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A Review of Parasites of Camels (*Camelus dromedarius*) in Saudi Arabia

A.A. BANAJA and A.M. GHANDOUR
Department of Biological Sciences, Faculty of Science, King Abdulaziz University, Jeddah, Saudi Arabia

ABSTRACT. The most common gastrointestinal helminths in camels in Saudi Arabia are *Haemonchus longistipes*, *Trichuris* spp., *Parabonema skrjabini*, *Camelostrongylus mentulatus*, *Trichostrongylus* spp., *Nematodirus* spp., *Fasciola gigantica* and *H. contortus*. *Onchocerca fasciata* is the most common extra-intestinal helminth in indigenous camels. Hydatidosis (due to infection with the metacestode of *Echinococcus granulosus*) was recorded at lower rates compared to animals from neighbouring countries. Various protozoal parasites such as *Trypanosoma evansi*, *Eimeria dromedarii*, *E. cameli*, *E. rajasthani*, *Sarcocystis cameli* and *Thileria* spp., have been recorded. Naso-pharyngeal myiasis, due to *Cephalopina titillator*, has been reported in imported as well as indigenous camels. Dermal myiasis due to presence of *Chrysomyia megacephala*, *C. albiceps*, *Wohlfahrtia* spp., and *Sarcophaga* spp. have been recorded. The most common ectoparasitic infestations of camels are 20 species of ticks and the sarcoptic mange mite, *Sarcoptes cameli*. The prevalence of most of these parasites, except *O. fasciata* and *S. cameli*, was higher in imported than in indigenous camels.

Introduction

The camel is the principal domestic animal in Saudi Arabia and its meat and milk still constitute a vital source of animal proteins to nomads and city dwellers. Few studies have been conducted on the incidence and control of the diseases of camels[1-4,7,16,17]. In Saudi Arabia camels are infected with many species of gastro-intestinal helminths, extra-intestinal helminths, protozoan parasites, nasopharyngeal and dermal myiasis as well as ectoparasites. The present article aims to review and collate most of the in-

formation in reports published on the prevalence, distribution and some epidemiological aspects of these parasites in camels in Saudi Arabia.

Gastro-Intestinal Helminths

Various gastro-intestinal helminths have been recorded from camels in Saudi Arabia (Table 1). The most common nematodes recorded in indigenous camels were *Haemonchus longistipes, Trichuris* spp., *Parabonema skrjabini, Camelostrongylus mentulatus, Trichostrongylus* spp., *Nematodirus* spp. and *Haemonchus contortus*[3,4]. The prevalence of these nematodes varied from region to region and from season to season. The maximum faecal egg counts of these nematodes were recorded during the period from October to January[2], a period when antihelminthic treatment is recommended[3]. Old camels were more often and more severely infected with *H. longistipes* than young camels. *Ostertagia ostertagi* was recorded for the first time in indigenous camels in Riyadh[4]. The most common cestodes in camels in the Kingdom are *Moniezia expansa. Avitellina centripunctata* and *Stilesia vittata*[4,5], *M. benedeni* was recorded for the first time in indigenous camels in Riyadh by Hussein and Hussein[4]. Only two trematode parasites, *Fasciola gigantica* and *Schistosoma bovis,* have been

TABLE 1. Gastro-intestinal Helminths of Camels in Saudi Arabia.

Parasite	Locality	Prevalence %	Authority
Nematodes			
Haemonchus longistipes	Hofuf	60.0	El Bihari & Kawasmah (1980)
	Riyadh	58.2	Hussein & Hussein (1985)
Trichuris spp.	Hofuf	46.0	El Bihari & Kawasmah (1980)
	Riyadh	38.6	Hussein & Hussein (1985)
Parabonema skrjabini	Hofuf	18.0	El Bihari & Kawasmah (1980)
	Riyadh	12.0	Hussein & Hussein (1985)
Cadmelostrongylus	Hofuf	14.0	El Bihari & Kawasmah (1980)
mentulatus	Riyadh	15.0	
Trichostrongylus spp.	Hofuf	6.0	El Bihari & Kawasmah (1980)
	Riyadh	occasional	
Nematodirus spp.	Hofuf	5.0	El Bihari & Kawasmah (1980)
	Riyadh	occasional	
Haemonchus contortus	Hofuf	2.0	El Bihari & Kawasmah (1980)
Ostertagia ostertaagi	Riyadh	occasional	Hussein & Hussein (1985)
Cestodes			
Moniezia expansa	Riyadh	occasional	Kasim & Al-shawa (1985)
Avitellina centripunctata	Riyadh	occasional	Kasim & Hussein (1985)
Stilesia vittata	Riyadh	occasional	Hussein & Hussein (1985)
M. benedeni	Riyadh	occasional	
Trematodes			
Fasciola gigantica	Eastern region	15.0	Magzoub & Kasim (1978)
	Jeddah	4.22 (imported camels)	Ghandour *et al.* (1989)
Schistosoma bovis	Jeddah	3.0 (imported camels)	Ghandour (1988)

recorded in camels in Saudi Arabia. *F. gigantica* was recorded at high rates in indigenous camels in the Eastern Region of Saudi Arabia (an area of high rainfall and agricultural schemes favouring the survival of the snail intermediate host)[6]. Ghandour *et al.*[7,8] did not record any infection with fascioliasis in indigenous camels in Jeddah (an area of low rainfall and very few agricultural schemes) but recoded a prevalence rate of 4.22% with *F. gigantica* in imported camels. *Schistosoma bovis* was reported from Sudanese camels in Jeddah abattoir at a rate of 3.0%, but not from indigenous camels in Jeddah or elsewhere in the Kingdom[8,9].

Extra-Intestinal Helminths

Extra-intestinal helminths such as *Onchocerca fasciata*, cysts of *Echinococcus granulosus* and *Dictyocaulus cameli* have been recorded in camels in Saudi Arabia. *O. fasciata* was first described from Arabian camels by Railliet and Henry[10], Henry and Masson[11] and recently by Bain and Nasher[12]. The worms occur as nodules in the nuchal ligaments and subcutaneous tissues of the head and neck. The microfilariae occur in the skin of these body regions and are especially abundant in the anterior crest of the lower eyelids[13-15]. The prevalence of this nematode in imported and indigeneous camels are recorded in Table 2. In Sudanese and Somali camels imported to Saudi Arabia, the prevalence was 15.5-20.0%[13,14]. In indigenous camels the prevalence in animals from the Southern Region of the Kingdom (59.0%) was higher than that (33.3%) in the Western Region[15]. The typical host tissue reaction of *O. fasciata* consisted of early granuloma formation and mineralization of nodules in old camels[13-15]. Viable nodules usually contain fertile worms but many (57.5%) are calcified[15] (Figure 1, Plate I).

TABLE 2. Onchocerciasis (*O. fasciata*) in camels in Saudi Arabia.

Locality	Prevalence %		Authority
	Indigenous	Imported	
Hofuf, Riyadh Bureida, Taif Najran, Jeddah, Abha Abha	34.3	15.5	Cheema *et al.* (1984)
(Southern region)	59.0	N.E.	Nasher (1986)
Jeddah	N.E.	20.0	Ghandour (1988)
(Western region)	33.3	N.E.	Ghandour *et al.* (1991)

N.E. : Not examined

The camel is regarded as one of the common intermediate hosts for the metacestodes of *E. granulosus*[16,17]. Hydatid cysts have been recorded from camels in different regions in Saudi Arabia at a higher incidence than in other livestock[17-20]. The prevalence of this parasite in all areas studied (except in Bureida, Central Region) was higher in imported than in indigeneous camels[18-20]. The incidence of hydatidosis in camels in Saudi Arabia is far less than that recorded in several countries such as

PLATE I.

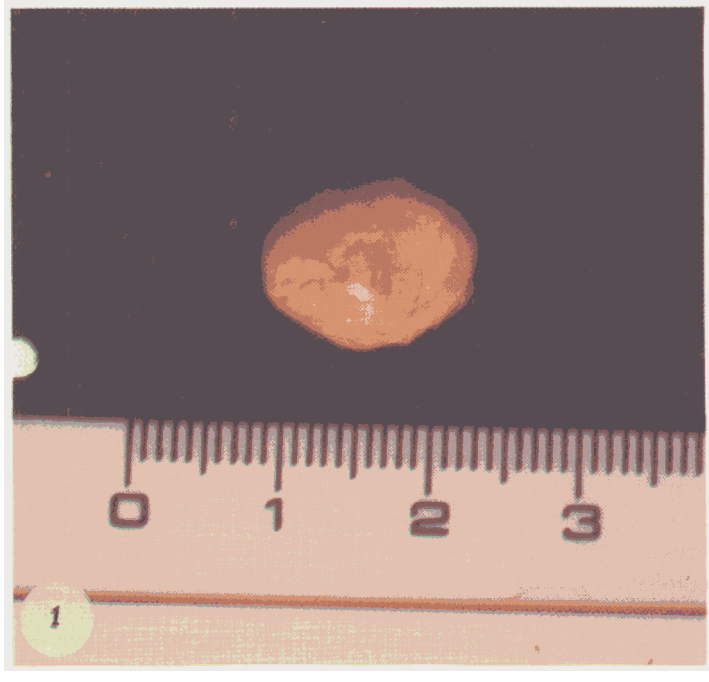

FIG. 1. Nodule of *O. fasciata*.

TABLE 3. Hydatidosis in camels in Saudi Arabia.

Locality	Prevalence %		Authority
	Indigenous	Imported	
Jeddah	0.0	4.0	Ghandour *et al.* (1988)
(Western region)	0.0	3.53	Ghandour & Saleh (1983)
Bureida	3.14	1.96	Farah *et al.* (1984)
(Central region)			
Al Hassa	0.8	6.4	Kawasmah *et al.* (1984)

10.8% in Somalia[21], 19.4% in Egypt[22], 45.4% in Sudan[23] and (80.0%) in Morocco[24] (Table 3). *D. cameli* has been recorded in camels in Jeddah area (Ghandour, personal communication).

Protozoan Parasites

Various protozoan parasites (*Trypanosoma evansi, Sarcocystis cameli, Eimeria dromedarii, E. cameli, E. rajasthani* and *Thileria* spp.) have been recorded in camels in Saudi Arabia (Table 4). Diab *et al.*[25] was the first to report *T. evansi* in imported and indigeneous camels in the Eastern and Southern regions of Saudi Arabia. Hussein and Hussein[4] recorded an incidence of 1.78% infection with this parasite in indigeneous camels slaughtered in Riyadh. Ghandour and Al-Hazmi[26] recorded a

TABLE 4. Protozoan parasites of camels in Saudi Arabia.

Parasite	Locality	Prevalence rate%	Authority
Trypanosoma evansi	Jeddah	25.0	Ghandour & Al-Hazmi (in press)
	Najran & (Eastern region)	Case record	Diab *et al.* (1984)
	Riyadh	1.78	Ghandour & Al-Hazmi (in press)
Sarcocystis cameli	Al Hassa	87.0	Ibrahim & El Bihari (1987)
	Riyadh	56.7	Hussein (1989)
Eimeria dromedarii	Eastern region	28.4	Hussein *et al.* (1987)
E. cameli	Eastern region	14.0	Kawasmah & El Bihari (1987)
		19.2	Kasim *et al.* (1987)
E. rajasthani	Eastern region	22.2	Kasim *et al.* (1985)
			Hussein *et al.* (1987)
Thileria spp.	Jeddah	5.0	Ghandour *et al.* (1989)

Plate I.

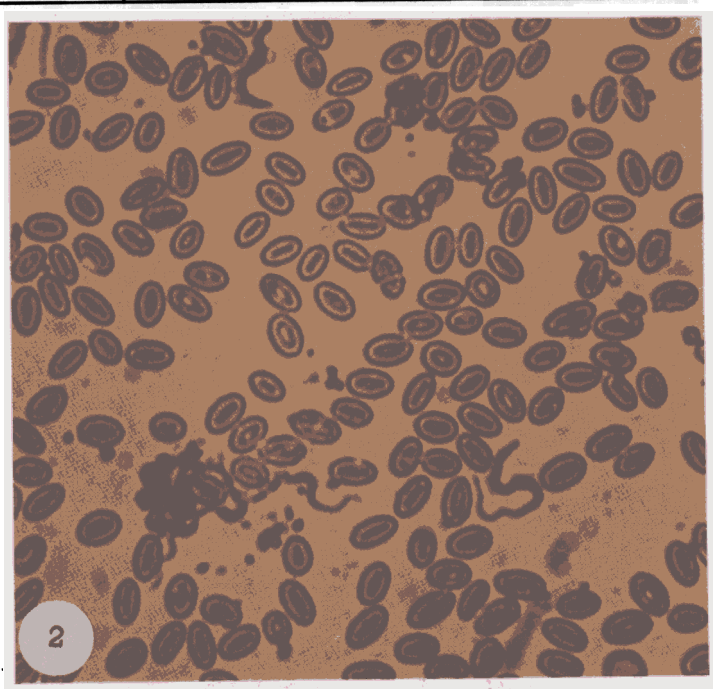

FIG. 2. *Trypanosoma evansi* in camel's blood (× 400).

rate of 25.0% in indigeneous camels in Jeddah area (Plate I).

S. cameli was found in indigeneous camels at a rate of 78.0% in Al Hassa (Eastern region of Saudi Arabia)[27]. Hussein[28] recorded this parasite in Riyadh area at a higher rate in imported than in indigeneous camels. Kawasmah and El Bihari[29] were the first to report *E. cameli* in 14.0% of camels in the Eastern region of Saudi Arabia. The increase in prevalence in the spring and autumn was attributed to high levels of

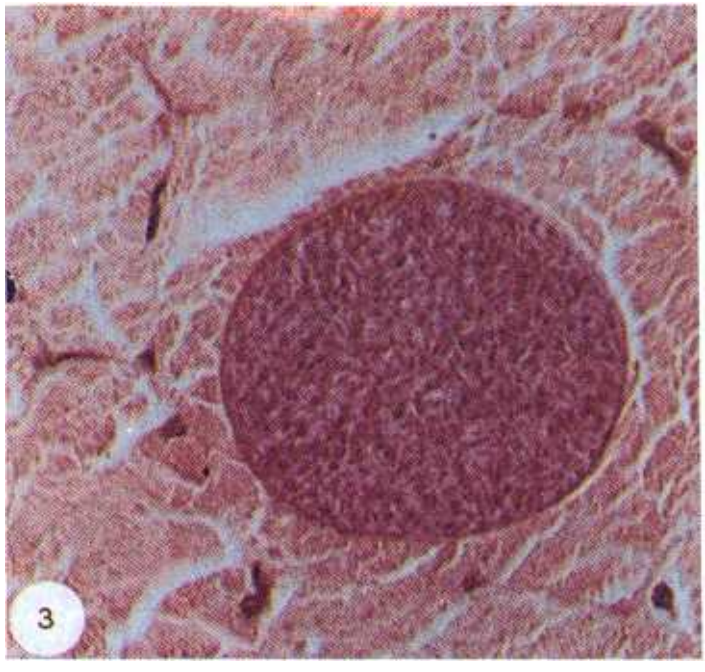

Plate I

FIG. 3. *Sarcocystis cameli* (× 400).

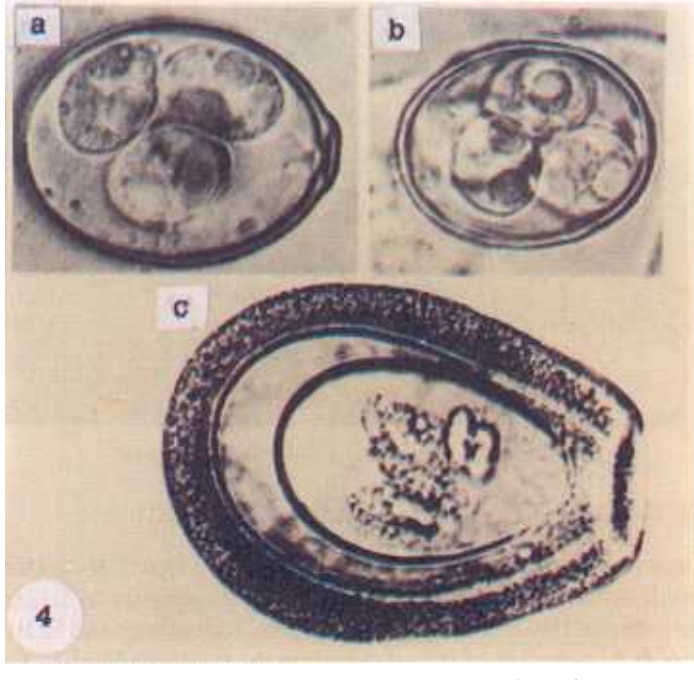

Plate I

FIG. 4. Cysts of *Eimeria* spp. from camels (× 400).

humidity in these seasons[29]. Three species of *Eimeria* were recorded in camels in surveys in different regions of Saudi Arabia[30,31]. *E. dromedarii* was the most prevalent (28.4%) and *E. cameli* the least prevalent (19.2%) while the incidence of *E. rajasthani* was 22.2%. The infection was, in general more prevalent along the humid coastal areas than in the arid interior[31]. *Thileria* spp. has been recorded in indigeneous camels in Jeddah area at the low incidence of 5.0%[8].

Naso-Pharyngeal Myiasis and Dermal Myiasis

Larvae of the nasal fly, *Cephalopina titillator* were first recorded from camels in Saudi Arabia by Beccarii[32]. The infection was recorded in camels in the Western Region of Saudi Arabia[8,33] as well as in Riyadh area[34,35] (Table 5). The overall prevalence in imported camels (87.7%) was higher than that in indigeneous camels (64.6%)[35]. The monthly incidence in indigeneous camels ranged from 29.0% in July to 89.0% in October. Male and female camels were almost equally infected with this ectoparasite[35]. The prevalence was low in very young camels (under 6 months) and in very old camels (over 12 years)[35]. Nasal myiasis due to infection with the fly *Oestrus ovis* was recorded in camels throughout in the Kingdom of Saudi Arabia[32] and

TABLE 5. Myiasis in camels in Saudi Arabia.

Myiasis producing fly	Locality	Prevalence rate%	Authority
Naso-pharyngeal myiasis			
Cephalopina titillator	Kingdom	Case record	Beccarii (1971)
	Western region	Case record	Banaja & Madbouly (1981)
	Riyadh	Case record	Buttiker and Zumpt (1983)
	Riyadh	64.6 & 78.7 in indigeneous & imported camels respectively	Hussein *et al.* (1983)
	Western region	Case record	Ghandour *et al.* (1989)
Nasal myiasis			
Oestrus ovis	Kingdom	Case record	Beccarii (1971)
	Western region	Case record	Banaja & Madbouly (1981)
Dermal myiasis			
Chrysomyia megacephala	Hofuf (Eastern region)	Case record	Ramadan & El Bihari (1980)
C. albiceps	Zilfi & Dawidmi	Case record	Dabbour (1979)
C. bezziana	Hofuf (Eastern region)	Case record	Ramadan & El Bihari (1980)
Wohlfahrtia spp.	Hofuf (Eastern region)	Case record	Ramadan & El Bihari (1980)
Sarcophaga spp.	Hofuf (Eastern region)	Case record	Ramadan & El Bihari (1980)

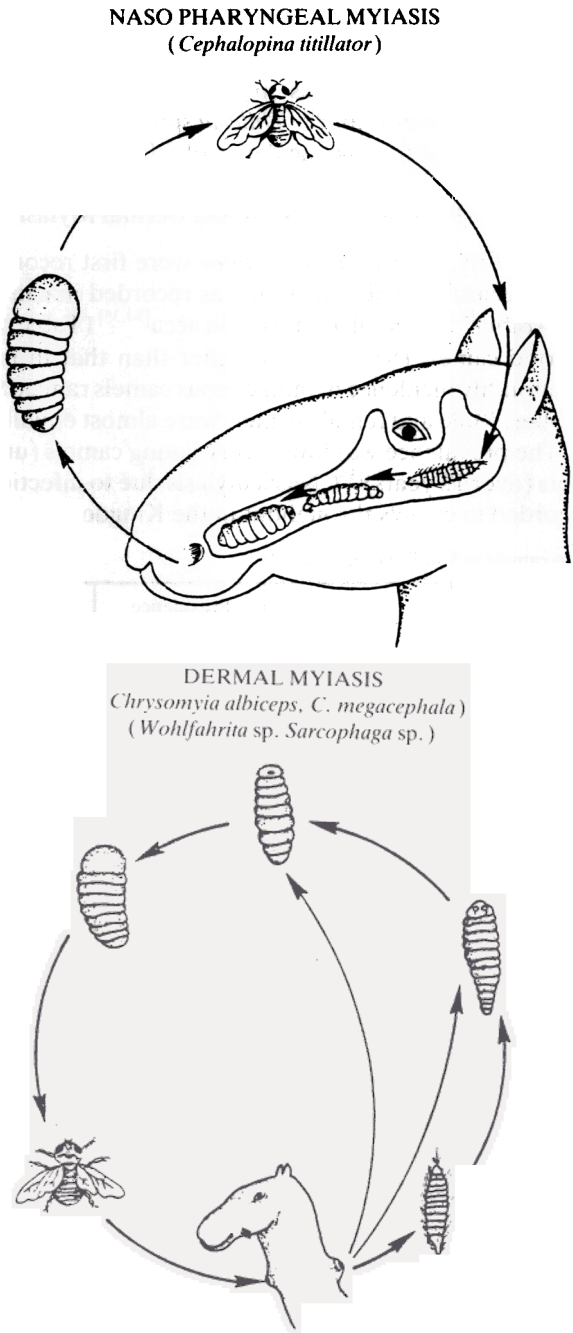

PLATE II. Life cycle of *Cephalopina titillator* and *C. albiceps, C. megacephala, Wohlfahrtia* and *Sarcophaga*.

Banaja and Madbouly[33] reported its presence in camels in the Western region (Plate II).

Dabbour[36] recorded dermal myiasis due to *Chrysomyia albiceps* in camels in the central region of Saudi Arabia. Infection with larvae of the flies *C. megacephala, C. albiceps, Wohlfahrtia* spp. and *Sarcophaga* spp. were recorded in indigeneous camels in the Hofuf area[37]. The lesions due to these larvae occurred mainly in the perineal region (53%), head and neck (23%), hind quarters (14%) back and sternum (6.9%) and the udder (3.5%). Very few cases of vaginal myiasis were recorded in camels[37]. A single case of ocular myiasis in camels due to infection with larvae of *C. bezziana* was also recorded[37] (Plate II).

Ticks and Mites Infestations

Twenty species of ticks have been recorded in camels imported to Saudi Arabia while only twelve species have been reported in indigeneous camels. The early records were of those of Hoogstraal and Kaiser[38]. Many recent records are also provided[39-44]. Three species of the genus *Amblyomma* were recorded (*A. gemma, A. lepidum, A. variegatum*). 10 species of the genus *Hyalomma* (*H. anatolicum anatolicum, H. anatolicum excavatum, H. dromedarii, H. erythraeum, H. impletatum, H. impressum, H. marginatum rufipes, H. marginatum turanicum, H. schulzei, H. turanicus*) and 7 species of the genus *Rhipecephalus* (*R. evertsi, R. guilhoni, R. pulchellus, R. sanguineus, R. simus, R. senegalensis, R. turanicus*). All introduced ticks as well as those which occur locally may feed on indigenous camels and may transmit various pathogenic agents[42]. Cheema[45] recorded *Sarcoptes cameli* at a rate of 60.0% in indigenebus camels and only 6.25% in imported camels in Saudi Arabia.

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طفيليـــات الجمـــال في المملـكة العربيـة السعوديـة

عبد الإله عبد العزيز باناجه و أحمد محمد غنـــدور
قسم علم الأحياء ، كلية العلوم ، جامعة الملك عبد العزيز
جـــــدة ، المملكة العربية السعودية

المستخلص . تصيب الجمال في المملكة العربية السعودية عدة أنواع من ديدان الجهاز الهضمي ، الأوليات الحيوانية الطفيلية ، النغف الأنفي الحلقومي ، التدود اليرقي وعدة أنواع من الطفيليات الخارجية . وتعد أهم ديدان الجهاز الهضمي :

Haemonchus longistipes, Trichuris spp., *Parabonema skrjabini, Camelostrongylus mentulatus, Trichostrongylus* spp., *Nematodirus* spp., *Fasciola gigantica* and *H. contortus.*

وتعد دودة *Onchocerca fasciata* أحد أهم الديدان التي تعيش خارج الجهاز الهضمي وقد سجلت الإصابة في الجمال المحلية نسبة أعلى (٣٣-٥٩٪) من تلك في الجمال المستوردة (١٥,٥-٢٠٪) . وقد سجلت الإصابة بالأكياس المائية لدودة *Echinococcus granulosus* نسبة منخفضة (١,٩٦-٦,٤٪) في الجمال المستوردة ، (صفر-٣,١٤٪) في الجمال المحلية بالمقارنة مع تلك النسبة في الجمال في بلاد مجاورة .

سجلت عدة أنواع من الأوليات الحيوانية الطفيلية :

Eimeria cameli, E. dromedarii, E. rajasthani, Trypanosoma evansi, Sarcocystyis cameli and *Thileria* spp.

كما سجلت الإصابة بالنغف الأنفي الحلقومي الناتج عن الإصابة بـ *Cephalopina titillator* وكذلك الإصابة بالتدود اليرقي الناتج عن يرقات *Chrysomyia megacephala*, *C. albiceps, Wohlfahrtia* spp. و *Sarcoptes* spp. . ويعـد القـراد أكثـر أنـواع الطفيليات الخارجية على الجمال ، إذ سجل ٢٠ نوعًا منه ، كما سجلت الإصابة بالجرب نتيجة لـ *Sarcoptes cameli* . وتعد نسبة الإصابة بأغلبية هذه الطفيليات ما عدًا *S. cameli, O. fasciata* أعلى في الجمال المستوردة عن النسبة في الجمال المحلية .