated by centrifugation and then stored at -20º C for later analysis. Total protein, albumin, cholesterol, triglycerides and glucose were determined by colorimetric method using commercial kits (Spain), globulin concentration was determined by subtracting albumin from total protein.

Statistical Analysis

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

Results

Table (1) shows the seasonal variation of ambient temperature and relative humidity during the experimental period. The highest value of ambient temperature was recorded during May, while the lowest value was recorded during January. The highest value of relative humidity was recorded during August, while the lowest value was recorded during April.

Table (1): Mean air temperature (°C) and relative humidity (%) during the different seasons

		Mean Temperature(°C)		Relative Humidity (%)
Season	Month	Min	Max	Mean
Summer	March	19.4	40.7	21
	April	21.6	41.5	19
	May	25.5	43.1	26
	June	25.5	41.2	41
		23	41.63	26.75
Autumn	July	24.9	38.5	51
	August	22.7	34.1	70
	September	23.2	37	59
	October	21.9	38.4	46
		23.18	37	56.5
Winter	November	18.7	37.6	30
	December	16.5	33.9	29
	January	15.7	34.4	30
	February	16.3	35.2	30
		16.8	35.28	29.75

Seasonal changes in the clinical parameters of camels are displayed in Table (2) The mean value of rectal temperature (Tr) measured during winter season was the lowest one compared with the values obtained for the other seasons ($P< 0.05$). The season did not affect the respiratory rate. The animal registered significantly lower values for pulse during autumn while no variation was found between summer and winter.

Table (3) shows the seasonal changes in erythrocytic indices. RBCs count, Hb concentration and MCH did not vary with the season. Significantly low values of PCV and MCV were observed during autumn than those observed during summer and winter. MCHC was varied significantly with season.

Table (4) shows that seasonal changes in leukocytic profile. Significantly high ($p< 0.05$) TWBCs count was registered during autumn. During winter the animal registered significantly lower neutrophils count and higher lymphocytes than the values obtained in summer and winter. No seasonal variation was found in eosinophils, basophils and monocytes.

Seasonal changes in the concentration of blood metabolites of camels are in Table (5). Significantly higher values of albumin, total protein, cholesterol and triglycerides were registered during autumn than those observed during summer and winter. Globulin was decreased during summer. Glucose concentration did not vary with the season.

Table (2): The effect of season on clinical parameters of camels

Parameters	Season (mean + SD)			Overall mean	LS
	Summer	Autumn	Winter		
Rectal temperature (^{o}C)	37.87^{a}+0.62	37.81^{a}+0.33	37.63^{b}+0.27	37.77+0.44	*
Respiration rate (breaths/min)	14.56+ 1.63	14.53+1.50	14.27+2.18	14.45+1.81	NS
Pulse (beats/min)	42.73^{a}+2.99	39.89^{b}+6.48	42.18^{a}+6.25	41.6+5.57	*

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

Table (3): The effect of season on erthrothytic indices of camels

Parametars	Season (mean + SD)			Overall mean	LS
	Summer	Autumn	Winter		
RBCs (x106/mm3)	6.74+0.75	6.72+0.67	6.85+0.81	6.77+0.74	NS
PCV (%)	29.00^{a}+4.71	27.13^{b}+2.87	30.09^{a}+4.79	28.74+4.36	**
Hb (g/dl)	12.78+1.23	10.65+0.98	10.36+1.06	11.26+1.09	NS
MCV (fl)	44.09^{a}+3.04	40.85^{b}+4.96	43.18^{a}+5.72	42.71+4.87	***
MCH (pg)	16.14+1.45	15.89+0.79	15.18+0.93	15.74+1.16	NS
MCHC (g/dl)	36.98^{b}+3.21	39.24^{a}+3.97	35.50^{c}+3.10	37.24+3.76	***

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

Table (4): The effect of season on leukocytic indices of camels

Parametars	Season (mean + SD)			Overall mean	Ls
	Summer	Autumn	Winter		
TWBCs (x103/mm3)	10.30^{b}+2.58	12.56^{a}+2.98	10.97^{b}+2.92	11.28+2.97	***
Neutrophil (%)	55.05^{a}+4.60	57.56^{a}+5.02	44.97^{b}+5.36	52.52+6.35	***
Lymphocytes (%)	37.40^{b}+3.13	35.67^{b}+4.96	48.11^{a}+5.23	40.39+5.69	***
Eosinophil (%)	5.09+1.82	4.45+0.76	4.53+0.79	4.70+1.25	NS
Basophil (%)	0.31+0.04	0.20+0.01	0.20+0.02	0.24+0.07	NS
Monocytes (%)	2.16+1.28	2.12+0.07	2.19+0.60	2.16+0.61	NS

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

Table (5): The effect of season on blood metabolites of camels

Parameters	Season (mean + SD)			Overall mean	Ls
	Summer	Autumn	Winter		
Albumin(g/dl)	2.82 ^{b} +0.47	3.77^{a}+0.45	3.2^{b} +0.32	3.2+0.58	***
Total protein(g/dl)	5.34^{c} + 0.28	6.54^{a}+0.4	5.77^{b} +0.44	5.89+0.62	***
Globulin(g/dl)	2.43^{b} +0.66	2.77^{a} +0.52	2.77^{a}+0.5	2.69+0.52	***
Cholesterol(mg/dl)	30.42^{b} +3.67	53.38^{a} +4.16	25.27^{b} +3.13	36.36+5.91	***
Triglyceride(mg/dl)	27^{c} +1.93	37.89^{a} +2.59	34.21^{b} +2.93	33.04+3.1	***
Glucose(mg/dl)	87.77 +3.6	86.66 +3.24	84.72 +3.76	86.39+3.87	NS

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

Discussion

In this work rectal temperature varied significantly with the season, being lower during winter than in summer and autumn. The lowest value of the rectal temperature was recorded during winter and the highest value during summer. This result is similar to the results of Mohammed et al. (2007), El-Harairy et al. (2010) and Abdoun et al. (2012) who concluded that the season had a significant effect on rectal temperature of camel being low in winter and high in summer. The increase in rectal temperature during the hot summer conditions most probably minimizes the temperature gradient between the body and the environment, thus resulting in a reduction of the body heat gain. Reduction of the body heat gain will minimize the heat stress on the camels. (Abdel-Samee and Marai, 1997). The overall mean rectal temperature in this study was 37.77˚c, which is near to the value of 37.36˚C reported by El-Harairy *et al.* (2010) for camels during summer.

The respiration rate (Rr) did not vary with the season in contrast to the finding of El-Harairy *et al.* (2010) who observed a significant higher respiration rate (Rr) during summer than winter.

The mean value of pulse rate during autumn season was significantly lower than the values obtained for winter and summer; this result disagrees with El-Harairy *et al.* (2010) who obtained a decrease on pulse rate during winter. The overall mean of pulse rate is near to the values for dromedaries obtained by Sarwar et al. (1998), and El-Harairy *et al.* (2010).

In this study the season did not influence the red blood cells count (RBCs); this result agrees with (Salman and Afzal, 2004) who did not find any seasonal variation on RBCs. Contradicting results were found among different researchers with regard to the effect of the season on RBCs. Badaway et al (2008) registered a significant reduction on RBCs count during summer, while Zeidan and Abbas (2004) and Amin *et al.*(2007) reported significantly higher

erythrocytes count during summer than the values of winter. Amin *et al* (2007) attributed the rise on the erythrocytes count during summer to dehydration increasing the half life of the RBCs. The overall mean of RBCs count observed in this work is near to the value found by Amin *et al*. (2007) and lower than that obtained by Rezakhani *et al*. (1997) and Barakat *et al*. (2007) .

In this study the mean value of PCV measured during autumn season was the lowest one compared with the values obtained for winter and summer. The decrease in PCV during autumn may be due to the high moisture of autumn roughage leading to unreal reduction in PCV. El-Harairy *et al*. (2010) found significantly higher PCV values during summer than the values obtained during winter, while Amin *et al*. (2007) not find any significant differences on PCV values among the different seasons. In this result the overall mean of PCV count was near to that reported by Zeidan and Abbas (2004), Higher than the values of Barakat *et al*. (2007) and much lower than the values of Amin *et al*.(2007)

The concentration of haemoglobin (Hb) in this work did not show any significant season variation, which is on line with the findings of Amin *et al*.(2007). Controversial results to the current study were reported in she-camel during summer and autumn being significantly higher than during winter (El-Harairy *et al*. 2010). The overall mean of Hb concentration was within the range registered by Barakat *et al*. (2007) and El-Harairy *et al*. (2010).

The mean value of MCV of autumn season was the lowest one and varied significantly compared with the values obtained during winter and summer. The decrease in MCV value during autumn might be due to the significant decrease in PCV value during autumn. Amin *et al*. (2007) reported an increase in MCV during autumn, and attributed it to the negative correlation between MCV and the RBCs count. In this result the overall mean of MCV was comparable to that reported by Amin *et al*. (2007), higher than the result of Barakat *et al*. (2007).

There was no significant seasonal variation on MCH in this study, this due to the steady state of both the erythrocytes count and haemoglobin concentration throughout the different seasons. The overall mean of MCH in this study, was on line with the results of Barakat *et al*. (2007).

In this study, MCHC mean value varied significantly with the season; the highest one was observed in autumn, this may be due to the decreases in PCV during autumn. The overall mean of MCHC was in this study, which was lower the values obtained for Sudanese camels by Amin *et al*. (2007) and Barakat *et al*. (2007).

The mean value of TLC measured during autumn season was the highest one and the lowest value was obtained during summer season, this disagree with the findings Amin *et al*. (2007) that there is a decrease in WBCs count during winter. The overall mean of TLC was 11.28which is on line with the findings of Rezakhani *et al*. (1997), Barakat *et al*. (2007) and El-Harairy *et al*. (2010).

The mean value of neutrophils during winter season was the lowest one and the mean value for autumn season was the highest one which accords with the findings of Amin *et al*. (2007) who reported that the neutrophils increases in autumn. The obtained overall mean of neutrophils is higher than that reported by Amin *et al*. (2007).

The mean of lymphocytes during winter season was the highest one. A reduction on lymphocytes was observed during summer and autumn this may be due to the animals during these seasons were stressed by dust and insects. Stress stimulates cortisol secretion which suppresses lymphocytes formation. The overall mean of lymphocytes accords with the findings Amin *et al*. (2007).

There was no significant seasonal variation in eosinophils, basophils and monocytes in this study which supports the findings of Amin *et al*. (2007).

The animals registered the lowest values of total protein and albumin during summer. The low albumin level in summer was found in Nubian goats and they attributed this in part to an expansion of plasma volume resulting in hemodilution. Al-Haidary (2006) reported that total protein was increased in the summer season compared with winter season. Badawy *et al*. (2008) found that the total protein was decreased during winter compared to summer and autumn seasons. Glucose concentration was not affected by seasonal climatic changes and this could be due to the fixed diet given throughout the study period. Controversial results were reported by Al-Haidary (2006) and Badawy *et al*. (2008),they reported that glucose increased during winter compared with summer. The overall mean of glucose concentration agrees with the range of Al-Sultan (2003), and El-Bahrawy and El Hassanein (2011).

The mean value of cholesterol concentration during autumn was the highest one, this result is similar to that found by Badawy *et al*. (2008). El-Harairy *et al*. (2010) obtained the highest concentration of cholesterol during winter, while Tajik *et al*. (2013) did not observe any variation with the season in serum cholesterol .The overall mean of cholesterol concentration was 36.96 which is on line with the finding of El-Bahrawy and El Hassanein (2011) and Omidi *et al*. (2014).

The mean value of triglycerides concentration determined during summer was lowest one than that during winter and autumn seasons. Al-Sultan (2003) and Omidi *et al*. (2014) reported higher cholesterol values than of the overall mean of this work.

Conclusion

Seasonal variation was observed in some of the stuied parameters. A variation was found in the results between the current work and some previous research and within the previous studies .This variation can be attributed to variations in the climate, animals breed, management and /or interlaboratory variations.

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