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Research Article **Open Access**

Prevalence of Babesia Infection in the Northeastern Part of Libya (Camelus Dromedaries)

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Abstract: A study was conducted to investigate *Babesia spp*. infections in one-humped camels (Camelus dromedarius) in northeastern Libya. Blood samples were randomly collected from camels of both sexes (115 females and 45 males) across seven selected regions: Tobruk Khoury, Alhamamuh, Sultana, Alqabah, Ajdabiya Road, Qanduluh, and Imsaeid. The sampling period spanned from February 2021 to January 2022. Giemsa-stained blood smears were used to diagnose *Babesia spp*. infections. The results revealed an overall infection prevalence of 35% among the tested samples. The highest prevalence rates were recorded in Tobruk Khoury (70%), followed by Ajdabiya Road (60.6%), Alhamamuh (60%), Sultana (46.6%), Alqabah (28.57%), Qanduluh (19.35%), and Imsaeid (7.1%).The prevalence among females (42.6%) was significantly higher than that among males (15.5%). Regarding age groups, middle-aged camels (1–15 years) exhibited the highest prevalence rate (45.1%). Seasonally, the highest infection rate was observed in autumn (50%), followed by spring (47.36%).

Keywords: Babesia Haemoparasitic, protozoa, Piroplasma,camels, Northeastern , Libya

نسبة انتشار البابيزيا في شمال شرق ليبيا في الإبل (ذو السنام الواحد)

المستخلص: تم العثور على إصابة بالبابيزيا في الإبل ذات السنام الواحد, في مناطق شمال شرق ليبيا. تم اخذ عينات دم من الإبل من كلا الجنسين عشوائي (115 أنثى و45 ذكراً) من سبع مناطق مختارة هي طبرق الخوير، الحمامة، اسلنطه، القبه، طريق أجدابيا، قندوله وامساعد خلال شهر فبراير 2021. حتى يناير 2022. تم استخدام مسحات دموية ملطخة بالغيمزا لتشخيص العدوى البابيزيا وأظهرت النتائج أن 35% من العينات كانت مصابة بالبابيزيا. وسجلت أعلى معدلات الإصابة في طبرق الخوير (70%)، طريق أجدابيا (60.6%)، الحمامة (60%)، اسلنطه (46.6%)، القبة (28.57%)، قندوله (19.35%) وامساعد (7.1%). وكانت نسبة الإصابة بين الإناث (42.6%) أعلى من الذكور (15.5%). ومن بين جميع الفئات العمرية، سجلت الأعمار المتوسطة (1–15 سنة) أعلى معدل انتشار (45.1%)، في حين سجلت أعلى نسبة إصابة هي الخريف (50%) عن الربيع (47.36%).

الكلمات المفتاحية: بابيزيا، طفيليات الدم، الأوليات، بيروبلازما، الجمال، شمال شرق ليبيا .

INTRODUCTION

The camel has been a vital animal for centuries, serving as a means of transportation and a source of meat, milk, and wool (Kamani et al., 2008). Its ability to thrive in harsh arid environments is attributed to its unique physiological adaptations (El-Naga & Barghash, 2016).

The genus Babesia, a protozoan parasite, causes diseases such as red water fever, babesiosis, piroplasmosis, Texas fever, and tick fever, which are emerging tick-borne diseases with significant global economic, medical, and veterinary impacts. Despite its importance, there is limited research on the potential infection of camels by *Babesia spp*., particularly under local conditions (Swelum et al., 2014).

Babesia spp. primarily infects red blood cells and affects a variety of species, including sheep, goats, cattle, horses, and camels, with a potential risk of zoonotic transmission to humans. The parasite is transmitted by ticks, with Anocentor nitens being the specific vector responsible for its spread (Abd-Elmalek et al., 2014).

Camels infected with *Babesia spp*. may exhibit symptoms such as fever, weakness, loss of appetite, depression, hemoglobinuria, anemia, and other blood abnormalities, which can result in mortality if untreated (Swelum et al., 2014; Jesca et al., 2017). Among dromedary camels, Babesia caballi is the primary species causing the disease, with age, gender, and season significantly influencing susceptibility (Abdelrahim et al., 2009).

Despite its importance, there is limited information on camels infected with B. caballi in northeastern Libya. To address this gap, the present study aims to:

1. Diagnose *Babesia spp*. infections in camels through microscopic examination using Giemsa-stained blood smears.
2. Determine the prevalence of *Babesia spp*. infections in camels across various regions in Al Jabal Al Akhdar and Tobruk.

Given the lack of comprehensive research on parasitic infections in camels in these regions, this study seeks to contribute to the understanding of *Babesia spp*. prevalence and its impact on camel health under local environmental conditions.

MATERIALS AND METHODS

The present study was conducted on 160 randomly selected camels from various localities in northeastern Libya, specifically in regions within Al-Jabal Al-Akhdar and Tobruk. The study spanned the period from 2021 to 2022. The areas included in this study were Tubrug-Khuayri, Al-Qubah, Al-Hamamuh, Sulanta, Qanduluh, Ajdubiya Road, and Imsaeid. Samples were collected from camels of different ages, both sexes, and across the different regions.

Blood samples collection

A total of 160 blood samples were collected from the jugular veins of camels using tubes containing EDTA as an anticoagulant. The samples were kept on ice during transportation to the Faculty of Veterinary Medicine, University of Omar Al-Mukhtar, Al-Bayda, Libya, for parasitological analysis.

Parasitological Examination

Thin blood smears were prepared and stained using the Giemsa staining method, following the standard protocol described by (Soulsby, 1968). The procedure involved the preparation of blood smears, air drying, fixation with methanol, staining with Giemsa, and examination under a compound binocular microscope using the 100x oil immersion lens. This method facilitated the identification and morphological characterization of *Babesia spp*.

Statistical Analysis

Data analysis was performed using SPSS version 20. Differences between means were assessed using the Student's t-test and ANOVA, while Chi-square tests were employed to examine the relationships between various risk factors. A significance level of $p < 0.05$ was set for the entire analysis.

RESULTS

Between February 2021 and January 2022, a total of 160 blood samples were collected from camels in northeastern Libya. Microscopic examination revealed that 56 samples (35%) were infected with *Babesia spp*. The infection was observed in camels of both sexes and across all age groups. Morphologically, *Babesia spp*. appeared as reddish-violet particles within red blood cells. The parasites displayed various shapes, including single or double pyriform, round, oval, and ring-shaped forms, depending on the specific type of parasite. These findings are illustrated in Figures 1 and 2.

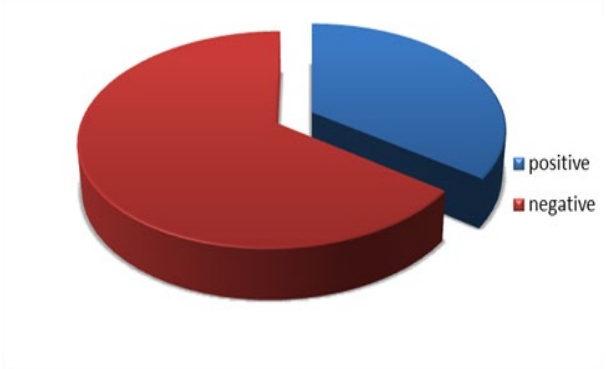

Figure (1). Overall prevalence of *Babesia spp* infection in camels

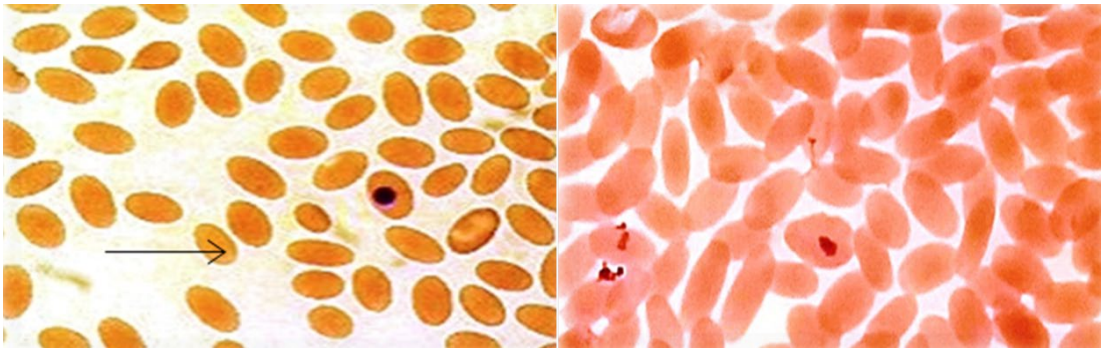

Figure (2). Pear-shaped and paired *Babesia spp*. blood smear from a naturally infected dromedary camel close to the edge of infected red blood cells (Giemsa, 100×)

The prevalence of *Babesia spp***.** infections varied significantly across the seven regions studied. The highest prevalence was observed in Tubrug-Khuayri (70%)**,** followed by Ajdubiya Road (60.6%)**,**

Alhamamuh (60%)**,** Sultana (46.6%)**,** Alqabah (28.57%)**,** Qanduluh (19.35%), and Imsaeid (7.1%), respectively. These results are summarized in Table 1**.**

Table (1). The prevalence of *Babesia spp* in Camels infected to different regions:

Regions	NO. of samples	*Babesia spp* infection	
		Positive	%
Tubrug-khuayri	10	7	70%
Ajdubiya- road	33	7	60.6%
Alhamamuh	15	9	60%
Sulanta	15	7	46.6%
Alqabah	14	6	28.4%
Qanduluh	31	4	19.35%
Imsaeid	42	3	7.1%
Total	160	56	35%

Among the 160 camel blood samples examined, the prevalence of *Babesia spp*. infections differed significantly between sexes. Infected females accounted for 49/115 (42.6%)**,** while infected males comprised 7/45 (15.5%)**.** Age-wise, the prevalence was highest in camels aged 1–15 years **(**37/82; 45.1%), followed by camels aged 15 – 25 yea 15–25 years (12/32; 37.5%). The lowest prevalence was observed in camels aged less than 1 year (7/46; 15.2%).

These results indicate a statistically significant difference ($p < 0.05$) in the prevalence of *Babesia spp***.** based on both sex and age, as detailed in Table 2**.**

Table (2): The prevalence of *Babesia spp.* in Camels infected both sexes and ages.

Parameters	No of examination	No of infected camels	
		Positive	%
Overall	160	56	35
Sex	Female (115)	49	42.6
	Male (45)	7	15.5
Age (years)	<1 (46)	7	15.2
	1-15 (82) *	37	45.1
	15-25 (32)	12	37.5

*significant difference at p<0.05

The prevalence of *Babesia spp***.** infections in camels varied significantly across different seasons. The highest prevalence rates were recorded in autumn (17/34; 50%) and spring (18/38; 47.36%). Conversely, lower prevalence rates were observed in summer (16/68; 23.52%) and winter (5/20; 25%). These differences were statistically significant ($p < 0.05$), as presented in Table 3.

Table (3). The Prevalence of *Babesia spp.* Infection in Camels Infected to Season:

Season	No. of samples	*Babesia .spp* infected	
		positive	%
Autumn*	34	17	50%
Spring*	38	18	47.36%
Summer	68	16	23.52%
Winter	20	5	25%
Total	160	56	35%

*significant difference at p<0.05

DISCUSSION

The findings of the present study revealed that out of 160 camel blood samples examined microscopically, 35% were infected with *Babesia spp*. This prevalence aligns closely with the rates reported by Elmaleck et al. (2016) in Egypt (46.9%) and (Ibrahim et al., 2017) in Sudan (43.6%). However, lower prevalence rates were reported in Iraq (19.5%, 17.5%, and 25%) by (Farhan & Hameed., 2017), (Amery et al., 2017), and (Al-Mialy et al., 2018), respectively. Similarly, (Wakil et al., 2016) found a prevalence of 24.3% in Nigeria. The lowest rates of infection were observed in Tunisia (1.0%) by (Selmi et al., 2019) and in Iran (10%) by (Mirahmadi et al., 2022). These variations in prevalence are attributed to factors such as the number of samples collected, availability of veterinary services, environmental conditions, and the geographic and strategic characteristics of study areas. Regional Prevalence

In our study, the highest prevalence rate was recorded in Tubruk-Khuayri (70%), followed by Ajdabiya Road (60.6%), Alhamamuh (60%), Sultana (46.6%), Alqabah (28.57%), Qanduluh (19.35%), and Imsaeid (7.1%). The elevated rate in Tubruk-Khuayri is likely influenced by high temperatures and humidity, with temperatures ranging from 30°C to 40°C, even during winter. These environmental conditions create an ideal habitat for tick vectors, promoting the growth and reproduction of *Babesia spp*. carriers.Sex-Based Prevalence

The infection rate among female camels (42.6%) was significantly higher than in males (15.5%). This finding is consistent with (Al-Mialy et al., 2018), who reported infection rates of 30% in females and 16% in males in Iraq, and (Ibrahim et al., 2017), who recorded rates of 47.1% in females and 38.1% in males in Sudan. Other studies, such as (Farhan & Hameed., 2017) in Iraq, observed similar prevalence in females (48.79%) and males (51.21%), while (Abdalla et al., 2017) in Somalia recorded a higher rate in females (54%). The disparity in infection rates between sexes is influenced by stress-related immune suppression in females, particularly during pregnancy and lactation, and the longer lifespan of females compared to males, which are often transported for slaughter.Age-Based Prevalence.

The highest prevalence was observed in camels aged 1–15 years (45.1%), followed by the 15–25 years group (37.5%) and the less than 1-year-old group (15.2%). These results align with those of (Al-Mialy et al., 2018), who reported 15.9% infection in young camels. Conversely, (Al-Amery et al., 2017) reported a lower prevalence of 6.66% in one-year-olds and 28.33% in middle-aged camels in Iraq. The higher prevalence in middle-aged camels is associated with sustained tick exposure under traditional grazing systems. Younger animals exhibit lower infection rates due to fewer tick infestations and the presence of maternal immunity, which enhances resistance to infection. Seasonal Prevalence

The prevalence of *Babesia spp*. was highest in autumn (50%) and spring (47.36%), compared to winter (25%) and summer (23.52%). Similar seasonal trends were noted by (Al-Mialy et al., 2018), who reported infection rates of 33.5% in summer and 17.6% in winter. Other studies, such as those by (Farhan & Hameed., 2017) and (Alimam et al., 2022) in Iraq, observed higher infection rates during the rainy season. Extreme climate changes, including rising temperatures and reduced cultivated areas due to water scarcity, have led to an unprecedented increase in tick populations, the primary vector for *Babesia spp*. These changes significantly impact the seasonal dynamics of infection.

CONCLUSION

The results of the present study showed that 35% of camels in northeastern Libya were infected with *Babesia spp*., highlighting the impact of *Babesia spp*. on the apparent health of one-humped camels (Camelus dromedarius) in the studied regions. The analysis revealed statistically significant differences in infection prevalence based on regions, sex, age, and seasons, emphasizing the influence of these factors on the distribution and severity of the infection.

RECOMMENDATION

In a different study, PCR was utilized for the detection of *Babesia spp*. due to its high sensitivity and specificity. Future research should focus on investigating whether *Babesia spp*. has the potential for zoonotic transmission to humans, particularly farmers and animal owners who are in direct contact with infected camels. Such studies are crucial to assess the pathogenic effects on humans and to develop appropriate preventive and control measures.

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