Assiut Vet. Med. J. Vol. 50 No 100, January 2004

Shalatin laboratory,
Animal Health Research, ARC, Egypt.

PREVALENCE OF ECTOPARASITES AND THEIR EFFECT ON SOME BIOCHEMICAL INDICES IN CAMELS (CAMELUS DROMEDARIUS) AT SHALATIN CITY

(With 10 Tables and 8 Figures)

By

O. M. MAHRAN and M. A. SALEH

Biochemistry unit, New-Valley laboratory, Animal Health Research Institute.

(Received at 22/12/2003)

انتشار الطفيليات الخارجية وتأثيرها على بعض المؤشرات البيوكيميائية في الجمال (وحيدة السنم) في مدينة شلاتين

عثمان محمد مهران ، مصطفى أحمد صالح

تم عمل مسح حقلي وبالمجزر على عدد ٨١٠ جمل من الجنسين ومختلف الأعمار وفصول السنة. لدراسة انتشار الطفيليات الخارجية. أوضحت النتائج وجود ٤٥,٥٩ في المائة من الجمال مصابة بالطفيليات الخارجية من أصل ٦٨٠ جمل في الدراسة الحقلية. منها ١١,٧٦ في المائة كانت مصابة بالجرب و ٣٠,١٤ في المائة مصابة بالقراد و٣,٦٧ في المائة أظهرت إصابة مختلطة بكليهما. كانت نسبة إصابة الجمال بالمجزر (٨٧,٧ في المائة) أعلى من المسح الحقلي نتيجة وجود نسبة عالية من الإصابة بذبابة الأنف (٦٧,٦٩ في المائة). وقد أسفر الفحص عن وجود أصناف مختلفة من القراد مثل الهيالوما دروميدرياي والأمبليوما ليبيدم والأورنيثودوروس سافينجياي. كانت الجمال المعمرة أكثر عرضة للطفيليات الخارجية عن الجمال صغيرة العمر. وأوضح البحث أن عدد الحيوانات المصابة بالحلم وذبابة الأنف كان اكثر في الإناث عن الذكور بينما القراد كان أكثر في الذكور ولكن كانت الإناث تحمل عدد أكبر من القراد. كما أظهرت النتائج أنه وعلى عكس القراد كان انتشار الجرب وذبابة الأنف أكثر فاعلية في الشتاء بينما كانت أقل في الصيف. كانت الأنيميا ذات الحجم والصبغة العادية مميزة للإصابة بالقراد وذبابة الأنف بينما كانت تتميز الإصابة بالجرب بالأنيميا ذات الضمور الخلوي و الصبغي. هذا بالإضافة إلى أن كل المجموعات المصابة أظهرت زيادة في العدد الكلي لكريات الدم البيضاء مصحوبا بزيادة في نسبة خلايا الكريات اللنفية والإزينوفيل. أوضح التحليل الكيميائي لمصل الدم وجود نقص في قيم البروتين الكلي مصحوبا بنقص في قيم الألبيومين وزيادة في قيم الجلوبيولينيات. كان هناك أيضا زيادة ملحوظة في قيم الألفاجلوبيولين والجاماجلوبيولين بدون تغيير في قيمة البيتاجلوبولين. علاج بعض الحالات المصابة بالحلم بعقار الإفرمكتين أدى إلى اختفاء الأعراض الإكلينيكية واسترداد المؤشرات الهيماتولوجية والبيوكيميائية قيمها الطبيعية.

SUMMARY

Field and abattoir survey was done on a total of 810 male and female camels at different ages and seasons to study the prevalence of ectoparasites at Shalatin City, Red Sea Governorate, Egypt. Out of 680 examined camels in the field study, 45.59% revealed infestation with ectoparasites. Of these animals 11.76% were infested with sarcoptic scabiei var cameli, 30.14% with ticks and 3.67% showed mixed infestation. The incidence of ectoparasites in the abattoir survey was higher (87.7%) because of the high incidence of Cephalopenia titillator (67.69%). Tick species like Hyalomma dromedarii, Amblyoma lepidum and Ornithodoros savignyi species were recorded. Older camels were more susceptible than younger individuals. Mange mites and bot flies were more prevalent with higher intensity in females than male camels, meanwhile tick infestation was more prevalent in males but females had higher burden. Contrarily to ticks, the highest rate of mites and nasal bot infestation was recorded in winter while the lowest was in summer. Normocytic normochromic anaemia was the hallmark of tick and nasal bot infestation, but infestation with mites revealed microcytic hypochromic anaemia. All infested groups showed leucocytosis accompanied by lymphocytosis and eosinophilia. Proteinogram showed hypoproteinaemia consequent to hypoalbuminaemia and hyperglobulinaemia. There was marked hyper α-globulinaemia and hyper γ-globulinaemia without changes in β-globulin fraction. Cases of sarcoptic mange treated with ivermectin showed disappearance of the initiated clinical signs and restored haematological and biochemical indices.

Key words: dromedary, ectoparasites, prevalence, protein lectrophoresis.

INTRODUCTION

The ectoparasitic fauna of the animals consists of two zoological classes, the *Arachnida* (mange mites and ticks) and the *Insecta* (insects), within the phylum *Arthropoda* (Soulsby, 1982 and Urquhart *et al.*, 1996).

Mange is the most feared and widespread disease affecting the camel second to Surra (Higgins, 1986). Because the disease is highly contagious, obstinate, debilitating and zoonotic, it is one of the two diseases, which cause severe economic losses, and camel herdsmen invariably seek modern veterinary treatments.

Like helminthiasis, ticks also play a major role in morbidity and mortality especially in young camels beside their role as an intermediate host for many tick borne diseases and harbouring of several viruses and rickettsia of biomedical and zoonotic importance (Pegram and Higgins, 1992).

The non-acarine ectoparasites of camels are the insects. The *Oestridae* (nasal flies) is a highly specialized family in which the adult mouth-part is non-functional but the larvae are obligatory parasites. The camel nasal bot fly (Cephalopina titillator) is host specific. The larvae of this fly are deposited in the nostrils, nasopharynx and nasal sinuses resulting in upper respiratory distresses (Musa, *et al.* 1989; Pegram and Higgins, 1992; Fatani and Hilali, 1994; Morsy, *et al.*, 1998 and Zayed, 1998).

Studies on the prevalence of camel ectoparasites are world widespread (Higgins, 1984 and 1986; Abbas *et al.*, 2000; Al-Rawashdeh *et al.*, 2000; Balasubramanian *et al.*, 2001 and Muhammad *et al.*, 2001) but unfortunately, it had not been fully established under the Egyptian conditions.

On the other hand, the effect of these ectoparasites on the general health of camels had not yet been recognized. To relate ectoparasite infestations with performance consequences of the host, specific indices are required. Blood serum proteins including albumin and total globulin were evaluated during mange mite infestation in camels (Rahman, *et al.* 2002), but not in animals infested with other ectoparasitic infestation.

Despite of its importance as an indicator for the general health (Thomas, 2000a,b), the electrophoretic pattern of blood serum proteins in camels and unfortunately in other ruminants infested with ectoparasites was neglected and had not been fully established. Therefore, the present work was designed to throw the light on the prevalence of ectoparasites affecting camels at Shalatin City and the effect of these parasites on clinical and some haematological parameters of camels. In addition, to evaluate the electrophoretic pattern of blood serum proteins during ectoparasitic infestation of camels with trials of treatment.

MATERIALS and METHODS

The study area: Shalatin City, Red Sea Governorate, Egypt, is a desert area, which represent the southern part of the eastern desert and is considered one of the southern borders of Egypt. Exported camels from

eastern Sudan are passed through this area. The total number of camels in this area is about 40 thousands, of a total 133 thousands camels present in Egypt (GOVS, 1998)

Animals

1- Field survey: a total of 680 male and female camels at different ages were subjected to careful examination for ectoparasitic infestation during the period from January to December 2003. A complete clinical examination was carried out on these animals according to Higgins (1986).

2- Abattoir survey: was done on a total of 130 male and female camels at different ages, which slaughtered at Shalatin abattoir.

Sampling:

1- Parasitological sampling:

a- Ticks were collected by detachment of different types of ticks from different parts of the body by the help of forceps without damaging the mouth parts. All ticks were preserved in 70% alcohol. Sites of ticks and number were recorded. Identification of ticks was done according to Hoogostral (1978) and Soulsby (1982).

b- Skin scraping was done at the edge of the suspected active mangy lesions by the help of sharp scalpel in a test tube. The collected parts were processed for mites examination by maceration methods (Coles, 1986). Identification of mites was carried out after Soulsby (1982).

c- Collection of Cephalopenia titillator larvae: The fascial cranium of the head of slaughtered camels was opened at the abattoir to reach the predilection sites of C. titillator in the anterior and posterior chambers of the naso-pharynx. The different stages of larvae were removed, counted and identified on the bases of measurement given by Soulsby (1982), Higgins (1984) and Urquhart *et al.* (1996).

2- Blood sampling: A total of forty male camels (4-6 years) were used for blood sampling. These animals were proved to be free from internal and blood parasites (by examination of their faeces and blood smears according to Coles, 1986) and had normal rectal temperature to exclude other bacterial or viral diseases. Thirty of these camels were classified into 3 groups (10 each) each one was heavily infested with only one ectoparasite species, either tick, mange or C. titillator. The rest (10 camels) were clinically healthy parasite-free group, which used as control. Two blood samples were drained from each camel. In C. titillator infested group sampling was carried out from suspected camels in labeled tubes before slaughtering which was confirmed after postmortem examination of the nasopharynx. In mite infected camels

sampling was carried out just before and four weeks after beginning of treatment. The first blood sample contained anti-coagulant, used for hematological studies (Wernery, *et al.* 1999 and Feldman *et al.*, 2000). The second one used to obtain serum for biochemical determination of total protein and protein electrophoretogram.

Total serum protein was measured after the methods described by Henry *et al.* (1974). Protein electrophoretogram was carried out by using Titan III cellulose acetate plate at pH 8.8 at ionic strength of 0.067, stained with Ponceau S dye and scanned by autodensitometer (HelenaLaboratories, Cat. 1023) at absorption peak of 525 nm according to manufacture instructions.

Therapeutic applications:

Mangy camels were injected subcutaneously with 0.2mg/kg BW (1ml commercial solution/50kg BW) ivermectin (MSD AGVET Merck & Co. Inc. Whitehouse Station, N.J., USA) twice with 15 days in between. Tick infested camels and the surrounding area were sprayed with diluted diazenon ((Neocidol, Hindustan Ciba Geigy Ltd.) at a rate of 1:1000 three times with two weeks interval.

RESULTS

Clinical signs: Mangy animals showed marked irritation and they were scratching and rubbing their bodies against objects. Lesions caused intense itching hypersensitivity, erythema and pruritis. Papules appear and enlarge peripherally and coalesce with other lesions so that very large areas of the affected skin were appeared. The hair was lost and the skin was covered with chalky scabs and became corrugated, thickened, keratinized and cracked into deep fissures. These fissures were oozing serohaemorrhagic exudates (Plate 1). The preferable predilection sites of these lesions were the axillae, inguinal regions, brisket, neck, around the root of the tail and on the face. In severely affected cases the legs were noticed to be swollen and oedematous and the animal lost appetite and became debilitated.

Ticks infested camels showed severe irritation, restlessness, and itching, which resulted in the damage of hides and traumatic injuries due to tick bites. Camels were severely debilitated, weak and exhausted, and the owners had a complaint of distraction from eating and loss of production. Manifestations of anaemia including paleness of the visible mucous membranes were also clear on these animals.

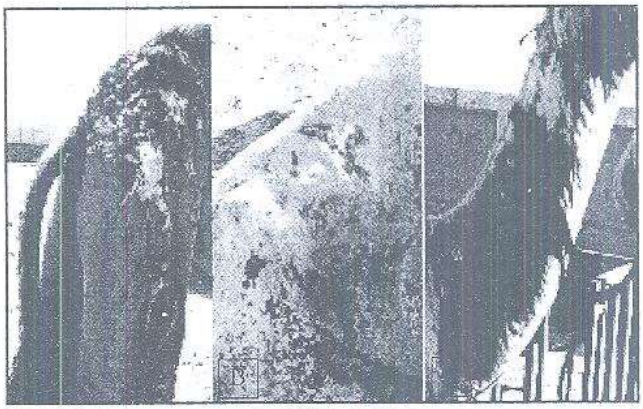

Plate 1: clinical signs of mange infestation in camel.
1st. on the thighs., B. on the back and abdomen., C. on the neck.

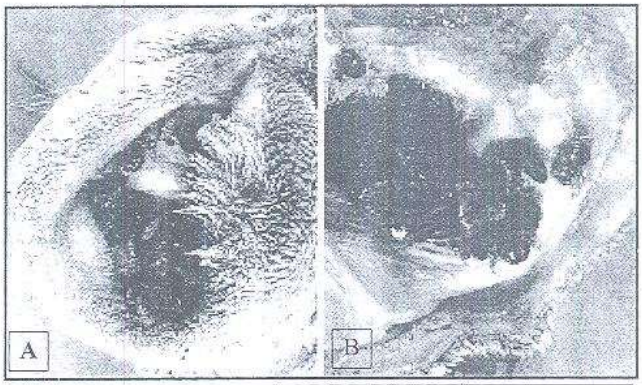

Plate 2: tick infestation in the nose of camel.
1st. In the live animal. B. After P.M. examination.

The predilection sites of ticks on these camels were the soft regions including the perineal, inguinal and axillary regions in addition to the inner sides of the ear, within the nostrils and around the eyes (Plate 2).

Camels infested with C. titillator showed restlessness, irritation, sneeze, snort, difficult breathing, neurological signs, anorexia and debility. The larvae may be sometimes expelled after a great deal of snorting. In the abattoir, these camels showed swollen, haemorrhagic and oedematous mucous membranes of the nasopharynx and nodules with central abscesses and foci of calcification at the sites of larval attachment. Occasionally, degenerated larvae were found embedded between the turbinated bones. The nasal cavity was congested and filled with mucus in which some larvae were entangled (plate 3).

Plate 3: Cephalopenea titillator in the nasopharynx of camel

Parasitological findings:

Field study: out of 680 examined camels, 310 (45.59%) revealed infestation with ectoparasites. Of these infested animals, 80 (11.76%) were infested with mange mites, 205 (30.14%) were infested with ticks and 25 (3.67%) showed mixed infestation by mange and ticks (Tab. 1 and Fig. 1).

Abattoir survey: out of 130 slaughtered camels, 114 (87.7%) were infested with ectoparasites. Of these camels, 88 (67.69%) were infested by C. titillator larvae, 15 (11.54%) were infested by ticks and 11 (8.46%) showed mixed infestation by C. titillator larvae and ticks (Tab. 2 and Fig. 2).

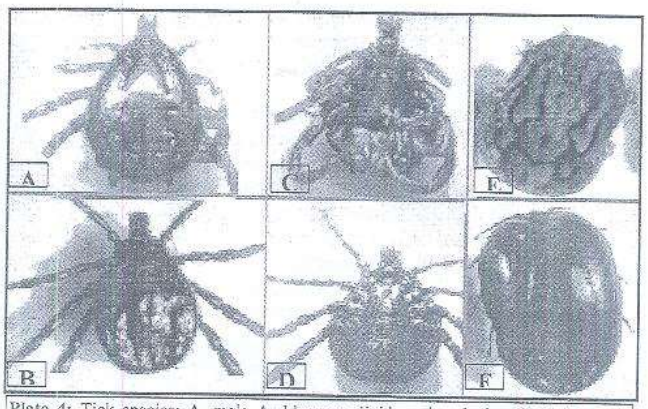

Plate 4: Tick species: A. male Amblyomma lipidum dorsal view (x 5), B. male Hyalomma dromedari dorsal view (x 5), C. male Amblyomma lipidum ventral view (x 5), D. male Hyalomma dromedari ventral view (x 5), E. Female Ornithodoros savignyi dorsal view (x 2), F. Female Hyalomma dromedari (x 2).

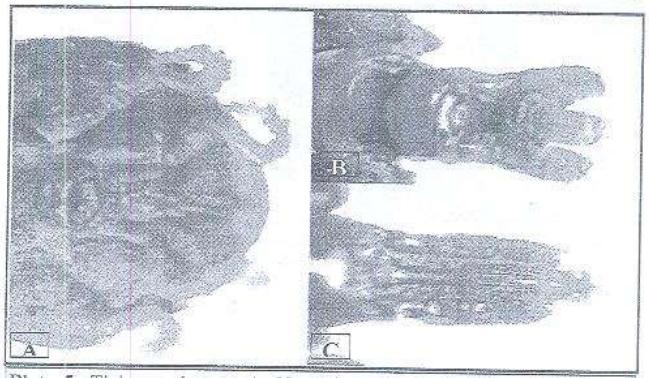

Plate 5: Tick mouthparts: A. Ventral anterior end of O. savengi (x10) showing mouthpart. B. Mouthpart of Amblyomma lipidum dorsal view (x 15). C. mouthpart of male Hyalomma dromedari dorsal view (x 15).

Identification of investigated ectoparasites:

1- Mange mites: Sarcoptic scabiei var cameli was the only species recorded in this work (Plate 6A). Mites were characterized by terminal anus, short legs not extended past body margin and suckers on long unjointed stalk.

2- Ticks: during the present investigation, Hyalomma dromedarii, Amblyoma lepidum and Ornithodoros savignyi species were recorded. Identification according to ventral and dorsal surfaces in addition to mouthparts of the examined tick is shown in plate (4&5). H. dromedarii was characterized by: presence of eyes, hypostome and palbs long. In males there was a pair of adanal shields and some times accessory adanal shields. Spiracles were triangular in females. A. lipidum was manifested by clear ornamented scutum without adanal shelds. The mouth parts were found anteriorly and the eyes were small dark hemosphere. There were 6-8 partially pigminted festoons. O. savignyi were characterized by presence of eyes.

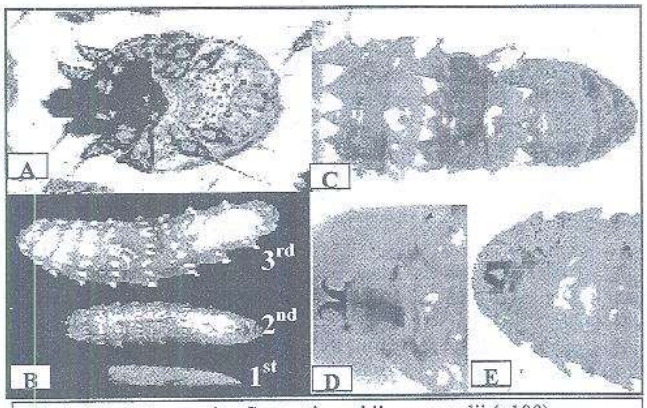

Plate 6: A- Mange mite, Sarcoptic scabii var camelii (x100)
B- C. titillator larvae x1.5 showing 1st, 2nd and 3rd stages.
C- C. titillator posterior dorsal view (x5)
D -Cephalopenia titillator (x5). Anterior dorsal view
E- Cephalopenia titillator (x5). Posterior dorsal view.

The dorsal and ventral surface of the body do not meet at the sharp lateral margin. Body surface roughened by tiny protuberances called mammillae.

3- Cephalopina titillator: after slaughtering, the larvae were found embedded in the mucous membranes and fill the cavity spaces of the nasopharynx (Plate 3). The larvae (Plate 6 B, C, D, E) were elongated white or slightly yellowish in colour with tapered anterior and flat posterior ends. Pair of small dark coloured oral hocks was present in the anterior. The posterior end had dark brown pea shaped stigmal plates. The ventral surface of these larvae presented scattered spines but their last segment had several rows of such spines. The first, second and third stage larvae were identified (Plate 5). The larval burden varied from 9 in light infested to 80 in heavily infested camels with a mean of 45 ±14 larva per camel.

The effect of age, sex and season on the prevalence of ectoparasites.

The effects of age and sex of camels in addition to the effect of different seasons of the year on the distribution of ectoparasites and their prevalence are presented in tables 2, 4, 5, 6 and 7 and figures 3 - 5.

The effect of ectoparasitic infestation on the haemogram and leucogram of camels:

Camels infested with ectoparasites showed significant reduction in the mean values of total erythrocytic count, haemoglobin concentration and packed cell volume. Consequently, there was normocytic normochromic anaemia in tick and C. titillator infested camels while mange infestation resulted in microcytic hypochromic anaemia, which was denoted by the reduced values of the mean corpuscular volume (MCV) and the mean corpuscular haemoglobin (MCH) as shown in table 8 and Figure 6. Leucogram of infested camels revealed leucocytosis accompanied by lymphocytosis and eosinophilia (Tab. 9 and Fig. 6).

The profile of blood serum protein during ectoparasitic infestation in camels:

Camels infested with ectoparasites showed marked hypoproteinaemia, hypoalbuminaemia and hyperglobulinaemia. Globulin fractionation revealed hyper-alphaglobulinaemia, and hyper-gammaglobulinaemia. Beta-globulin region remained constant and did not differed than control animals. Albumin / globulin ratio was significantly decreased in parasite infested camels if compared with healthy individuals (Table 10 and figure 7&8).

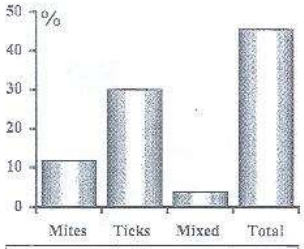

Fig. 1: A field survey showing the prevalence of ectoparasites in camels at Shalatin City.

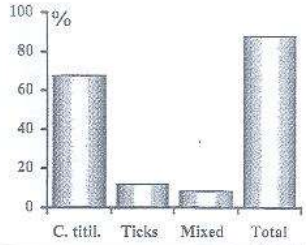

Fig. 2: An abattoir survey showing the prevalence of ectoparasites in camels at Shalatin City.

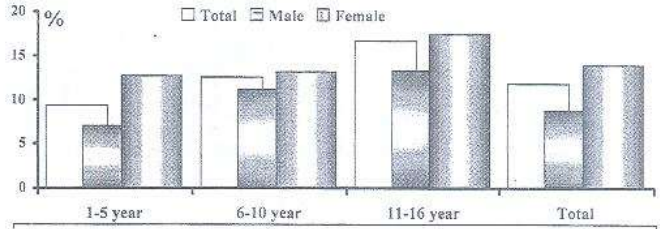

Fig. 3: The effect of age and sex on the rate of mites infestation in camels at Shalatin City.

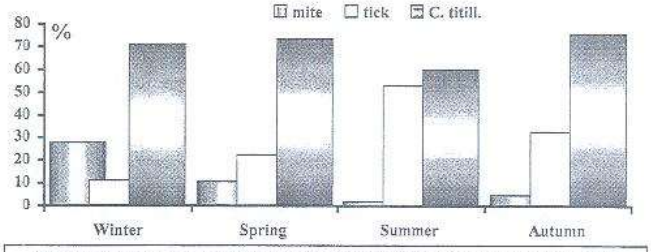

Fig. 4: Seasonal variations of ectoparasitic infestation in camels at Shalatin City.

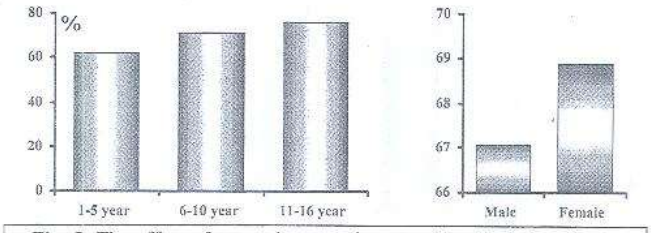

Fig. 5: The effect of age and sex on the rate of bot fly infestation in camels at Shalatin City.

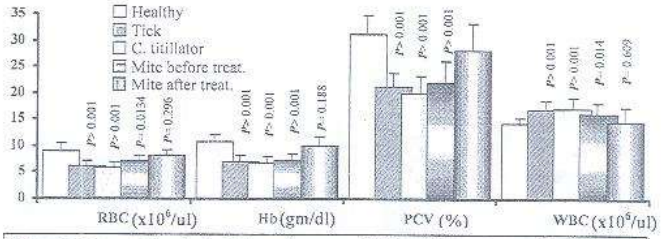

Fig. 6: Haematological picture (means ±SD bar) in ectoparasite infected camels. P value indicate the probability level of significance than control group of each category.

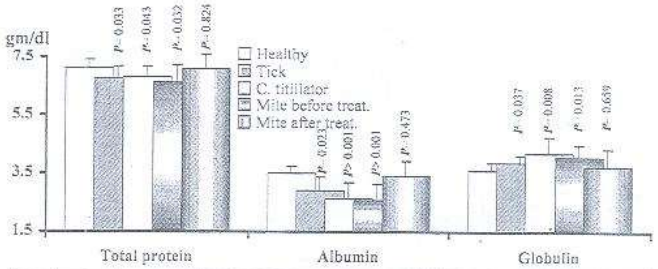

Fig. 7: blood serum protein profile (means ±SD bar) in ectoparasite infected camels. P value indicate the probability level of significance than control group of each category.

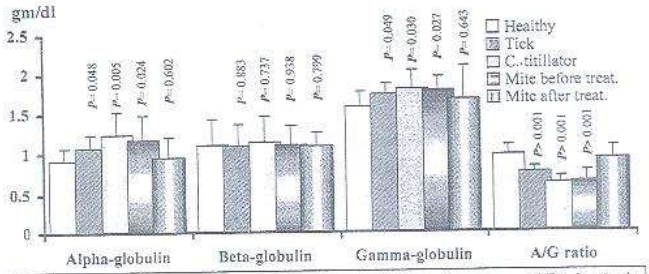

Fig. 8: blood serum globulin fractionation (means ±SD bar) in ectoparasite infected camels. P values indicate the significance probability than control group of each category.

Effect of treatment:

One month after beginning of treatment of mangy camels, the clinical signs disappeared and there was restore of the haematological and biochemical indices (Tables 8, 9&10).

Table 1: A field survey showing the prevalence of ectoparasites in camels at Shalatin City.

Total No. of examined camels	Mites		Ticks		Mixed		Total infested	
	No.	%	No.	%	No.	%	No.	%
680	80	11.76	205	30.14	25	3.67	310	45.59

Table 2: The effect of age, sex and season on the rate of ectoparasites infestation in camels at Shalatin City abattoir.

Factors	Examined camels			C. titillator		Ticks		Mixed	
	Total	Infested	%	No.	%	No.	%	No.	%
Total	130	114	87.7	88	67.69	15	11.54	11	8.46
Effect of age									
1-5 year	60	48	80.0	37	61.66	8	13.3	3	5.00
6-10 year	45	42	93.3	32	71.11	4	8.89	6	13.33
11-16 year	25	24	96.0	19	76.00	3	12.0	2	8.00
Effect of sex									
Male	85	72	84.7	57	67.06	9	10.6	6	7.06
Female	45	42	93.3	31	68.88	6	13.3	5	11.1
Effect of season									
Winter	45	37	82.22	32	71.11	3	6.66	2	4.44
Spring	30	28	93.33	22	73.33	4	13.33	2	6.66
Summer	25	23	92.00	15	60.00	4	16.0	4	16.0
Autumn	30	26	83.33	19	76.00	4	13.33	3	10.0

Table 3: distribution of different tick species on the common predilection sites of camels.

Tick species	Nostrils		Ear		Neck and axillary		Perineal and inguinal		Sample size
	No.	%	No.	%	No.	%	No.	%	
Hyalomma dromedarii	170	25.0	202	29.7	155	22.79	153	22.5	680
Amblyoma lepidum	18	11.25	21	13.13	55	34.38	66	41.25	160
Ornithodoros savignyi	-	-	6	7.5	33	41.25	41	51.25	80

Table 4: The effect of age and sex on the rate of mange mite infestation in camels at Shalatin City.

Age group	No. of examined camels			No. of infested camels			% of infested camels		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
1-5 year	280	170	110	26	12	14	9.29	7.06	12.73
6-10 year	310	90	220	39	10	29	12.58	11.11	13.18
11-16 year	90	15	75	15	2	13	16.67	13.33	17.33
Total	680	275	405	80	24	56	11.76	8.72	13.83

Table 5: The effect of season on the rate of mange mite infestation in camels at Shalatin City.

	Winter	Spring	Summer	Autumn	Total
No. of examined camels	185	176	195	124	680
No. of infested camels	51	19	4	6	80
%	27.56	10.80	2.05	4.84	11.76

Table 6: Prevalence and seasonal variations of tick infestation of camels at Shalatin City.

Season	No. of examined camels	No. of infested camels	Male camels			Female camels			Total	
			No. of animals	No. of collected ticks	Mean / animal	No. of animals	No. of collected ticks	Mean / animal	No. of ticks	Mean / animal
Winter	180	20	12	215	17.9	8	135	16.9	350	17.5
Spring	175	39	23	645	28.0	16	460	28.7	1105	28.3
Summer	200	105	70	2610	37.3	35	1615	46.1	4225	40.2
Autumn	125	41	23	655	28.5	18	525	29.2	1180	28.8
Total	680	205	128	3080	24.1	77	2735	35.5	6860	33.4

Table 7: The effect of age on the rate of tick infestation in camels at Shalatin City.

Age group	No. of examined camels	No. of infested camels	% of infested camels
1-5 year	260	55	21.15
6-10 year	310	85	27.42
11-16 year	110	65	59.09
Total	680	205	30.14

Table 8: Some haematological parameters in ectoparasite infested camels.

Parameter	Unit	Healthy control camels	Tick infested camels	C. titillator infested camels	Mange infested camels	
					Before treatment	After treatment
RBCs count	x 10^6/ul	8.82 ±1.67	6.19 ±0.97*	5.79 ±1.04*	7.07 ±1.05*	8.12 ±1.19
Hb	gm %	10.85 ±1.25	6.90 ±1.20*	6.70 ±1.34*	7.20 ±1.32*	9.90 ±1.79
PCV	%	31.20 ±3.43	21.10 ±2.69*	19.90 ±3.38*	21.90 ±4.20*	28.10 ±5.17
MCV	fl	35.37 ±2.22	34.09 ±2.96	34.37 ±2.84	30.8 ±4.45*	34.61 ±3.19
MCH	pg	12.30 ±2.21	11.15 ±2.35	11.57 ±2.80	10.2 ±2.04*	12.19 ±1.87

* Values are significantly differing than control at P> 0.05.

Table 9: Leucogram of ectoparasite infested camels.

Parameter	Unit	Healthy control camels	Tick infested camels	C. titillator infested camels	Mange infested camels	
					Before treatment	After treatment
WBCs count	x 10^3/ul	14.19 ±1.23	16.9 ±1.66*	17.0 ±2.05*	15.97 ±2.2*	14.7 ±2.75
Neutrophils	%	43.12 ±4.41	38.10 ±6.66	39.04 ±6.32	38.22 ±6.36	41.08 ±6.10
Lymphocytes	%	47.61 ±1.58	51.3 ±3.56*	50.1 ±2.15*	50.1 ±2.69*	49.97 ±6.2
Monocytes	%	2.36 ±0.54	2.02 ±0.34	1.98 ±0.45	1.87 ±0.55	2.09 ±0.37
Eosinophiles	%	6.91 ±1.33	8.57 ±1.78*	8.86 ±1.51*	9.78 ±2.04*	6.86 ±1.65
Basophils	%	00.0 ±0.00	00.0 ±0.00	00.0 ±0.00	00.0 ±0.00	00.0 ±0.00

* Values are significantly differing than control at P> 0.05.

Table 10: Serum protein electrophoretogram (gm/dl) in ectoparasite infested camels.

Parameter	Healthy control camels	Tick infested camels	C. titillator infested camels	Mange infested camels	
				Before treatment	After treatment
Total protein	7.13 ±0.283	6.77 ±0.397*	6.81 ±0.367*	6.63 ±0.593*	7.09 ±0.482
Albumin	3.52 ±0.204	2.91 ±0.458*	2.61 ±0.559*	2.57 ±0.560*	3.39 ±0.515
Total globulin	3.61 ±0.260	3.86 ±0.237*	4.20 ±0.533*	4.06 ±0.430*	3.7 ±0.575
α-globulin	0.91 ±0.166	1.07 ±0.170*	1.25 ±0.284*	1.18 ±0.294*	0.96 ±0.246
β- globulin	1.11 ±0.321	1.09 ±0.277	1.14 ±0.320	1.10 ±0.236	1.08 ±0.175
γ- globulin	1.59 ±0.179	1.74 ±0.135*	1.81 ±0.233*	1.78 ±0.175*	1.66 ±0.430
A/G ratio	0.97 ±0.126	0.75 ±0.067*	0.62 ±0.075*	0.63 ±0.132*	0.92 ±0.146

* Values are significantly differing than control at P> 0.05.

DISCUSSION

It has been generally recognized that camels are exposed to wide range of external parasites which irritate, debilitate and resulted in serious tissue damage both directly and indirectly. Consequently, the clinical signs observed in ectoparasite infested camels in the current study including mite, ticks and nasal botfly larvae confirm these facts and agree with those previously recorded by Hussein, *et al.* (1982), Higgins (1986), Pegram and Higgins (1992), Egbe-Nwiyi and Chaudhari (1996), Suchitra Sena *et al* (1999a,b), Al-Rawashdeh, *et al.* (2000), Bekele (2001), Zeleke and Bekele (2001) and Baraka and Illek (2003).

The prevalence of camel ectoparasites in this study was considerably coinciding with the findings of Suchitra Sena *et al* (1999a,b) in India, Zeleke. and Bekele (2001) in Ethiopia, Rahman *et al.* (2002) in Pakistan and Jemli (2002) in Tunis. However, our results were higher than those reported by Hamoda (2002) in the Nile Valley of Egypt and by Abou-El-Ela (2003) in the western Egyptian desert. This may be perhaps due to variations in the climatic conditions including warm weather and suitable humidity which may favour the flushing of these ectoparasites (Soulsby, 1982 and Higgins, 1986). On the other hand, the prevalence of ectoparasites noticed in slaughtered animals was higher than the field study (87.7% vs. 45.59% respectively) which was clearly due to detection of high number of camels infested by C. titillator in the nasopharynx after postmortum examination.

In the current study, only one species of mite was recorded (Sarcobtic scbii var cameli). This result coincided with the reports of Pegram and Higgins (1992), Kumar *et al* (1992) and Muhammad *et al* (2001). The identification of ticks revealed species like Hyalomma dromedarii, Amblyoma lepidum and Ornithodoros savignyi (sand tampan). H. dromedarii was the most abundant while A. lepidum and O. savignyi were found in less numbers. These results agree with Higgins (1986), El-Refaii and Wahba (2003) who mentioned that the variety of tick infestation in camels depend on the study area and geoclimatic conditions. Pegram and Higgins (1992) added that Hyalomma species is a highly desert adopted and widely distributed in arid areas. It was noticed that H. dromedarii was more condensed around and within the nostrils and ear than other parts of the body, but other species were scattered on other soft parts of the body which agree with the reports of Higgins (1986).

The effect of season was clear on ectoparasitic infestation of camels. The highest rate of mites was recorded in winter while the

lowest was in summer. Similar results were obtained by Egbe-Nwiyi and Chaudhari (1996), Suchitra Sena *et al* (1999a) and El-Kholany and Abd alllah (2001). The functioning skin and the high ambient temperature during summer may not favour the activity of mites which may hide in skin folds to protect themselves from sunlight (Grioryon, 1987 and Abdel Rahim *et al*., 1995). Contrary to mites, the current study showed more pronounced prevalence of ticks during summer while it was at its lowest prevalence during winter. These results coincide with those reported previously by Abdel Rahim *et al*. (1995) and El Khalany and Abd allah (2001) which indicate that hot summer environment is the favourable condition for high prevalence of ticks. However, contradict reports found more activity of ticks during winter months (Robson *et al*., 1968 and Berdyev, 1969). The prevalence of C. titillator during the current study was more pronounced during winter and temperate seasons (spring and autumn). It seems that wet and temperate environment favour the multiplication of the flies with production of high number of larvae (Higgins, 1986 and Bekele, 2001).

The current study emphasized that age had a large effect on ectoparasetic infestation of camels. Older animals were more infested than young individuals. These results agree with the findings of Higgins (1986), Pegram and Higgins (1992), Egbe-Nwiyi and Chaudhari (1996), Suchitra Sena *et al* (1999a,b), Al-Rawashdeh, *et al*. (2000), Bekele (2001), Zeleke and Bekele (2001) and El-Kholany and Abd alllah (2001). The higher rate of ectoparasite infestation in aged camels might be perhaps due to the long time exposure of these animals to these ectoparasites. The quietness of older animals than the active and transmissible young individuals may also play role in the condensation of ectoparasites.

The current work showed that mange mites and bot flies were more prevalent with higher intensity in females than male camels, meanwhile tick infestation was more prevalent in males but females had higher burden of ticks. These results are in agreement with the reports of Higgins (1986), Pegram and Higgins (1992), Egbe-Nwiyi and Chaudhari (1996), Suchitra Sena *et al* (1999a), Al-Rawashdeh, *et al*. (2000), Bekele (2001) and Zeleke and Bekele (2001). The differences in the prevalence and burden in relation to sex might be due to the differences in the management, stress of pregnancy and lactation in addition to hormonal factors (Abd El-Gowad, 1979).

Haematological findings revealed normocytic normochromic anaemia in tick and nasal bot infested camels. Loss of blood encountered

by these parasites for feeding may be responsible for this type of anaemia. These results agree with those reported by Mourad *et al* (1987). Higgins (1986) reported that blood loss might amount up to 3 ml for each tick completing its life cycle on the animal. In mange infested camels, there was a microcytic hypochromic anaemia, which may indicate dishaemopoiesis and disturbances in the reticulo-endothelial function (Jain, 1993 and Feldman *et al*, 2000).

Urquhart *et al*. (1996) and Wernery, *et al*. (1999) had described that Leukocytosis accompanied by lymphocytosis and eosinophilia are common features of parasetic diseases. In the present study, these changes were evident in all infested groups as a reaction of the host against the heavily invading parasite (Jain, 1993 and Radostits, *et al*. 2000).

The current work revealed that blood serum proteins were highly affected by the ectoparasitic infestation in camels. The mean values of blood serum albumin were significantly decreased in infested camels. Similar results were obtained in camel sarcoptosis by Rahman *et al*. (2002) but there were no available literatures to compare such reduction in tick and nasal bot infestation. The reduction of blood serum albumin in this study may reflect the anorexia and disturbed nutritional status of these camels as a result of irritation and discomfort. The loss of exudates due to tissue injuries may also be a contributing factor for reduction of blood serum albumin.

The mean values of blood serum alpha globulin were significantly increased in parasited camel than controls. By tracing the available literatures, there were no reports describe the behaviour of alpha band of protein electrophoresis during external parasitic infestation. However, according to Jain (1993), Kaneko (1997) and Thomas (2000a,b) this rise in alpha globulin indicate induction of pivotal pro-inflammatory cytokins and production of acute phase proteins (APP). These APP are the main components of alphaglobulin region as haptoglobin, α_1-acid glycoprotein and serum amyloid A (Thomas, 2000a,b), which up till now they had not been recognized in camels yet. The acute cases, severe intensity of infestation and perhaps invasion of secondary bacterial infection to the injured tissues in the examined camels in this work may suggest the induction of these cytokines. Consequently these cytokins synthesized the liver for production of acute inflammatory reactors and hence the α-globulin region increased. Liver involvement in ectoparasitic infestation was noticed by Fisher and Crookshank (1982), and production of

inflammatory cells which attracted to the site of infestation by means of chemoattractants secreted by the parasite was postulated by Uhlir (1991) and Zahran (1997).

The mean values of betaglobulin region in this work did not show significant variation in infested camels when compared with control animals meanwhile the mean values of gammaglobulin was increased. It seems that there are no similar reports to compare betaglobulin values but the elevated gammaglobulin were in consistent with the reports of Rechav *et al*. (1991) in laboratory animals, Banerjee *et al* (1990), Sahibi *et al*. (1997) in cattle and Szabo *et al*. (2003) in dogs. It was noticed that the elevation of gammaglobulin was comparable with the induced lymphocytosis in this study. Skerratt (2003) noticed presence of plasma cells and B-lymphocytes in wombats experimentally infected with external parasites and suggested that some immune tolerance may develop with severe infections.

The sum of globulin fractions values resulted in hyperglobulinaemia, meanwhile the sum of albumin and globulin resulted in hypoproteinaemia in infested camels if compared with control animals. This consequently resulted in decreased A/G ratio in diseased groups. These result agree with those reported by El-Kholany and Abd alllah (2001) and Rahman *et al*. (2002).

Treatment of mange infested cases with ivermectin resulted in the disappearance of the clinical signs and restore of the investigated haematological and biochemical parameters. These results agree with those reported by Hiepe (1988) and Leppard and Naburi (2000) who reported that the discovery of Ivermectin, a derivate of Streptomyces avermitilis which is now already fully integrated as an effective antiparasitic drug.

This paper had created a practical emphasis on the ecology and biosystematics of ectoparasitic fauna haurbouring pastoral camels reared at the eastern south part of the eastern desert of Egypt. Further investigation into the relationship between parasite burden and health of camels is required to assess the emphasized potential significance of pastoral camel ectoparasitism.

REFERENCES

Abbas, B; Al Qarawi, A. A. and Al Hawas, A. (2000): Survey on camel husbandry in Qassim region, Saudi Arabia: Herding strategies, productivity and mortality. Revue Élev. Méd. Vét. Pays Trop. 53: 293-298.

Abd El-Gowad, A. (1979): Some morphological-biochemical studies on camelian ticks under the Egyptian environmental conditions. Ph. D. Thesis, Cairo Univ.

Abdel Rahim, M; Hayat, B; Hayat, C. S. and Akhtar, M. (1995): Studies on the prevalence of ectoparasites of the dromedary in Faisal Abad division. 15:

Abou El-Ela, A. A. M. (2003): Trace Elements Status in Healthy and Diseased Camels in New-Valley Governorate. Ph. D. Thesis, Fac. Vet. Med. Assiut Univ.

Al-Rawashdeh, O. F; Al-Ani, F. K; Sharrif, L. A; Al-Qudah, K. M; Al-Hami, Y. and Frank, N. (2000): A survey of camel (Camelus dromedarius) diseases in Jordan. J. Zoo Wildl. Med. 31: 335-338.

Balasubramanian, G. A; Rao, G. V. S; Balachandran, C; George, V. T. and Vairamuthu, S. (2001): Incidence of parasitic diseases among domestic animals in Namakkal district of Tamil Nadu. Indian J. Anim. Sci. 71: 340-341.

Banerjee, D. P; Momin, R. R. and Samantaray, S. (1990): Immunization of cattle (Bos indicus X Bos taurus) against Hyalomma anatolicum anatolicum using antigens derived from tick salivary gland extracts. Int J Parasitol. 20: 969-972.

Baraka, T. A. and Illek, J. (2003): Clinical investigation of thyroid hormones profile as a diagnostic aspect in camels (Camelus dromedarius) in Egypt. J. Egypt Vet Med. Assoc. 65: 297-309.

Bekele, T. (2001): Studies on Cephalopina titillator, the cause of 'Sengale' in camels (Camelus dromedarius) in semi-arid areas of Somali state, Ethiopia. Trop. Anim. Helth Prod. 33: 489-500.

Berdyev, A. (1969): Parasitism of H. dromedarii Koch in domestic animals in the foothills of Turkemania. Parazitologica, Leningrad. 314: 287-291.

Coles, E. H. (1986): Veterinary Clinical Pathology. 4th ed. Saunders Co. Philadelphia, London, Torento.

Egbe-Nwiyi, T. N. and Chaudhari, S. U. R (1996): Sarcoptosis in camels of Nigeria: Prevalence, Associated Haematological and Histopathological changes. Pakistan. Vet. J., 16: 65 - 67.

El-Kholany, K. A. and Abd alllah, H. M. L. (2001): Some physiological and immunological studies on camels infested with Hyalomma dromedarii. J. Egypt. Vet. Med. Ass. 61: 239-249.

El-Refaii, M. A. and Wahba, A. A. (2003): Amblyomma lipidum donitz, 1909 (Acari: Ixodidae) recovered from camels in Egypt. The 2nd Sci. Cong. For Provincial Ladoratories, 7-10 Sept., 2003, Dokki, Cairo, Egypt.

Fatani, A. and Hilali, M. (1994): Prevalence and monthly variations of the second and third instars of Cephalopina titillator (Diptera: Oestridae) infesting camels (Camelus dromedarius) in the Eastern Province of Saudi Arabia. Vet Parasitol. 53: 145-151.

Feldman, J. G. Zinkl and N. C. Jain (2000): Schalm's Veterinary Hematology, 5th Ed., (Lippincott Williams & Wilkins, Philadelphia and Baltimore).

Fisher, W. F. and Crookshank, H. R. (1982): Effects of Psoroptes ovis (Acari: Psoroptidae) on certain biochemical constituents of cattle serum. Vet. Parasit. 11 :241-251.

GOVS, (1998): Technical veterinary report 1998, General Organization of Veterinary Service, Cairo, Egypt.

Grioryon, V. V. (1987): Sarcoptic mange in camels. Vet. Moscow, 12: 49-50.

Hamoda, F. K. (2002): Studies on camel trypanosomiasis with special reference to concomitant infections. J. Egypt. Vet. Med. Assoc. 62: 167-182.

Henry, R.J; Cannon, D.C. and Winkelman, J.W. (1974): Clinical Chemistry: Principles and Techniques. 2nd Ed. Harper and Row; Hagerstown M D. pp. 473.

Hiepe, T. (1988): Advances in control of ectoparasites in large animals. Angew Parasitol. 29: 201-210.

Higgins, A. J. (1984): Diagnosis and treatment of sarcoptic mange in Arabian camel. Wld Animal Rev. 49: 2-5.

Higgins, A. (1986): The Camel in Health and Disease, Baillere Tindall, London, Philadelphia, Toronto.

Hoogostral, H. (1978): Biology of ticks. In: Tickborne diseases and their vectors. Ed: J. K. H. Wilde. Proc. Int. Conf. Edinburgh, pp 3-14.

Hussein, M. F; Elamin, F. M; El-Taib, N. T. and Basmaeil, S. M. (1982): The pathology of nasopharyngeal myiasis in Saudi Arabian camels (Camelus dromedarius). Vet Parasitol 9: 253-260.

Jain, N.C. (1993): Essentials of veterinary hematology, 1st Ed. Lea & Febiger, Philadelphia.

Jemli, M. H. (2002): Main parasitosis of the dromedary in Tunisia. 27th World Vet. Cong. 25-29 Sept. 2002 Tunis (abstract) pp 79-80.

Kaneko, J. J. (1997): Serum Proteins and dysproteinemias, In Clinical biochemistry of domestic animals. Eds, Kaneko, J. J., Harvey, J. W., and Bruss, M. L., 5th Ed, Academic press, London. pp 117.

Kumar, D; Raisinghani, P. M. and Manohar, G. S. (1992): Sarcoptic mange in camel: a review. Proceedings of the first international camel conference, held at Dubai, UAE, 2-6 February 1992. Ed. Allen, W R; Higgins, A J; Mayhew, I G; Snow, D H and Wade, J F., R&W Publication Ltd., Pp. 79-82.

Leppard, B. and Naburi, A.E. (2000): The use of ivermectin in controlling an outbreak of scabies in a prison. Journal of Dermatology. 143: 520-525.

Morsy, T. A; Aziz, A. S; Mazyad, S. A. and al Sharif, K. O. (1998): Myiasis caused by Cephalopina titillator (Clark) in slaughtered camels in Al Arish Abattoir, North Sinai governorate, Egypt. J Egypt Soc Parasitol. 28: 67-73.

Mourad, I. M; Karram, M. H; Abdel All, Th. S. and Abdel Salam, F. A. (1987): Clinical and some blood constituents studies on healthy and mangy camels. Assiut Vet. Med. J. 19: 155-159.

Muhammad, G; Iqbal, M; Athar, M; Khan, M. Z. and Butt, A. A. (2001): A study on clinical disorders of one-humped draught camels (Camelus dromedarius) working in Faisalabad City, Pakistan. Intern. Confer. on reproduction and production of camelids. 11-13 Nov. 2001. AL-Ain UAE.

Musa, M. T; Harrison, M; Ibrahim, A. M. and Taha, T. O. (1989): Observations on Sudanese camel nasal myiasis caused by the larvae of Cephalopina titillator. Rev Elev Med Vet Pays Trop. 42: 27-31.

Pegram, R. J. and Higgins, A. J. (1992): Camel ectoparasites: a review. Proceedings of the first international camel conference, held at Dubai, UAE, 2-6 February 1992. Ed. Allen, W R; Higgins, A J; Mayhew, I G; Snow, D H and Wade, J F., R&W Publication Ltd., Pp. 69-78.

Radostits, O. M., Gay, C. C., Blood, D. C. and Hinchcliff, K. W., (2000): Veterinary Medicine. 9th Ed. (Baillier Tindall, London, Philadelphia, New York).

Rahman, Z. Ur; Yuosaf, A. and Sandhu, M. A. (2002): Haematological response to ectoparasite infestation in camel. The 27th World Vet. Cong. 25-29 Sept. Tunis. Abstract. pp. 70.

Rechav, Y; Clarc, F. C; Els, D. A. and Dauth, J. (1991): Development of resistance in laboratory animals to adults of the tick Rhipicephalus Evertsi evertsi. Medical and veterinary Entomology. 5: 29-34.

Robson, J; Robb, J. M. and Al-Wahayyib, T. (1968): Ticks (Ixodoidae) of domestic animals in Iraq. Part 2. Summer infestation in Liwas of Hilla, Korbala, Diwaniya and Nasiriya. J. Med. Ent. 5: 27-31.

Sahibi, H; Rhalem, A; Tikki, N; Ben Kouka, F. and Barriga, O. (1997): Hyalomma ticks: bovine resistance under field conditions as related to host age and breed. Parasite. 4: 159-165.

Skerratt, L.F. (2003): Cellular response in the dermis of common wombats (Vombatus ursinus) infected with Sarcoptes scabiei var. wombati. J Wildl Dis. 39:193-202.

Soulsby, E. J. L. (1982): Helminth, arthropods and protozoa of domesticated animals. 7ed. The English language Book Society. Balliere, Tindall and Cassel. London.

Suchitra Sena, D; Kumar, R. and Sahani, M. S. (1999a): Incidence of sarcoptic mange in camels. Indian Vet. J. 76: 556-557.

Suchitra Sena, D; Mal, G; Kumar, R; Singhvi, N. M; Chirania, B. L. and Sahani, M. S. (1999b): Clinico-haematological and therapeutic studies on mange in camels. Indian Vet. J. 76: 998-1000.

Szabo, M.P; Aoki, V. L; Sanches, F. P; Aquino, L. P; Garcia, M. V; Machado, R. Z. and Bechara, G. H. (2003): Antibody and blood leukocyte response in Rhipicephalus sanguineus (Latreille, 1806) tick-infested dogs and guinea pigs. Vet. Parasitol. 115: 49-59.

Thomas, J. S. (2000a): Overview of Plasma Proteins. In Schalm's Veterinary Hematology. 5th Ed. Feldman, B. F., Zinkl, J. G. and Jain, N. C. Lippincott Williams & Wilkins, Philadelphia, Baltimore. pp. 891-898.

Thomas, J. S. (2000b): Protein Electrophoresis. In Schalm's Veterinary Hematology. 5th Ed. Feldman, B. F., Zinkl, J. G. and Jain, N. C. Lippincott Williams & Wilkins, Philadelphia, Baltimore. pp. 899-903.

Uhlir, J. (1991): Blood phagocytic cell response of rabbits infested with Psoroptes cuniculi., The Hague, 2: 409-414.

Urquhart, G. M., Armour, J., Duncan, J. L., Dunn, A. M. and Jennings, F. W. (1996): Veterinary parasitology, 2nd ed., Blackwell Science.

Wernery, U; Fowler, M. E. and Wernery, R. (1999): Color atlas of camelid hematology. Blackwell Wissenschafts Verlag, Berlin.

Zahran, W. M. (1997): Sarcoptic mange haematological alterations, skin lesions and hypersensitivity in naturally infested rabbits. J. Union Arab Biology, Cairo., 7(A) Zoology: 379-410.

Zayed, A. A. (1998): Localization and migration route of Cephalopina titillator (Diptera: Oestridae) larvae in the head of infested camels (Camelus dromedarius). Vet Parasitol. 15: 65-70.

Zeleke, M. and Bekele, T. (2001): Effect of season on the productivity of camels (Camelus dromedarius) and the prevalence of their major parasites in eastern Ethiopia. Trop. Anim. Hlth. Prod. 33: 321-329.