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Temperature Difference and Parasite Infection at Qassim Region, Saudi Arabia

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Abstract: Aiming to design a strategic parasite control program at Qassim region, types, distribution and seasonality of different animal parasite in the region were investigated. During the study, 2670 camel, 2713 sheep and 2689 goats were examined in five provinces represent Qassim region. The incidence of infection by different parasites was 53.5±2.2, 62.6±3.4 and 34.7±2.17 in the three animal species, respectively. Five enteric parasites, *Trypanosoma evansi*, *Theileria ovis*, hard ticks and mange were recorded. The highest incidence is that of gastrointestinal nematode (GIN) as 25.8±2.24, 35.9±3.16 and 18.5±1.89% in camel, sheep and goats, respectively. They are abundant during March to May at temperature (temp.) of 14.5-37°C, (Mean 26.53±2.4°C) and relative humidity % (Rh.%) of 51.5-32.5%, (Mean 41.3±2.66%). *Eimeria* species infection was high in sheep (22.8±2.49) followed by camels (20.3±1.51) then goats (12.7±1.29%). High incidence was recorded during April to June at temp. of 18.5-40°C, (Mean 35.33±2.85°C) and Rh.% of 42-19, (Mean 26.6±2.33%). Infection by hard ticks was high in camels (20.7±2.35) followed by sheep (15.7±1.9) then goats (12.9±2.19). The parasite are common during June to August, at temperature ranged from 28-46.5°C, (Mean 37.66±3.11°C) and Rh. of 19-11%, Mean of 13.3±1.5%). *Sarcoptic* mange was higher in sheep (15.7±1.62%), followed by camels (12.9±1.14%) then goats (8.8±1.07%). The parasite was abundant during May to July, (temp. of 20.5-44.5°C, Mean 36.33±2.88°C) and Rh.% of 32.5 to 10% (mean 19.5±2.33%). Low rate of infection by *Strongyloies* and *Trichuris* species was recorded also. Moreover, camels are infected by *Trypanosoma evansi* (7.7±1.18%) among the year. Significant difference ($p<0.05$) was recorded between the level of infection in different study sites, different parasites and between different season. For conclusion, temperature and relative humidity work as key factor affect on type of the parasitic distribution at Qassim region. Infective stages of parasite in this region have ability to tolerate the freezing temperature during winter season and that very high during summer. These facts facilitate determination of the critical period for each parasite life cycle and selection to the most effective time for strategic control program application.

Key words: Parasites, temperature, sheep, goats, camels

INTRODUCTION

Qassim Governorate is an agriculture region at North-east of Kingdom of Saudi Arabia (KSA), the area has special atmospheric condition as it exposed to rain fall 3-5 time per year. The temperature can be decreased till freezing degree for 2-3 days in winter as it can be raised up to over 50°C

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during July and August. This wide range of temperature during the years suppose to be act as inhibitor factor for successful parasite life cycle, but really parasitic disease in the region considered as one of the most important animal production problems.

At Qassim region, Magzoub *et al.* (1997) recorded infection by *Trichostrongylus* (30-82%), *Nematodirus* (21-50%), *Strongyloides* (0-23%), *Blantidium* and *Eimeria* (0-9%) in camels. High to moderate eggs per gram was recorded in 9.1% of positive animals.

On cultivation of the infected fecal samples six nematode species larvae were identified include *Haemonchus* sp. (78%), *Camelostrongylus* (40%), *Trichostrongylus* (21%), *Strongyloide*, *Oeophagostomum* species (20%) and *Cooperia* sp. up to (10%). *Haemonchus* species larva are abundant in the pasture herbage during April and May. Moreover two *Cestoda* species (*Moniezia* and *Stilesia* sp.) were recorded infecting camels also. The same research determined that camel acquire helminths infections during the rainy season of the year. Camels are commonly infected by *Haemoncus longistipes*, *Trichuris* sp., *Camelostrongylus mentulatus*, *Trichostrongylus* sp. and *Parabronema skrjabini*, While *Nematodirus* sp., *Strongyloides* sp., *H. contortus* and *Ostertagia ostertagi* were occasionally found (Chhabar and Gupta, 2006).

El-Azazy (1995) recorded infection by different nematode species in 47.9% of slaughtered sheep and 43.8% of goats at Jeddah abattoir. Eight nematode species being found. *Haemonchus contortus* and *Marshallagia marshalli* appeared to be the most important parasites. Other species were less prevalent: *Trichostrongylus axei*, *Camelostrongylus mentulatus*, *Parabronema skrjabini*, *Ostertagia circumcincta*, *Skrjabinagia lyrata*, *Ostertagia trifurcata*. He cleared that lowest infection rate was in the winter. *Trichostrongylus*, followed by *Haemonchus*, then *Ostertagia* are the most common nematode species infecting goats (Rahman and Collins, 1990).

Hussain *et al.* (1991) investigated blood parasites of native camels, sheep and goats in several localities in Saudi Arabia. They diagnose *Trypanosoma evansi* and an *Eperythrozoon* sp. in camels. Sheep and goats were infected with *Theileria ovis*, *T. hirci* and with *Eperythrozoon ovis*.

Concerning infection by external parasites, Chhabra and Khurana (2007) mentioned that *Sarcoptic* mange (*Sarcoptes scabiei* var. *cameli*) and Hard tick infection (*Hyalomma dromedarii*) are the most commonly prevalent in Saudi Arabia. The recorded hard ticks is a desert-adapted 2 (occasionally 3)-host ticks.

No enough published data concerning the incidence of different animal parasite at Qassim regions. The last study done is that of Magzoub *et al.* (2000) as they investigate nematode infection in camels only. For this reason, the present study was done as part of funded research study aimed at design a strategic parasite control model to be applied at Qassim region.

In this study incidence, types and seasonality of different parasites infecting camel, sheep and goats were investigated. This in order to determine the most critical time for each parasite life cycle. Application of an effective control plan at this time will led to maximum eradication for those parasite (strategic control) during the next year of the project.

MATERIALS AND METHODS

Study Sites

The study was undertaken during the period from December 2007 to November 2008, at Al-Qassim Region, KSA. The region has a total area of 87000 km^2 and a human population of 933,146 (estimated in 1999). The animal population estimated at 1997 as: sheep, 876, 065; goats, 207, 837 and camels, 69, 147. Five localities represent the region were selected. They include, Buraydah (the capital), Al-Mezneb and Al-Asiah which are more popular more cultivated lands and contain several

veterinary clinic. Al-Rass and Oklet Al-Sakor considered more desert less popular contain sporadic animal farms.

Collection of Samples

Via two monthly visit for each study sites, a random samples represent the number of the available animals were collected. A total number of 2670 camel, 2713 sheep and 2689 goat fecal and blood samples were collected. The samples were identified by owner's name, locality, animal species, age, sex, approximate body weight and owner complain if present.

Examination of Fecal Samples

The collected fecal samples were examined for infection by large size worm eggs using Fluke finder technique according to Welch *et al*. (1987). Concentration flotation technique using concentrated salt solution was adopted for diagnosis of different eggs, cysts and oocysts, according to Cebra (2008). Moreover counting of the eggs and oocysts was don using McMaster slide according to Soulsby (1986). Cultivation of fecal samples for separation of *Nematoda* larvae and collection of larvae using Modified Baermann technique was done. Measurement for different eggs and larvae was done using Micrometer slide and micrometer eye piece. The isolated eggs, oocysts and larvae were identified according to Solusby (1986), Levine *et al*. (1980) and Burger and Stoye (1968).

Diagnosis of Blood Parasites

Thin fixed, Geimsa stained blood films were prepared from each animal. Moreover, wet blood smear technique was used for fast diagnosis of Trypanosomiasis according to Solusby (1986).

Atmospheric Data

The daily and average temperature degrees and relative humidity percentage of the study sites were obtained from Qassim Meteorological Station. LAT: 26 18 28N LONG: 43 46 03E Elevation: 646.71 m, Meteorology and Environmental Protection Administration, Kingdom of Saudi Arabia.

Statistical Analysis

All values were presented as the Mean±SE. Significant differences were determined using ANOVA test via STATVIEW/SAS 1999 program. Significance of the value was estimated using Tur Key/Kromer (M = 0) at $p<0.001$-0.05.

RESULTS

Incidence of Infection by Different Parasites

Examination of 2670 camel, 2713 sheep and 2689 goats in five localities representing Qassim region was demonstrated in Table 1-3. The data revealed infection by different parasites reached to 53.5±2.2, 62.6±3.4 and 34.7±2.17 in the above 3 animal species, respectively. Five enteric parasites, hard ticks and mange were recorded by different percentage. The highest incidence is that of gastrointestinal nematode as 25.8±2.24, 35.9±3.16 and 18.5±1.89% in camel, sheep and goats, respectively. Infection by *Eimeria* species oocysts was high in sheep (22.8±2.49) followed by camels (20.3±1.51) while the lowest rate (12.7±1.29%) was recorded in goats. High infection by hard ticks was recorded in camels (20.7±2.35) followed by sheep (15.7±1.9) and goats (12.9±2.19). Infection by mange was higher also in sheep, followed by camels then goats as the percentage was 15.7±1.62,

12.9±1.14 and 8.8±1.07%, respectively. Low rate of infection by *Strongyloies* and *Trichuris* species was recorded also. Morover, camels are infected by *Trypanosoma evansi* (97.7±1.18%) (Table 1). The lowest incidence was in Al-Asiah locality with significant difference ($p<0.05$) with the other study sites. Infection by *Theileria* and *Fasciola* species was recorded only in sheep as 1.14±0.28 and 4.6±1.52, respectively (Table 2).

Cultivation the infected fecal samples revealed eight types of GIN larvae in camels and seven types in cultivated sheep feaces. These larvae are *Haemonchus* sp. (32.8±0.59 and 30.3±0.63), *Nematodirus* sp. (20.2±0.28 and 20.2±0.39), *Trichostrongylus* sp., (9.9±0.49 and 9.6±0.43), *Oestertagia* sp. (6.3±0.44 and 21.8±0.36), *Marchelagia* sp. (4.6±0.36 and 4.1±0.23) *Cooperia* sp.

Table 1: Significant differences between incidence of infection by different parasites in camels at Qassim reigon

Study sites	No. of examines	Infection (%)	GIN	*Trichuris* sp.	*Strongyloides* sp.
Briyda	772	57.9±2.12^{a}	2.38±31.3^{a}	0.32±3.3	0.29±3.4
Al-Mezneb	557	52.2±1.98^{ab}	2.72±24.3^{b}	0.00±0.0	0.00±0.0
Al-Asiah	508	55.0±2.83^{a}	2.23±23.6^{b}	0.61±3.4	0.00±0.0
Al-Rass	555	54.0±3.44^{a}	2.88±26.5^{b}	0.66±1.9	0.51±1.6
Oklet Al-Sakoor	278	48.5±1.66^{b}	1.93±23.5^{b}	1.78±3.4	0.00±0.0
Total	2670	53.5±2.20	2.42±25.8	0.67±2.4	0.16±1.0
Study sites	*Coccidia* sp.	*Trypanosoma evansi*		Hard ticks	Mange
Briyda	1.54±23.9^{a}	1.16±8.6$_{a}$		2.06±19.3^{ab}	1.52±17.1^{a}
Al-Mezneb	1.28±21.7^{ab}	1.48±8.1$_{a}$		1.77±18.7^{b}	0.64±10.1^{c}
Al-Asiah	1.45±18.6^{b}	1.59±6.3$_{b}$		2.35±21.2^{a}	1.17±12.4^{b}
Al-Rass	1.97±23.6^{a}	1.00±8.5$_{a}$		2.85±20.6^{a}	0.99±13.0^{b}
Oklet Al-Sakoor	1.30±13.6^{b}	0.66±6.9$_{ab}$		2.70±23.5^{a}	1.38±12.3^{bc}
Total	1.51±20.3	1.18±7.7		2.35±20.7	1.14±12.9

GIN = Gastro-Interites Nematodes. Mean values of different letter(s) per column (a-d) are significant different at ($p<0.05$)

Table 2: Significant differences between incidence of infection by different parasites in sheep at Qassim reigon

Study sites	No. of examinies	Infection (%)	GIN	*Fasciola* sp.	*Trichuris* sp.
Briyda	823	67.6±3.98^{a}	3.15±41.2^{a}	2.64±8.3	0.200±2.14
Al-Mezneb	544	62.9±4.4a^{b}	2.66±40.3^{a}	2.15±6.8	1.210±3.60
Al-Asiah	531	68.6±2.77^{a}	3.06±36.5^{b}	1.09±2.1	0.053±0.97
Al-Rass	539	68.1±3.66^{a}	4.78±39.9^{a}	1.74±5.6	0.890±2.80
Oklet Al-Sakoor	276	45.7±3.13^{b}	2.15±21.4^{c}	0.00	0.550±1.02
Total	2713	62.6±3.40	3.16±35.9	1.52±4.6	0.670±1.70
Study sites	*Strongyloides* sp.	*Coccidia* sp. *oocysts*	*Theileria* sp.	Hard ticks	Mange infection
Briyda	1.13±3.9	3.59±21.9^{b}	0.33±1.70	0.94±18.8^{ab}	2.12±14.9^{b}
Al-Mezneb	0.74±2.3	2.68±18.6^{c}	0.84±2.50	2.27±17.3^{b}	1.62±13.0^{b}
Al-Asiah	0.00	2.30±28.9^{a}	0.00	2.34±17.3^{b}	1.20±13.4^{b}
Al-Rass	0.60±2.9	2.25±22.6^{b}	0.54±1.50	2.43±22.7^{a}	0.90±14.4^{b}
Oklet Al-Sakoor	0.00	1.65±22.2^{b}	0.00	1.99±19.4^{ab}	2.25±22.9^{a}
Total	0.49±1.8	2.49±22.8	0.28±1.14	1.90±15.7	1.62±15.7

GIN = Gastro-Interites Nematodes, Mean values of different letter(s) per column (a-d) are significant different at ($p<0.05$)

Table 3: Significant differences between incidence of infection by different parasites in goats at Qassim region

Study sites	No. of examines	Infection (%)	GIN	*Trichuris* sp.
Briyda	772	37.3±2.43^{b}	2.32±21.8^{a}	0.74±2.20
Al-Mezneb	556	26.4±1.72^{c}	1.49±17.0^{b}	0.68±2.08
Al-Asiah	497	38.4±2.33^{b}	1.75±18.40^{b}	0.00
Al-Rass	571	29.1±2.93^{c}	2.37±17.9^{b}	0.63±2.10
Oklet Al Sakoor	293	42.5±1.96^{a}	1.50±18.1^{b}	0.00
Total	2689	34.7±2.17	1.89±18.5	0.68±1.30
Study sites	*Strongyloides* sp.	*Coccidia* sp. *oocysts*	Hard ticks	Mange
Briyda	0.58±2.3	1.33±9.4^{c}	2.01±8.7^{c}	1.07±7.8^{b}
Al-Mezneb	0.39±1.2	1.24±9.1^{c}	1.34±5.9^{d}	0.47±5.4^{c}
Al-Asiah	0.00	1.42±16.1^{b}	2.36±16.2^{b}	0.88±8.1^{b}
Al-Rass	0.53±1.0	0.96±9.1^{c}	2.78±11.9^{c}	0.36±4.0^{d}
Oklet Al Sakoor	0.00	1.53±19.7^{a}	2.49±22.2^{a}	1.34±18.7^{a}
Total	0.30±0.9	1.29±12.7	2.19±12.9	0.82±8.8

GIN = Gastro-Interites Nematodes. Mean values of different letter(s) per column (a-d) are significant different at ($p<0.05$)

(3.5±0.28 and 4.0±0.24) in camel and sheep, respectively. *Oesophagostomum* sp. (8.9±0.33) and *Camelostrongylus* sp., (13.4±0.47) were recorded in camel while *Chabertia* sp. larvae (4.1±0.23) were recorded in sheep only (Table 4).

Two types of *Eimeria* species oocysts (*E. dromedari* and *E. rajasthani*) were identified in the infected camels, six species (*E. intricata*, *E. pallidae*, *E. faurei*, *E. parva*, *E. ahsata* and *E. ovina*) infect sheep and five species (*E. arlongi*, *E. caprina*, *E. ninakohlyakimova*, *E. alijevi* and *E. caprovina*) infect goats.

Significant difference at ($p<0.05$) was recorded between the different study sites. High rate was recorded in Bryhda region and the lowest rate was recorded at Oklet Al-Sakkor rigon. Also the highest rate of infection was recorded in sheep and the lower one was in goats.

Seasonality of Infection by Different Parasites

The data in Table 4-6 revealed the relation between in seasonal temperature variations, relative humidity and abundance of different parasites infect animals at Qassim region. A high significant difference ($p<0.001$) was recorded for the incidence of infection by GIN in spring and each of summer and autumn. Maximum rate of infection was during March to May at temperature of 14.5-37°C, (Mean 26.53±2.4°C) and relative humidity % (Rh.%) of 51.5-32.5%, (Mean 41.3±2.66%). *Coccidia* infection was abundant during April to June at temp. of 18.5-40°C, (Mean 35.33±2.85°C) and Rh.% of 42-19, (Mean 26.6±2.33%), with significant difference ($p<0.001$) between spring and the other seasons. In time no significant difference ($p<0.05$) for the incidence between the other seasons. *Fasciola* infection was diagnosed along the year except winter season. The parasite are abundant at May to July (20.5-44.5°C Mean, 36.33±2.88°C). *Theileri ovis* was recorded in sheep during spring and their incidence increased during summer season, at temperature ranged from 28-46.5°C, (Mean 37.66±3.11°C) and Rh.% of 19-11, Mean of 13.3±1.5%). This was associated by increase in the number of hard ticks during summer also. Significant difference was recorded between incidence of infection in summer ($p<0.001$) in comparison with the other seasons. The data (Table 1, 4)

Table 4: Types of GIN larvae diagnosed in cultivated fecal samples

	Percentage of different GIN larvae in cultivated infected feacel samples			
	Camel		Sheep	
Type of larvae	Minimum-Maximum	Mean	Minimum-Maximum	Mean
Trichostrongylus sp.	5.0±0.41-10.0±0.41	9.9±0.49	5.7±0.85-14.0±0.41	9.6±0.43
Oestertagia sp.	2.2±0.48-10.5±0.64	6.3±0.44	18.2±0.85-25.2±0.85	21.8±0.36
Haemonchus sp.	25.0±0.41-38.7±0.64	32.8±1.59	24.7±0.48-37.0±0.41	30.3±0.63
Cooperia sp.	1.7±0.48-2.6±0.48	3.5±0.28	2.0±0.41-6.0±0.41	4.0±0.24
Nematodirus sp.	18.0±0.91-23.0±1.08	20.2±1.28	17.0±0.41-23.0±1.08	20.2±0.39
Camelostrongylus sp.	11.5±0.64-18.0±0.91	13.4±0.47		
Marchelagia sp.	1.7±0.48-8.0±1.08	4.6±0.36	2.0±0.41-6.0±0.71	4.1±0.23
Oesophagostomum sp.	7.0±0.41-12.0±0.91	8.9±0.33		
Chabertia ovina			7.2±0.48-13.0±1.08	9.9±0.26

Table 5: Seasonal incidence of infection by different parasites in camels at Qassim area

Season	Infection (%)	Mean temp. (°C)	Relative humidity (%)	PGI	*Trichuris* sp.
Winter	49.1±4.1^{c}	13.10±1.10	49.60±4.5	30.4±1.6^{b}	
Spring	59.3±2.9^{a}	26.53±2.40	30.60±2.2	35.7±1.2^{a}	6.5±0.58
Summer	55.9±2.9^{b}	36.30±3.02	9.66±0.9	18.8±1.7^{c}	3.5±0.15
Autumn	51.4±3.7^{c}	27.50±2.80	26.00±1.8	18.0±1.06^{c}	
Season	*Strongyloides* sp.	*Coccidia* sp.	*Trypanosoma evansi*	Hard ticks	Mange
Winter		18.6±1.18^{b}	3.60±0.6^{c}	12.8±1.30^{c}	11.50±1.30^{c}
Spring	3.1±0.22	26.6±2.30^{a}	7.60±0.7^{b}	15.4±2.00^{c}	14.20±1.69^{b}
Summer		18.5±1.90^{b}	11.80±0.9^{a}	29.2±1.30^{a}	16.80±1.40^{a}
Autumn	4.2±0.16	17.3±1.70^{b}	5.74±0.7^{ab}	22.7±3.08^{b}	9.32±1.04^{c}

Mean values of different letter(s) per column (a-d) are significant different at ($p<0.05$)

Table 6: Seasonal incidence of infection by different parasites in sheep at Qassim area

Season	Infection (%)	Mean temp. (°C)	Relative humidity (%)	PGI	*Trichuris* sp.
Winter	61.0±3.5^{c}	13.10±1.10	49.60±4.5	44.06±2.1^{a}	
Spring	73.2±2.2^{a}	26.53±2.40	30.60±2.2	46.80±1.4^{a}	5.80±0.70
Summer	67.1±3.8^{b}	36.30±3.02	9.66±0.9	27.60±2.8^{b}	0.52±5.48
Autumn	49.2±5.3^{d}	27.50±2.80	26.00±1.8	25.10±1.3^{b}	
Season	*Coccidia* sp.	*Theileria* sp.	*Fsciola* sp.	Hard ticks	Mange
Winter	24.3±2.1^{b}			13.07±1.5^{b}	11.6±1.8^{c}
Spring	32.7±2.9^{a}	1.2±0.3	6.40±0.8	2.09±14.9^{b}	2.4±18.2^{b}
Summer	17.8±2.9^{c}	3.1±0.8	7.20±1.2	26.70±1.3^{a}	20.5±2.4^{a}
Autumn	16.6±2.1^{c}		4.58±0.3	21.10±5.2^{ab}	12.3±1.7^{c}

Mean values of different letter(s) per column (a-d) are significant different at ($p<0.05$)

Table 7: Seasonal incidence of infection by different parasites in goats at Qassim area

Season	Infection (%)	Relative humidity (%)	Mean temp. (°C)	PGI	*Trichuris* sp.
Winter	30.2±2.8^{b}	49.60±4.5	13.10±1.10	21.7±1.3^{b}	
Spring	42.5±2.8^{a}	30.60±2.2	26.53±2.40	26.5±1.5^{a}	2.7±0.3
Summer	35.5±3.1^{ab}	9.66±0.9	36.30±3.02	13.4±2.1^{c}	2.9±0.2
Autumn	28.5±2.8^{c}	26.00±1.8	27.50±2.80	13.6±1.5^{c}	
Season	*Strongyloides* sp.	*Coccidia* sp.	Hard ticks		Mange
Winter		11.3±2.09^{b}	4.30±0.3^{d}		7.30±1.01^{c}
Spring	1.7±0.36	17.4±2.30^{a}	9.90±1.7^{c}		9.90±1.30^{a}
Summer	1.4±0.30	11.9±1.90^{b}	20.70±1.3^{a}		10.03±1.30^{a}
Autumn		10.1±1.60^{b}	17.04±2.6^{b}		8.00±0.96^{b}

Mean values of different letter(s) per column (a-d) are significant different at ($p<0.05$)

demonstrate infection of camels by *Trypanosoma evansi* (7.7±1.18). Significant difference was recorded ($p<0.05$) between incidence in summer (11.8±0.9) in comparison with other seasons. Mange infection was appearing during March and propagates during May to July, (temp. of 20.5-44.5°C, Mean 36.33±2.88°C) and Rh% of 32.5 to 10% (Mean 19.5±2.33%). A significant difference ($p<0.05$) was recorded between rate of infection among different season. There is no significant difference for seasonality of each parasite between the different study sites.

DISCUSSION

Strategic parasite control is an application of massive treatment for special parasite or groups of parasites at critical time for the parasite life cycle among the year. Time of this treatment was selected to induce maximum relief to the animal from different parasitic stress and decrease the number of shed eggs specially at transmission season of each parasite. Without application to control measures around the animals, two successive year strategic treatment application, will led to decrease in the number of infective stages around the animal (Malone *et al.*, 1990).

For design a model like this, complete idea about the parasitic infection in different animals in the target area must be available. Moreover, seasonality and time of infection (transmission season) must be identified.

The present study is the first part to design a strategic parasite control model that will be design for application at Qassim region. In this study incidence, types and seasonality of different parasites infect camel sheep and goats were estimated. The data demonstrate high incidence of parasitic infection in sheep than camel and goats. This fact was in agreement with Abdel-Rahman (1996) as sheep grazing at low level than camel so, they have more chance to catch the infective stages. Low infection in goats was related to the system of breeding in the examined region as they breed goats usually in closed farms. Five enteric parasites include GIN, *Trichuris*, *Strongyloides*, *Fasciola* and *Coccidia* infection was recorded in the present study. Moreover hard ticks and mange were recorded by different percentage. There is a significant difference ($p<0.05$) between incidence of different parasites per each animal species as well as between the different study sites. These data was in agreement with Banaja

and Ghandour (1992) and with Magzoub *et al*. (1997) at the same regions of the present study. Most of the infected animals (78.5±4.33) harbor low (200 eggs/gram feaces[epg]) to moderate (1000 to less than 2000 epg). Small percentage (26.5±2.66) are infected by high eggs/gram feaces (over 2000 epg). This rate considered to be higher than that previously mentioned by Magzoub *et al*. (1997) as they recorded high to moderate epg in 9.1% of the examined animals at Qassim region.

The obtained nematode larvae post cultivation to the infected fecal samples are similar to that previously mentioned by Banaja and Ghandour (1992), El Azazy (1995) and Chhabar and Gupta (2006). In the contrary with Magzoub *et al*. (1997), no record for Cestoda infection was recorded in the examined animals. Infection by GIN considered the highst rat of all parasites, this was agreed with El Azazy (1995) and Magzoub *et al*. (2000).

Two types of *Eimeria* species oocysts (*E. dromedari* and *E. rajasthani*) were identified in the infected camels. These data were in agreement with Kasim *et al*. (1985) as they recorded infection of camels by 3 species of *Eimeria* include, *E. dromedary* (28.4%), *E. rajasthani* (22.2%) and *E. cameli* (19.2%). Six species of *Eimeria* (*E. intricata*, *E. pallidae*, *E. faurei*, *E. parva*, *E. ahsata* and *E. ovina*) infect sheep and five species (*E. arlongi*, *E. caprina*, *E. ninakohlyakimova*, *E. alijevi* and *E. caprovina*) infect goats. Part from these species were previously mentioned by Al-Yousif *et al*. (1992), as they demonstrate infection of sheep by 10 types of *Eimeria* species in the middle region of King Saudi Arabia.

Trypanosoma evansi infection was recorded in different examined sites. The incidence was increased in summer with significant difference ($p<0.05$) in comparison with other seasons diagnosis of *T. evnsi* from the different study sites was agreed with that mentioned by Hussein *et al*. (1991).

Concerning the relation between atmospheric temperature and parasitic infection. The study cleared increase in the rate of infection by *GIN*, *Trichuris* and *Strongylus* during spring season (March-May).

According to Solusby (1986) the incubation periods of these nematodes species ware 28-35 days. This meaning that the attach of new infection was occurs 4-6 weeks before the increase in the mean eggs/gram of the infected animals. According to this schedule, the exact time of infection could be estimated as during February. This was agreed with Magzoub *et al*. (2000) as they, cleared that gastrointestinal nematodes are the most common parasitic infection in camels at Qassim region. The incidence increased during the rainy season of the year. Decrease the recorded GIN infection during summer season was agreed also with the same researchers. They mentioned that lowest nematodes egg count and lowest prevalence rate in camel feaces were recorded during dry months of the year.

From the same view, *Coccidia* sp. are abundant during April to June and their incubation period is about 1-2 week, so new infection could be occurs in the same period as end of March till end of June. The earlier group of parasites considered to be soil related as their infective stags were developed mainly in the soil. So, they propagate during the worm wet period of the year (end of February till summer). This was agreed with Magzoub *et al*. (2000). Increase the rate of infection and increase in the mean eggs/gram led to increase in the number of survived infective larvae in the pasture. This was agreed with Rahman and Collins (1990) as they mentioned that the profile of the graph of larval availability in herbage paralleled those for temperature and rainfall, suggesting that larval peaks was associated with special temperature and moisture. These cycle keep continuous exposure of the animal to the parasitic infective stage. This occurs when the infective stage still able to survive the temperature and relative humidity. Ability of some types of nematode larvae to survive as arrested larva (El-Azazy, 1995), let the parasite able to protect their persistence in the animal during the dry period of the year. *Fasciola* sp. is a chronic infection and the infection was diagnosed in imported sheep only. Moreover no data about availability of *Lymnea truncatula* (*F. hepatica* intermediate hosts) in the water sources of the region.

Concerning infection by external parasites, hard ticks infection was predominate during summer (June to August) while mite infection could be diagnosed among the year specially during May. *Hyalomma* species hard ticks were recorded in each of camels and sheep. *Rhipicephalus* sp. and *Boophilus* sp. were recorded infecting sheep and goats. The recorded incidences were differ than that previously mentioned, but the species were agreed with that stated by Yeruham *et al*. (1996).

Sarcoptic mange infection in camels caused by *Sarcoptes scabiei var. cameli* is often regarded as the second most important disease of dromedary camels, after trypanosomosis. It is a highly contagious chronic debilitating condition with high degree of morbidity. Infected camels may stop grazing and milk production may show a rapid fall. In the present study *Sarcoptic* mange infection was recorded in the examined animals during spring and summer. The infection was abundant during May to July, this was agreed with Chhabra and Khurana (2007).

Camel breeders in Qassim region follow special way as camels grazing on very wide area. They walk behind the green plants. The available green plants were decreased from Spring to Autumn. The owners usually don't apply any control measures. For this reason camels and other animals are able to spread and receive different parasitic infection along the year. These facts were agreed with Parmar *et al*. (2005) as they mentioned that parasitic diseases are associated with poor management and malnutrition. The problem was more common in older camels.

The study concluded presence of clear seasonality for different parasites infecting camel, sheep and goats at Qassim region. Enteric parasites (GIN, *Trichuris*, *Strongyloides* and *Coccidia*) are associated with warm-rainy period of the year (end of February to May), hard tick infection was abundant during summer season (July-August). *Sarcoptic* mange infection was recorded from spring till end of summer season. These data were facilitating selection of the critical time for each parasite life cycle. Massive treatments at this time considered more effective for parasitic eradication in their final host. Also it will minimize the level of the parasite infective stages in the nature around the animal.

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REFERENCES

Abdel-Rahman, M.S., M.M. El-Bahy, N.M. El-Bahy and E.I. Ramadan, 1996. Testing a new formulation of Ivermectin (Ivomec pour-on and bolus) as broad spectrum parasiticide. Vet. Med. J. (Egypt), 44: 637-656.

Al-Yousif, M.S., A.A. Kasim and Y.R. Al-Shawa, 1992. *Coccidia* of the domestic goat (*Capra hircus*) in Saudi Arabia. Int. J. Parasitol., 22: 807-811.

Banaja, A.A. and A.M. Ghandour, 1992. Parasites of camels in Saudi Arabia: A review. 1st International Camel Symposium, Feb. 2-6, Dubai, pp: 15-18.

Burger, H.J. and M. Stoye, 1968. Parasitologische Diagnostik (Teil 11): Eizahlung und larven differenzierung. Therapogen Praxisdienst, 3: 1-22.

Cebra, C.K., 2008. Comparison of methods to detect gastrointestinal parasites in llamas and alpacas. J. Am. Vet. Med. Assoc., 232: 733-741.

Chhabra, M.B. and S.K. Gupta, 2006. Parasitic diseases of camels-an update. 2-Helminthosis. J. Camel Prac. Res., 13: 81-87.

Chhabra, M.B. and K.L. Khurana, 2007. Parasitisms of camels revisited: 3-Ectoparasites. J. Camel Prac. Res., 14: 1-8.

El-Azazy, O.M., 1995. Seasonal changes and inhibited development of the abomasal nematodes of sheep and goats in Saudi Arabia. Vet. Parasitol., 58: 91-98.

Hussein, H.S., N.A. Al-Asgah, M.S. Al-Khalifa and F.M. Diab, 1991. The blood parasites of indigenous livestock in Saudi Arabia. Arab. Gulf. J. Sci. Res., 9: 143-160.

Kasim, A.A., S.H. Hussein and Y.R. Al-Shawa, 1985. *Coccidia* in camels (*Camelus dromedarius*) in Saudi Arabia. J. Protozool., 32: 202-203.

Levine, N.D., J.O. Corliss, F.E.G. Cox, G. Deroux, J. Grain and B.M. Honigberg *et al*., 1980. A newly revised classification of the protozoa. J. Protozool., 27: 37-58.

Magzoub, M., O.H. Omer, E.M. Haroun, O.M. Mahmoud and Y.M. Abdel Hamid, 1997. Gastrointestinal parasites of dromedary camels in Qassim region, Saudi Arabia. Indian Vet. J., 74: 373-376.

Magzoub, M., O.H. Omer, E.M. Haroun and O.M. Mahmoud, 2000. Effect of season on gastrointestinal nematode infection in Saudi Arabian camels (*Camelus dromedaries*). J. Camel Prac. Res., 7: 107-108.

Malone, J.B., J.C. Williams, N. Fagan, E. Jones and E. Willis, 1990. Efficacy of concomitant early summer treatment with fenbendazole and closulon against *Fasciola hepatica* and gastrointestinal nematodes in calves in Louisiana. Am. J. Vet. Res., 51: 133-136.

Parmar, A.J., V. Singh and Y.S. Sengar, 2005. Epidemiological studies on sarcoptic mange in camel (*Camelus dromedaries*) in Banaskantha district (N. Gujarat). J. Parasit. Dis., 29: 67-70.

Rahman, W.A. and G.H. Collins, 1990. Seasonal variations in the populations of infective larvae on pasture and the numbers of nematode eggs in the faeces of farmed goats. J. Helminthol., 64: 263-270.

Soulsby, E.J., 1986. Helminths, Arthropods and Protozoa of Domesticated Animals. 6th Edn., Williams and Wilkins Co., Baltimore, Tindall and Cassell Ltd., London, ISBN: 0702002372.

Welch, R.D., P.H. Smith, J.B. Malone, R.A. Holmes and J.P. Geaghan, 1987. Herd evaluation of *Fasciola hepatica* infection in Louisiana cattle by an ELISA. Am. J. Vet. Res., 48: 345-347.

Yeruham, I., A. Hadani, F. Galker and S. Rosen, 1996. The seasonal occurrence of ticks (Acari: Ixodidae) on sheep and in the field in the Judean area. Exp. Applied Acarol., 20: 47-56.