

Communication

A note on the haemogram of the dromedary camel in Bahrain

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Les hémogrammes de 186 dromadaires de selle femelles et 115 mâles ont été étudiés. Les frottis sanguins ne comportaient pas de parasites sanguins, y compris *Trypanosoma evansi*. Cependant, 72 p. 100 des femelles et 80 p. 100 des mâles présentaient des parasites gastro-intestinaux. Chez les femelles infectées, les valeurs des numérations érythrocytaires, Hb et Ht étaient significativement plus faibles que chez les animaux non infectés mais la proportion d'éosinophiles était plus grande. Les valeurs de l'hémogramme étaient respectivement les suivantes pour les femelles et les mâles non infectés : Hb 11,4 ± 1,8, 11,0 ± 1,0 g/dl ; Ht 0,295 ± 0,033, 0,287 ± 0,043 l/l ; nombre de GR 9,01 ± 1,21, 8,26 ± 1,62 x 10¹²/l ; VGM 32,8 ± 3,7, 34,8 ± 5,1 fl ; TMCH 13,0 ± 2,1, 13,3 ± 1,3 pg ; CCMH 38,7 ± 6,2, 38,3 ± 3,6 g/dl ; numération leucocytaire 14,09 ± 4,03, 10,24 ± 2,01 x 10⁹/l ; neutrophiles 6,46 ± 1,64, 4,67 ± 1,23 x 10⁹/l ; lymphocytes 6,78 ± 1,27, 4,74 ± 1,19 x 10⁹/l ; éosinophiles 0,56 ± 0,49, 0,56 ± 0,44 x 10⁹/l ; monocytes 0,27 ± 0,14, 0,26 ± 0,09 x 10⁹/l. Les valeurs moyennes correspondantes chez les animaux infectés étaient les suivantes : Hb 10,01 ± 1,35, 11,55 ± 1,21 g/dl ; Ht 0,261 ± 0,033, 0,304 ± 0,041 l/l ; nombre de GR 7,52 ± 1,79, 8,40 ± 1,54 x 10¹²/l ; VGM 34,6 ± 4,3, 36,0 ± 4,9 fl ; TCMH 13,3 ± 1,8, 13,8 ± 1,4 pg ; CCMH 38,3 ± 5,2, 38,2 ± 4,0 g/dl ; numération leucocytaire 10,50 ± 2,47, 9,55 ± 1,88 x 10⁹/l ; neutrophiles 5,18 ± 1,41, 4,51 ± 0,99 x 10⁹/l ; lymphocytes 4,37 ± 1,37, 4,12 ± 1,08 x 10⁹/l ; éosinophiles 0,69 ± 0,41, 0,61 ± 0,43 x 10⁹/l ; monocytes 0,28 ± 0,17, 0,29 ± 0,14 x 10⁹/l. Les résultats sont discutés et comparés aux observations antérieures réalisées dans d'autres pays. **Mots clés** : Dromadaire - *Camelus dromedarius* - Hémogramme - Sang - Protozoose - Helminthose gastro-intestinale - Bahrain.

Introduction

The blood picture of the dromedary camel has been reported from various countries, including Sudan (1, 2, 11, 18, 23, 24), Egypt (5, 17, 20), India (4, 10, 12, 13), Iran, Pakistan and Australia (9, 14, 15). In the Gulf region, few studies have been carried out in Saudi Arabia, Kuwait and United Arab Emirates (7, 8, 19).

This research was undertaken in 301 dromedary camels to provide information on the haematology of camels in Bahrain and to compare them with previous findings.

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Materials and Methods

Animals and sampling

One hundred and eighty six female and 115 male adult riding dromedary camels were investigated during the period September-December 1990. The animals received no treatment before or during the investigation period. Blood samples were drawn by jugular venipuncture in tubes containing EDTA for haematological analysis. Faecal samples were taken from the rectum for coprological examination.

Haematological methods

Packed cell volume (PCV) was determined by microhaematocrit centrifugation, red blood cells (RBCs), white blood cells (WBCs) and haemoglobin (Hb) by using a Coulter counter. Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were calculated from the values of RBC, PCV and Hb.

Parasitological methods

Thin blood smears were prepared and stained with Giemsa stain for the detection of blood parasites. Parasitic eggs in faeces were counted by the McMaster and Stoll techniques (21) and the values expressed as eggs per gram of faeces (epg).

Statistical analysis

Analysis of variance was carried out according to the Statistical Package for the Social Sciences (22).

Results

Parasitological findings

Blood smears were negative for blood parasites including *Trypanosoma evansi*. Faecal examination revealed that 72 % of the females and 80 % of the males passed parasitic eggs in their faeces, mainly the strongyle, *Nematodirus* and *Trichuris* species. *Strongyloides*, *Monezia* eggs and coccidia oocysts were seen in a few cases. According to the faecal egg count infection was graded as mild, moderate or heavy (table I).

TABLE I Results of coprological examination in 301 camels (in %).

Group	Grade of infection	Females		Males		Total	
		Number	%	Number	%	Number	%
1	Negative	71	38.2	23	20.0	94	31.2
2	Mild (500 epg or less)	20	10.8	18	15.6	38	12.6
3	Moderate (501-5,000 epg)	46	24.7	34	29.6	80	26.6
4	Heavy (more than 5,000 epg)	49	26.3	40	34.8	89	29.6
	Total	186		115		301	

Haematological findings

Means and standard deviations ($\bar{X} \pm SD$) of the blood values are presented in tables II and III. Generally, parasite-free females tended to have higher haematological values than the male counterparts, but the differences were not significant. On the other hand, females with internal parasites had significantly lower values for Hb, RBC and PCV, but higher eosinophil counts ($P < 0.01$) than non-infected ones. No significant variations were observed in the male group.

Discussion

The present findings indicate that infection with gastrointestinal parasites is common in camels in Bahrain. The overall effect of infection on the levels of various blood parameters was not marked except for a decrease in Hb, RBC and PCV values and an increase in eosinophils only in parasitised females. Reduction in RBC and Hb values associated with peripheral and/or tissue eosinophilia is an expected outcome of gastrointestinal and other helminth

TABLE II Mean \pm SD of haematological values (erythrocytic series) in camels.

Group	Hb (g/dl)	PCV (l/l)	RBC ($\times 10^{12}/l$)	MCV (fl)	MCH (pg)	MCHC (g/dl)
F1 (71)	11.4 \pm 1.8 ^a	0.295 \pm 0.033 ^a	9.01 \pm 1.21 ^a	32.8 \pm 3.7	13.0 \pm 2.1	38.7 \pm 6.2
F2 (20)	9.5 \pm 1.4 ^b	0.247 \pm 0.023 ^c	6.69 \pm 2.21 ^b	36.9 \pm 3.4	14.2 \pm 2.1	38.4 \pm 5.6
F3 (46)	10.2 \pm 1.5 ^b	0.275 \pm 0.042 ^b	8.13 \pm 1.58 ^b	33.9 \pm 5.2	12.6 \pm 1.9	37.2 \pm 5.6
F4 (49)	10.3 \pm 1.2 ^b	0.262 \pm 0.033 ^{bc}	7.72 \pm 1.59 ^b	33.9 \pm 4.2	13.4 \pm 1.5	39.5 \pm 4.4
x = infected (2 + 3 + 4)	10.0 \pm 1.4	0.261 \pm 0.033	7.52 \pm 1.79	34.6 \pm 4.3	13.3 \pm 1.8	38.3 \pm 5.2
Overall mean	10.8 \pm 1.7	0.280 \pm 0.038	8.36 \pm 1.62	33.5 \pm 4.5	12.9 \pm 2.1	38.6 \pm 6.1
M1 (23)	11.0 \pm 1.0	0.287 \pm 0.043	8.26 \pm 1.62	34.8 \pm 5.1	13.3 \pm 1.3	38.3 \pm 3.6
M2 (18)	11.8 \pm 1.3	0.308 \pm 0.043	9.07 \pm 1.62	34.0 \pm 4.7	13.1 \pm 1.4	38.6 \pm 4.1
M3 (34)	11.5 \pm 1.3	0.307 \pm 0.041	8.31 \pm 1.21	36.9 \pm 4.9	13.9 \pm 1.5	37.6 \pm 4.1
M4 (40)	11.25 \pm 1.1	0.299 \pm 0.041	7.83 \pm 1.78	37.4 \pm 5.1	14.4 \pm 1.4	38.4 \pm 3.8
x = infected (2 + 3 + 4)	11.5 \pm 1.2	0.303 \pm 0.041	8.40 \pm 1.54	36.0 \pm 4.9	13.8 \pm 1.4	38.2 \pm 4.0
Overall mean	11.4 \pm 1.2	0.287 \pm 0.040	8.24 \pm 1.61	36.3 \pm 5.0	13.8 \pm 1.4	38.1 \pm 3.98

F : females ; M : males (see table I for groups and grade of infection).
Means in a, column having the same or no letter are not significantly different ($P > 0.05$).

TABLE III Means \pm SD of white cells counts in camels.

Group	WBC ($\times 10^9/l$)	Lymphocytes		Neutrophils		Eosinophils		Monocytes	
		(%)	($\times 10^9/l$)	(%)	($\times 10^9/l$)	(%)	($\times 10^9/l$)	(%)	($\times 10^9/l$)
F1	14.1 \pm 4.0	48.2 \pm 11.4	6.8 \pm 1.7	45.9 \pm 10.8	6.5 \pm 1.6	4.0 \pm 3.3 ^a	0.6 \pm 0.5 ^b	1.9 \pm 1.0	0.3 \pm 0.1
F2	10.3 \pm 3.0	43.7 \pm 17.0	4.5 \pm 1.8	49.2 \pm 16.6	5.1 \pm 1.7	4.8 \pm 2.9 ^b	0.5 \pm 0.3 ^b	2.3 \pm 1.4	0.3 \pm 0.2
F3	10.5 \pm 1.9	36.6 \pm 10.5	4.2 \pm 1.1	51.2 \pm 11.7	5.4 \pm 1.2	6.7 \pm 5.3 ^a	0.7 \pm 0.4 ^a	2.5 \pm 1.5	0.3 \pm 0.2
F4	10.9 \pm 2.6	41.6 \pm 11.8	4.5 \pm 1.3	47.6 \pm 12.0	5.2 \pm 1.3	8.1 \pm 5.4 ^a	0.9 \pm 0.6 ^a	3.0 \pm 2.0	0.3 \pm 0.2
X : infected (2 + 3 + 4)	10.5 \pm 2.5	41.6 \pm 13.1	4.4 \pm 1.4	49.3 \pm 13.4	5.2 \pm 1.4	6.5 \pm 3.9	0.7 \pm 0.4	2.6 \pm 1.6	0.3 \pm 0.2
Overall mean	12.9 \pm 3.0	44.6 \pm 12.2	5.8 \pm 1.6	47.5 \pm 11.8	6.1 \pm 1.5	5.5 \pm 4.3	0.7 \pm 0.6	2.3 \pm 1.5	0.3 \pm 0.2
M1	10.2 \pm 2.0	46.3 \pm 11.6	4.7 \pm 1.2	45.6 \pm 12.1	4.7 \pm 1.2	5.4 \pm 4.3	0.6 \pm 0.4	2.7 \pm 0.9	0.3 \pm 0.1
M2	9.2 \pm 1.3	40.9 \pm 9.9	3.8 \pm 0.9	48.9 \pm 9.7	4.5 \pm 0.9	6.8 \pm 4.4	0.6 \pm 0.4	3.5 \pm 1.3	0.3 \pm 0.1
M3	7.6 \pm 2.1	43.1 \pm 13.1	4.2 \pm 1.3	46.4 \pm 10.8	4.5 \pm 1.0	7.3 \pm 5.3	0.7 \pm 0.5	3.1 \pm 1.5	0.3 \pm 0.1
M4	9.8 \pm 2.3	45.4 \pm 11.0	4.4 \pm 1.1	46.4 \pm 10.4	4.5 \pm 1.0	5.2 \pm 4.0	0.5 \pm 0.4	2.8 \pm 1.5	0.3 \pm 0.1
X : infected (2 + 3 + 4)	9.6 \pm 1.9	43.1 \pm 11.3	4.1 \pm 1.1	47.3 \pm 10.3	4.5 \pm 1.0	6.4 \pm 4.5	0.6 \pm 0.4	3.1 \pm 1.4	0.3 \pm 0.1
Overall mean	9.7 \pm 2.0	44.1 \pm 11.6	4.3 \pm 1.1	46.7 \pm 10.6	4.5 \pm 1.0	6.3 \pm 4.7	0.6 \pm 0.5	2.8 \pm 1.3	0.3 \pm 0.1

F : females ; M : mâles (see table I for groups and grade of infection).
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infections which varies with the nature and severity of infection as well as with the nutritional and immunological status of the animal (3, 21).

Haematological parameters can be affected by various factors including age, sex, physiological state, nutrition, season, infection and their interactions (8, 9, 18, 19). In the present study the influence of infection seems to be stronger while the interaction between sex and parasitism appears to be weak. The values obtained here for RBC, Hb and PCV are in general agreement with those given by many authors for apparently normal camels (1, 5, 9, 11, 12, 15, 17). Lower RBC counts associated with high PCV and Hb levels were recorded by some workers (4, 13, 20) while others gave comparable RBC counts, but higher PCV and Hb values (2, 14, 18, 23). Lower PCV associated with either low RBC counts (6, 8, 10, 16) or higher Hb concentrations (24) have also been observed. The blood indices, on the other hand, were generally lower than those reported in most studies (1, 2, 4, 8, 10, 14, 16, 18, 20, 23).

WBC and differential cell counts were not largely different from those given in some reports (1, 6, 15). However, comparable WBC counts have been noticed by many authors but with variable differential cell counts (10, 16, 20, 24). On the other hand, high WBC counts associated with low neutrophil and high lymphocyte counts or *vice versa* have been previously recorded (2, 4, 5, 9, 11, 17, 23).

Comparing the present values with data from the Gulf region, it appears that RBC and PCV values were higher than those reported in Saudi Arabia (8), but lower than those reported from Kuwait and United Arab Emirates (7, 19); high Hb concentrations were observed in the Emirates. The WBC counts were not much different from those recorded in Saudi Arabia and United Arab Emirates, but they were higher than those observed in Kuwait (7, 8, 19). Higher neutrophil and lower lymphocyte counts were, however, reported in Saudi Arabia and Kuwait camels (7, 8).

Further research is necessary to provide more accurate and comparative information on the dromedary blood parameters in the region.

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The blood picture was studied in 186 female and 115 male riding dromedary camels. Blood smears were negative for blood parasites including *Trypanosoma evansi*. In total, 72 % of the females and 80 % of the males had gastrointestinal parasites. Infected females had significantly lower RBC, Hb and PCV values but higher eosinophil counts than non-infected ones. For the non-infected females and males, respectively the values were : Hb 11.4 ± 1.8 , 11.0 ± 1.0 g/dl ; PCV 0.295 ± 0.033 , 0.287 ± 0.043 l/l ; RBC 9.01 ± 1.21 , $8.26 \pm 1.62 \times 10^{12}/l$; MCV 32.8 ± 3.7 , 34.8 ± 5.1 fl ; MCH 13.0 ± 2.1 , 13.3 ± 1.3 pg ; MCHC 38.7 ± 6.2 , 38.3 ± 3.6 g/dl ; WBC 14.09 ± 4.03 , $10.24 \pm 2.01 \times 10^9/l$; neutrophils 6.46 ± 1.64 , $4.67 \pm 1.23 \times 10^9/l$; lymphocytes 6.78 ± 1.27 , $4.74 \pm 1.19 \times 10^9/l$; eosinophils 0.56 ± 0.49 , $0.56 \pm 0.44 \times 10^9/l$; monocytes 0.27 ± 0.14 , $0.26 \pm 0.09 \times 10^9/l$. The average corresponding values for infected animals were : Hb 10.01 ± 1.35 , 11.55 ± 1.21 g/dl ; PCV 0.261 ± 0.033 , 0.304 ± 0.041 l/l ; RBC 7.52 ± 1.79 ,

$8.40 \pm 1.54 \times 10^{12}/l$; MCV 34.6 ± 4.3 , 36.0 ± 4.9 fl ; MCH 13.3 ± 1.8 , 13.8 ± 1.4 pg ; MCHC 38.3 ± 5.2 , 38.2 ± 4.0 g/dl ; WBC 10.50 ± 2.47 , $9.55 \pm 1.88 \times 10^9/l$; neutrophils 5.18 ± 1.41 , $4.51 \pm 0.99 \times 10^9/l$; lymphocytes 4.37 ± 1.37 , $4.12 \pm 1.08 \times 10^9/l$; eosinophils 0.69 ± 0.41 , $0.61 \pm 0.43 \times 10^9/l$; monocytes 0.28 ± 0.17 , $0.29 \pm 0.14 \times 10^9/l$. The results are discussed and compared with previous findings in other countries. *Key words* : Dromedary - *Camelus dromedarius* - Haemogram - Blood - Protozoan disease - Gastrointestinal helminthiasis - Bahrain.

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