

## Original paper

# Investigation of internal and external parasites of the camels (*Camelus dromedarius*) in Algeria

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**ABSTRACT.** Parasitic diseases are one of the dominant pathological entities with significant consequences on camel productivity. This survey was carried out to determine the prevalence of camel infection with internal and external parasites in two regions in southern Algeria, between January and December 2015. The investigation of external parasites was carried out in Oued Souf and concerned 406 camels. For internal parasites, two studies were conducted; the first was realized at the slaughterhouse in the Ouargla and concerned 273 camels and the second study was realized in Oued Souf region which aimed to search for digestive parasites; therefore, 64 samples of camel faeces were taken. The results showed that 232/406 (57.14%), 114/406 (28%) and 67/406 (16.5%) camels were infested with ticks, scabies and ringworms, respectively. Camels were significantly more infested with ticks than scabies and ringworms ( $p < 0.001$ ). The identification of ticks revealed *Hyalomma dromedarii* (83.98%), *Hyalomma impeltatum* (10.58%), *Amblyomma variegatum* (5.12%) and *Rhipicephalus sanguineus* (0.32%). Camels were more infested with *H. dromedarii* ( $p < 0.001$ ). For internal parasites, 22/64 (34.37%) camels were found infected with digestive strongyles of which 8/64 (12.5%) were infected with *Nematodirus* sp. At the Ouargla slaughterhouse, 23/273 (8.42%) camels were revealed infected with hydatid cyst. Camels appear to be highly parasitized in Algeria and its cohabitation with other animal species increases the risk of its contamination. Therefore, it is important to take into consideration the parasitism of the camel in Algeria and appropriate control measures are recommended in order to improve camel productivity.

**Keywords:** camel, ticks, scabies, ringworms, digestive strongyle, cystic hydatid

## Introduction

The aptitude of camels (*Camelus dromedarius*) to survive in desert regions and their resistance to periods of prolonged drought make them of crucial importance to pastoralists [1]. In Algeria, the camel represents a definite economic, social and cultural interest. It remains a main source of animal protein for the Saharan population. It is particularly important because it operates in environments where the existence of other livestock alternatives would be random and expensive [2]. Camel production (milk, meat, hair and leather) has helped the populations of these regions to adapt to the harsh climate. In addition

to its ability to produce milk and meat, the camel is also used as a means of transport [3].

Despite its great importance to pastoralists, the dromedary is still neglected compared to other species of domestic animals in many parts of the world, including Algeria. Among the many constraints that limit the development of camel farming in Algeria, parasitic diseases are one of the dominant pathological entities with significant consequences on camel productivity. They are relatively unknown compared to those of other domestic animals [4]. In Algeria, parasitic diseases are a major pathological disease of the camel, in particular trypanosomosis, tick and mange



Figure 1. Presentation of the study area

infestation [5,6]. The pathogenic role of ticks appears to be mainly related to traumatic action and pathogen transmission. Blood spoliation sometimes causes anaemia and asthenia [7].

The internal and external parasitism of the camel in Algeria has been little studied and remains limited. Therefore, this study was carried out to study the internal and external parasites of the camel in Algeria and to determine the tick species isolated in two regions in southern Algeria: Ouargla and Oued Souf.

## Materials and Methods

**Study area.** The study was carried out between January and December 2015 in two regions in southern Algeria: Oued Souf (longitude 6.86667°E, latitude 33.3667°N and altitude 80 m) and Ouargla (longitude: 4.783°E, latitude: 31.617°N and altitude: 227 m) (Fig. 1). These regions are characterized by an arid Saharan climate, with rainfall of less than 100 mm per year and average temperatures exceeding 40°C [8].

**The animals.** The identification of external parasites was carried out in Oued Souf region and concerned 406 camels. External parasites were detected throughout the animal's body and more particularly in areas with thin skin for ticks (ears,

testicles, udders, inguinal region). Only one tick sample was taken from each animal.

For the identification of internal parasites, two studies were carried out; the first was conducted at the slaughterhouse in the Ouargla region and concerned 273 slaughtered camels. The second study was realized in Oued Souf which aimed to search for digestive parasites, thus, 64 samples of camel faeces were taken. These faeces samples were collected only once from each animal, stored in sterile vials and transported to the laboratory in a cooler at 4°C.

The field data of each sample such as date, locality, and number of examined animals were recorded.

**Laboratory diagnosis.** Ticks were collected and stored in identified vials containing 70% alcohol were identified under a binocular loupe using the key of Walker et al. [9].

The coproscopy was performed as follows: homogenize the faeces sample, mix 5 g of faeces with 70 ml of dense solution (NaCl with a density of  $d = 1.20$ ) in a stand glass, sieve the mixture through a strainer, fill a dry tube to the brim with the mixture obtained and then cover it with a lamella, after 20 minutes recuperate the lamella and place it on a slide for observation under optical microscope GX10 and GX40 [10].

Table 1. Number of examined camels (n = 406) and prevalence of external parasite infestation in the Oued Souf region

Risk factors	Category level	Ticks	Scabies	Ringworm
Sex	Males (%)	141 (60.77) <sup>b*</sup>	59 (51.75) <sup>c</sup>	50 (74.63) <sup>a*</sup>
	Females (%)	91 (39.23) <sup>b</sup>	55 (48.25) <sup>a</sup>	17 (25.37) <sup>c</sup>
	Total	232 (57.14) <sup>a</sup>	114 (28.07) <sup>b</sup>	67 (16.50) <sup>c</sup>
Seasons	Winter (%)	40 (17.24) <sup>b</sup>	48 (42.10) <sup>a*</sup>	6 (8.95) <sup>c</sup>
	Spring (%)	31 (13.36) <sup>b</sup>	18 (15.79) <sup>b</sup>	17 (25.37) <sup>a*</sup>
	Summer (%)	98 (42.24) <sup>a*</sup>	45 (39.47) <sup>a</sup>	21 (31.34) <sup>b*</sup>
	Autumn (%)	63 (27.15) <sup>a</sup>	3 (2.63) <sup>b</sup>	23 (33.32) <sup>a*</sup>
Age (years)	< 1	35 (15.08) <sup>b</sup>	36 (31.57) <sup>a</sup>	13 (19.40) <sup>b</sup>
	1–5	179 (77.15) <sup>a*</sup>	65 (57.01) <sup>b*</sup>	51 (76.12) <sup>a*</sup>
	5–10	10 (4.31) <sup>a</sup>	7 (6.14) <sup>a</sup>	3 (4.47) <sup>a</sup>
	> 10	8 (3.44) <sup>a</sup>	6 (5.26) <sup>a</sup>	0

Explanations: a, b, c - values not marked with the same letter in the same line are different at  $p < 0.05$ ; \* - these values are significantly higher than the other values in the same column at  $p < 0.05$ .

**Statistical analysis.** The statistical program used was R i386 3.0.2 for Windows GUI front-end. Chi square test, ANOVA and multiple range tests were used for the statistical analysis. The threshold value of different tests was  $p < 0.05$ .

## Results

A total number of 406 camels were examined for external parasites, of which 232 (57.14%), 114 (28%) and 67 (16.5%) were found to be infected with ticks, scabies and ringworms, respectively. Camels were shown to be significantly more infested with ticks than by scabies and ringworms ( $p < 0.001$ ) (Table 1).

Compared to sex type, males were found to be significantly more infested with ticks and ringworms than females ( $p < 0.001$ ). No significant differences were observed for scabies.

Males were found to be more infested with

ringworms than ticks and scabies. On the other hand, females were shown to be more infested with scabies than ringworms and ticks ( $p < 0.001$ ) (Table 1).

Infestation of camels with external parasites has been significantly related to the season. In fact, ticks were more prevalent in summer and scabies in winter. On the other hand, ringworms were less observed during the winter ( $p < 0.001$ ) (Table 1).

Considering the age of the camels, it was noted that animals aged 1–5 years were the most infested with ticks, scabies and ringworms compared to other age groups ( $p < 0.0001$ ) (Table 1).

A total number of 312 ticks were collected, including 77 larvae and 235 adults. Also, 249 and 63 ticks were males and females, respectively.

The identification of ticks revealed four species: *Hyalomma dromedarii* (83.98%), *Hyalomma impeltatum* (10.58%), *Amblyomma variegatum* (5.12%) and *Rhipicephalus sanguineus* (0.32%). Camels were more infested with *H. dromedarii* than other species ( $p < 0.001$ ) (Table 2).

*H. dromedarii* was isolated throughout the year and *H. impeltatum* was isolated during the spring season only. *A. variegatum* and *Rh. sanguineus* were isolated in summer.

For internal parasites, 22/64 (34.37%) camels were found infected with digestive strongyles (11 males and 11 females) of which 8 (12.5%) were infected with *Nematodirus* sp. (4 males and 4 females) (Table 3).

Table 2. Proportion of tick species collected from camels in the Oued Souf region

Tick species	No ticks collected	Proportion (%)
<i>Hyalomma dromedarii</i>	262	83.98*
<i>Hyalomma impeltatum</i>	33	10.58
<i>Amblyomma variegatum</i>	16	5.12
<i>Rhipicephalus sanguineus</i>	1	0.32
Total	312	100

Table 3. Prevalence of internal parasite infection among camels in Ouargla (slaughterhouse, n = 273) and Oued Souf (number of coproscopies n = 64)

No of infected animals	Hydatid Cyst	Digestive Strongyles	<i>Nematodirus</i> sp.
No infected camels (%)	23 (8.42%)	22 (34.37%)*	8 (12.50%)
No infected males (%)	8 (34.78%)	11 (50%)	4 (50%)
No infected females (%)	15 (65.22%)*	11 (50%)	4 (50%)

The search of internal parasites at the Ouargla slaughterhouse revealed that 23/273 (8.42%) camels were infected with hydatid cyst, including 8 males (34.78%) and 15 females (65.22%) ( $p < 0.001$ ) (Table 3).

The prevalence of camel infection with digestive strongyles was significantly higher compared to hydatid cyst ( $p < 0.001$ ) (Table 3).

## Discussion

Parasitic diseases constitute one of the dominant pathological entities that limit the development of camel farming. They are relatively unknown compared to those of other domestic animals [4]. In our study, the identification of external parasites revealed the presence of ticks, scabies and ringworms. Four tick species were identified: *H. dromedarii*, *H. impeltatum*, *A. variegatum* and *R. sanguineus*. For internal parasites, digestive strongyles including *Nematodirus* sp. were identified by coproscopy. Hydatid cyst was revealed at the slaughterhouse.

A total number of 232/406 (57.14%) camels were found infested with ticks in our study. This prevalence was in agreement with the findings of Moshaverinia and Moghaddas [11] in Iran and Dinka et al. [12] in Ethiopia. On the other hand, our result is lower than that reported by Bouhous et al. [5] in Algeria, Kiros et al. [13] in Ethiopia and Lawal et al. [14] in Nigeria.

Compared to sex type, camels males were found to be significantly more infested with ticks than females which is in concordance with Bouhous et al. [5].

Ticks were present on camels throughout the year in our study, which is consistent with the findings of Faye et al. [7]. On the other hand, ticks were more prevalent in summer in our study, which is in concordance with Moshaverinia and Moghaddas [11], Jemli et al. [15], Salimabadi et al. [16] and Fard et al. [17].

In our study, camels were detected more infested

with *H. dromedarii* than other species which is in concordance with Bouhous et al. [5] in Algeria and other parts of the world (11,15–17).

The high level of camel infestation by *H. dromedarii* may be related to the adaptation of this tick to the unfavourable climatic conditions of the Sahara, knowing that it can perform several cycles during the year [9]. The assembling of camels around the water points of the oases facilitates their infestation, as the oases offer a favourable microclimate for ticks, particularly of the genus *Hyalomma* [5], which have long legs and actively move in search of the camels [9].

*Amblyomma variegatum* is one of the commonest and most widely distributed ticks on livestock in Africa [9]. In our study, *A. variegatum* was isolated for the first time in Algeria from camels with a percentage of 5.12% of all ticks collected. This result is consistent with the data provided by Zeleke and Bekele [18] and Kiros et al. [13]. Contact with cattle can be the source of contamination of camels. This tick transmits the bacterium *Ehrlichia ruminantium* which causes heartwater in ruminants. It also transmits *Ehrlichia bovis*, causing bovine ehrlichiosis, and the protozoans *Theileria mutans* and *Theileria velifera* causing benign bovine theileriosis [9].

In our study, a total number of 114/406 (28%) camels were found to be infested by scabies. This is in agreement with Khallaayoune et al. [19] in Morocco. In Tunisia, all camel farms are contaminated and about 10% of animals express the disease each year [15].

Depending on the sex of the camels, no significant differences were observed between males and females in our study. Some authors reported that male camels were more affected by scabies than females [20]. However, others reported that females were more affected than males [21–23].

In our study, scabies were more prevalent in winter, which is in concordance with Khallaayoune et al. [21] in Morocco. However, other studies indicate that the prevalence of scabies increases in

the dry season, due to the decrease in the quantity and quality of food resources, and the grouping of herds around water points. In fact, food stress promotes the clinical expression of the disease and the grouping of animals promotes transmission [24].

Considering the age of the camels, it was noted that animals aged 1–5 years were the most infested by scabies. Kumar et al. [25] in Morocco, found that scabies affects camels of all ages, but is more common in animals over three years of age.

Ringworm or dermatophytosis is a zoonotic skin infection caused by fungi dermatophytes [26]. The disease can affect all domestic animals, including camels [27]. In our study, a total number of 67/406 (16.5%) camels were found infested by ringworms. This result was close to the findings reported in other countries [28,29] and lower than those registered by other authors [27,30,31]. On the other hand, our result is higher than the result of Gitao et al. [32] which reported lower prevalence of 8.58%.

Autumn and winter are the seasons with the highest incidence of ringworms, with a mild and humid climate that is favourable to fungal development [27]. On the other hand, in our study, ringworms were less observed during winter.

The ringworm mainly affects young and generally in poor condition animals with a high prevalence. Ringworm lesions were more frequently observed in animals under 3 years of age [28,30]. In our study, it was noted that camels aged 1–5 years were the most infested by ringworms compared to other age groups. The variation of the prevalence among different studies may be influenced by the hygienic measures applied in each farm and by the immunity of the camels under study [29,31].

Hydatidosis due to *Echinococcus granulosus* larvae is localized in various tissues and organs, mainly liver and lung [4]. Camels infect by the ingestion of tapeworm eggs during transhumance, through different pastures and water points, such as ponds and marigolds, frequented by wild carnivores and sheepdogs [33]. In some countries hydatid cysts have also been found in high levels in camels [34]. In our study, a number of 23/273 (8.42%) camels were infected with hydatid cyst. This result is consistent with the results reported by Ouchene et al. [35] in Algeria (8.35%). On the other hand, our result was lower than the results obtained in Algeria (24.8%) by Bardonnnet et al. [36], in Mauritania (53.07%) by Pangui and Ould Ahmedou [37], in Libya (31.9%) [38], in Niger (55%) [39], and in Tunisia (7 to 62%) [40].

In our study, females (65.22%) were detected more infected with hydatid cysts than males (34.78%) which are in concordance with Ould Ahmed Salem et al. [41].

A prevalence of digestive strongyles infection of 34.37% of which 12.5% were *Nematodirus* sp. was revealed in our study. These results are similar to those reported for digestive strongyles by Bakhsh Alhendi [42] in Saudi Arabia (38%), for *Nematodirus* sp. by Jemli et al. [15] in Tunisia (9.40%), and Parmar et al. [43] in India (13.16%).

However, our results are lower than those reported by other authors [44,45].

There were no significant differences between female and male camels which is in concordance with the findings of Radfar and Gowhari [44], Demelash et al. [46], Ukashatu et al. [47].

Based on the results of this study, it is concluded that camels are mostly infected with external and internal parasites despite its presence in a desert environment. In fact, the investigation of external parasites revealed the presence of ticks, scabies and ringworms. *H. dromedarii* was the most abundant tick and the discovery of *A. variegatum* for the first time in Algeria requires particular attention, especially for public health. The study of internal parasites allowed detecting digestive strongyles and hydatid cyst. Therefore, appropriate parasites control measures need to be employed, endectocide and pour-on method for acaricide application is suggested because this method is fast, easy and suitable for use by camel owners in deserts.

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