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Research Reports

Prevalence of Camel Mange and Associated Risk Factors in The Banadir Region, Somalia

Prevalensi Tungau Pada Unta dan Faktor Risiko Terkait di Wilayah Banadir, Somalia

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ABSTRACT

Background: Camel mange, a highly infectious and itchy condition brought on by *Sarcoptes scabiei* var. cameli, can be spread through direct and indirect contact. It is one of the most significant parasitic diseases affecting camels, severely impacting their productivity and health, with substantial economic consequences. **Purpose:** Assessing the prevalence of camel mange mites and identifying potential risk factors. **Method:** This cross-sectional study was carried out between June 2023 and February 2024 in the Benadir region of Somalia. A total of 384 camels were randomly selected for skin scrapings, with samples from suspected lesions being microscopically examined. **Results:** Of these, 82 camels (21%) were infested with mange mites, with *Sarcoptes scabiei* var. cameli identified as the only mite species. The research uncovered that the condition of the body, the size of the herd, and age substantially influenced the prevalence of mange mites ($p<0.05$), while district, sex, and age had no significant effect on infestation rate ($p>0.05$). **Conclusion:** The results suggest that mange mite infestations in the camel populations in the Benadir region negatively affect their health and productivity. Therefore, there is an urgent need to improve management practices and conduct further research and control measures to mitigate the effects of mange mite infestations on camel husbandry.

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ABSTRAK

Latar Belakang: Kudis unta merupakan penyakit dengan kondisi yang sangat menular dan gatal yang disebabkan oleh *Sarcoptes scabiei* var. cameli. Penyakit ini dapat menyebar melalui kontak langsung dan tidak langsung. Ini adalah salah satu penyakit parasit paling signifikan yang menyerang unta, yang berdampak parah pada produktivitas dan kesehatan mereka, dengan konsekuensi ekonomi yang substansial. **Tujuan:** Menilai prevalensi tungau unta dan mengidentifikasi faktor risiko potensial. **Metode:** Studi cross-sectional ini dilakukan antara Juni 2023 dan Februari 2024 di wilayah Benadir, Somalia. Sebanyak 384 unta dipilih secara acak, kemudian dilakukan pengerokan kulit, dengan sampel dari lesi diperiksa secara mikroskopis. **Hasil:** Dari jumlah tersebut, 82 unta (21%) terinfeksi tungau kudis, dengan *Sarcoptes scabiei* var. cameli diidentifikasi sebagai satu-satunya spesies tungau. Penelitian ini mengungkap bahwa kondisi tubuh, jumlah ternak, dan usia secara substansial memengaruhi prevalensi tungau kudis ($p<0,05$), distrik, jenis kelamin, dan usia tidak menunjukkan pengaruh signifikan terhadap tingkat infestasi ($p>0,05$). **Kesimpulan:** Hasil penelitian menunjukkan bahwa infestasi tungau kudis pada populasi unta di wilayah Benadir berdampak negatif pada kesehatan dan produktivitas mereka. Oleh karena itu, ada kebutuhan mendesak untuk meningkatkan praktik pengelolaan dan melakukan penelitian lebih lanjut serta tindakan pengendalian untuk mengurangi dampak infestasi tungau kudis pada peternakan unta.

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INTRODUCTION

The camel *(Camelus dromedarius)* is an essential livestock species adapted to arid, hot environments. It is mainly found in Eastern Africa's lowlands, where about 11.5 million camels account for over 80% of Africa's population, and two-thirds of the global camel population (Schwartz, 1992). These animals are invaluable to the regions they inhabit, providing milk, meat, and drought power, as well as serving as a mode of transportation, supporting the livelihoods of millions in semi-arid and arid areas (Schwartz and Dioli, 1992). Camels' remarkable capacity to withstand harsh climates, survive prolonged droughts, and transform-limited desert resources into milk and meat highlights their importance to pastoralists (Wosene, 1991). The camels' ability to thrive in arid climates is attributed to their unique physiological traits (Hailu *et al.,* 2020). They can survive several days without water in harsh conditions, earning them the moniker "the ship of the desert" (Giro and Jilo, 2020). Moreover, camels continue to produce milk during periods of famine and drought, conditions under which other livestock species often fail to survive (Jilo, 2016). Their capacity to withstand extreme heat and dehydration is critical for their survival in arid regions (Rabana Kumshe *et al.,* 2011). As other species are less suitable to harsh and dry preferences, camels are an essential livestock species in arid and semi-arid regions (Tadesse *et al.,* 2019).

Somalia is renowned for its large camel population but camel mange remains a significant challenge in regions with poor hygiene and high levels of overcrowding, which are common in some parts of Somalia, meaning that infestations can spread rapidly among camels. Somali pastoralists principally depend on camel herds due to the arid and desert climate (Prior, 1994). The majority of the world's camels are found in Somalia, where camel pastoralism supports over 60% of the population (Frumkin, 2019).

The livelihoods of pastoral and agro-pastoral communities are founded on camels *(Camelus dromedarius)*, which are the most climatically adaptable livestock. The camel's significance to the Somali economy and culture is unparalleled (Nyariki *et al.,* 2004). In the arid and semi-arid regions of Africa and Asia, camels are the most vital livestock species for transportation, field cultivation, and the production of milk, meat, and skin. Camels are exceptionally suited to harsh environments and can produce more milk for extended periods than other domestic dairy animals (Schwartz and Dioli, 1992; Suliman *et al.,* 2014). The lack of comprehensive parasitological research and documentation in Somalia hinders the development of effective control programs for camel mange infections. This study looks to fill in these gaps by investigating the prevalence of camel mange and its associated risk factors in the Banadir region of Somalia.

MATERIALS and METHODS

Research Design

A cross-sectional study was conducted between June 2023 and February 2024 in the Benadir region of Mogadishu, Somalia, to assess the prevalence of camel mange and its associated risk factors.

Study Area

The study was conducted in the capital city of Somalia, Mogadishu, from June 2023 to February 2024. Mogadishu is located in the southern part of the country and is bordered by the Middle Shebelle to the north and east and the Lower Shebelle to the west. It encompasses an area of and is subdivided into 18 districts. This investigation was conducted in six districts of the Benadir region, including Daarusalaam, Deyniile, Dharkeynley, Garasbaaley, Kaxda, and Yaqshid.According to Metz (1993), Mogadishu has a hot and semi-arid climate, with an average annual rainfall of 399 mm. Its geographic coordinates are 2°2'13.6"N latitude and 45°20'37.5"E longitude, and it is estimated to have a population of 2,425,000. Mogadishu is relatively flat, with elevations ranging from sea level to a maximum of 30 feet above sea level.

Population of the Study

The study's target population was comprised of randomly selected camel in Mogadishu city, with a total of 384 skin scraping samples collected and examined for mange lesions from farms to estimate prevalence and associated risk factors. Farms were selected purposively based on the higher camel populations of the area. Data on the age, sex, body condition, management, and housing type of the camels was gathered through owner interviews and the study camels were grouped into sex (male and female), age (classified as young and adult), management (confined and non-confined), and body condition (poor, middle, and good).

Sample Size Determination and Sampling Method

The expected prevalence of camel mange and the associated risk factors in the study area was assumed to be 50% and the sample size was determined using the formula given by Thrust (2005). The parameters used were a 95% confidence interval and a 5% desired level of precision.

Formula N= [1.962 Pexp (1-Pexp)]/d2

Survey, Collection, and Examination of Skin Scrapings

The camel owners thoroughly inspected their animals, paying close attention to any suspected of having mites. These animals underwent a more detailed examination using the skin-scraping technique, and their condition was documented through photography. Additionally, a questionnaire was completed to gather information on the prevalence of mites and their associated risk factors, including age, breed, sex, body condition, immunocompromised status, overcrowding, environmental factors, type of lesions, housing management, and response to treatment.

Collection and Examination of Skin Scrapings

Samples of deep skin scrapings were collected from camels infested with mites. The procedure was carried out until the appearance of redness, without causing any bleeding. Following this, the samples were examined with a 10% KOH solution to identify the presence of mites.

Laboratory Investigation

Skin samples from animals suspected of having mange were collected and placed in petri dishes, before being preserved in a 10% formalin solution. These samples were then transported to the laboratory for further examination. To dissolve the scraped material and facilitate the release of mites from the scabs and crusts, a 10% potassium hydroxide (KOH) solution was added. The scraped tissues were then carefully placed on microscopic slides and looked at under a microscope at 10x or 40x magnification.

Statistical Analysis

The data collected underwent a thorough analysis using SPSSv26, a statistical software package in the social sciences. Initially, descriptive statistical analysis was conducted, which incorporated frequency distribution and cross-tabulation tables. Subsequently, a chi-square test was performed for the qualitative data as part of a univariate analysis. A significance level of 0.05 was established for the analysis, and any relationships with a p-value of ≤0.05 were considered statistically significant. Additionally, forward stepwise logistic regression was employed in the multivariate analysis to identify the risk factors related to the prevalence of camel mites. The same significance level of 0.05 was maintained, and any associations with a p-value of ≤0.05 were deemed significant.

RESULTS

Overall Prevalence of Camel Mange

The overall prevalence of camel mange mites in this study was 21%. *Sarcoptes scabiei* var. cameli was the only mite species identified in all skin samples collected from the affected regions.

Prevalence of Camel Mange Based on Sex

The findings indicate that the occurrence of camel mange mites in females and males in the study area was 22% and 21%, respectively. No statistically significant difference was observed between the two groups, as demonstrated by the x^2 test (1, N=384) with a p-value of 0.008, greater than 0.05 (Table 1).

Table 1. Prevalence of Camel Mange Based on Sex.

Sex	Examined	Positif	% Prevalence	X^2	p-value
Male	128	27	21%	0.008	1.000
Female	256	55	22%		

Prevalence of Camel Mange based on Age

The most recent research demonstrates a greater incidence of mange mite infestation in camels belonging to the younger age group (33%), compared to those in the adult age group (17.7%). This difference was found to be statistically significant, as evidenced by the results of the chi-square test (x^2(1, N=384) = 10.044, p<0.05) as shown in Table 2.

Prevalence of Camel Mange among the Districts in the Benadir Region

Daarusalam and Kahda exhibited a slightly higher infestation prevalence than the other districts of the Benadir region with respective percentages of 25.5% and 25%. Deynile, Garasbaley, Yaaqshid, and Dharkenleey followed with prevalence rates of 23%, 23%, 21%, and 16%. There was no statistically significant difference found among the districts in the Benadir region regarding the occurrence of camel mange, as evidenced by the x^2 (1, N=384) value of 2.708 and a p-value greater than 0.05 (Table 3).

Table 2. Prevalence of Camel Mange Based on Age.

Age	Examined	Positif	% Prevalence	X^2	p-value
Young	294	52	17.7%	10.044	0.003
Adult	90	30	33%		

Table 3. Prevalence of Camel Mange among the Districts.

District	Examined	Positif	% Prevalence	X^2	p-value
Darussalam	43	11	25.5%	2.708	0.730
Kahda	36	9	25%		
Deynile	48	11	23%		
Garasbaley	105	24	23%		
Yaaqshid	57	12	21%		
Dharkenley	95	15	16%		

Prevalence of Camel Mange among Body Condition Scores

In this research, it was observed that camels with a poor body condition had a higher prevalence of camel mange (26.8%), followed by those with a medium (22.1%) and good body condition (7%). The difference in prevalence was statistically significant (x^2(1, N=384) = 11.655, p<0.05) as shown in Table 4.

Table 4. Prevalence of Camel Mange Based on Body Condition Score.

BCS	Examined	Positif	% Prevalence	X^2	p-value
Good	71	5	7%	11.655	0.003
Medium	145	32	22.1%		
Poor	168	45	26.8%		

Prevalence of Camel Mange Based on Herd Size

The outcomes of this study's examination indicated that the prevalence of small, medium, and large herd sizes was 28%, 21%, and 12.5%, respectively. There was a statistically significant difference in prevalence, as evidenced by the results of the chi-square test (x^2(1, N=384) = 7.492, p<0.05) (as shown in Table 5).

Table 5. Prevalence of Camel Mange Based on Herd Size.

Herd Size	Examined	Positif	% Prevalence	X^2	p-value
Large	88	11	12.5%	7.499	0.024
Medium	155	32	21%		
Small	141	39	28%		

DISCUSSION

Mange Infestation

The present study established a 21% incidence of mange infestations among the studied camel herds. This finding aligns with the observations of Ahmed (2020) in Eastern Harerge, Ethiopia, and Yohannis (2021) in Borana, Southern Ethiopia, and Ahmed, in the Kebri-Beyah District of Fafan Zone, in the Somali Regional State of Ethiopia who reported prevalences rates of 25% and 25.9%, 30.2% respectively (Mume, 2020; Jilo *et al.,* 2021; Ibrahim *et al.,* 2024) However, the prevalence discovered in this research surpasses those reported by Awol *et al.,* (2014) in the Azebu district of northern Ethiopia, Zahid *et al.,* (2015) in Punjab, Pakistan, Dinka *et al.* (2010) in eastern Ethiopia, Lawal *et al.* (2007) in Sokoto, Nigeria, and Chaudhry *et al.* (2014) in Cholistan, Pakistan, with prevalences of 16.7%, 11.28%, 10.7%, 3.5%, and 3.14%, respectively (Ameh *et al.,* 2007; Chaudhry *et al.,* 2014; Kiros *et al.,* 2014; Maqbool *et al.,* 2015). The differences in mange mite prevalence across these studies may be attributed to variations in the study periods, geographic location, environmental conditions, level of community awareness regarding transmission and control methods, and differences in animal husbandry and management practices.

The results of this study showed there to be no considerable differences ($p>0.05$) in the occurrence of camel mange mite infestations across various groups, including peasant associations, gender, and age range. This outcome aligns with the findings of Teka (2015) in eastern Ethiopia and Bekele in Borana, southern Ethiopia (Damena *et al.,* 2012; Admasu *et al.,* 2015). This similarity might be attributed to the consistent management practices, equal access to veterinary services, and comparable microclimatic conditions in the study areas. However, a substantial variation ($p<0.05$) was observed in mange mite prevalence based on body condition score and herd size. These findings are not agreed from those of Bekele *et al.* (2012) and Awol *et al.* (2014), likely due to the differences in environmental condition, study periods, and management practices (Damena *et al.,* 2012; Kiros *et al.,* 2014).

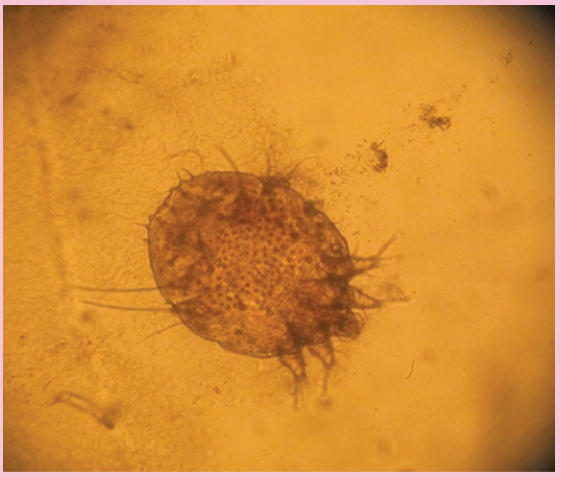

Figure 1. Microscopic findings of camel mange *(Sarcoptes scabiei var. cameli)*

Mange Prevalence

The investigations uncovered that the prevalence of camel mange mites was 22% in females and 21% in males, with no statistically discernible variation between the genders ($p>0.05$). This finding aligns with the findings of other researchers including Teshome in the Borana Zone, Southern Ethiopia, Mohammed in eastern Harergae, Ethiopia and Admasu in Eastern Ethiopia (Admasu *et al.,* 2015; Teshome *et al.,* 2021; Ame, 2023). A slightly greater prevalence in females could be attributed to hormonal influences, such as increased prolactin and progesterone levels, which might heighten their susceptibility to infection. Moreover, the stress of pregnancy and lactation could exacerbate this susceptibility. In addition, the breeding of mange-infected males might transmit the disease to multiple females (Lioyd, 1983).

A difference in the prevalence of mange mites was observed between younger and older camels. Among 33% of the younger camels, the prevalence was higher compared to 17.7% of adults. This difference was statistically significant ($p<0.05$) between the two age groups. The higher prevalence in young camels, those below four years of age, could be attributed to their weaker immune defenses. Proximity to infested lactating females might also be a contributing factor, making them more susceptible to the disease. This finding aligns with those of previous researchers, including Dinka *et al.,* (2010) and Ashraf *et al.,* (2014) (Dinka *et al.,* 2010; Zahid *et al.,* 2015). However, they did not mention how age affected the incidence of the condition. The age factor plays a role in mange infestation, with really young and elderly camels being especially susceptible (Awol *et al.,* 2014).

According to the study, there were notable differences in the prevalence of mites between small, medium and large herd sizes, with rates of 28%, 21% and 12.5%, respectively. These were significant ($p<0.05$), possibly due to the increased exposure to infected animals, which supports the contagious nature of mite infestations. This result did not agree with the results reported by Ahmed in 2020 in Jimma, Ethiopia, and Feyera in Eastern Ethiopia (Feyera *et al.,* 2017; Mume, 2020). This study suggests that interactions during herding, housing, and watering points, as well as auction marts, can contribute to the spread of mites.

Furthermore, camel mange was more common in animals with a poor body condition, accounting for 26.8% of cases, followed by those in medium (22.1%) and good (7%) body conditions. These findings showed there to be a statistically significant difference ($p<0.05$) between the groups. This finding aligns with the findings of researchers including Mustafe in the District of the Fafan Zone, in Ethiopia, and Feyera in Eastern Ethiopia (Feyera *et al.,* 2015; Ahmed *et al.,* 2023).

According to researchers, the increased prevalence in poorly conditioned animals may be caused by allergic reactions and the intense itching triggered by histamine released from damaged body cells. In addition, other factors such as trypanosomosis, heavy worm burdens, and poor nutritional

status may contribute to the increased prevalence in animals in a poor condition, as reported by Jarso *et al.* (2018) and Yifat *et al.* (2013).

CONCLUSION

The present study aimed to investigate the prevalence of camel mange mites and associated risk factors in the Benadir region. A total of 384 camels were examined, of which 82 (21%) were found to be infested with mange mites. The primary causative agent identified was Sarcoptes scabiei var. cameli. The study outcomes indicated that mange infestations were more prevalent in camels with poor body conditions and those in smaller herds. The scarcity of feed in the area resulted in close contact among camels at communal watering points, facilitating the development and spread of mite infestations. This research underscores that a substantial proportion of camels carry mange mites, which has significant implications for their health and productivity.

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CONFLICT of INTEREST

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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ETHICAL PPROVAL

The research protocol, due to involving animals, was evaluated and sanctioned by the Ethics Committee of the Somali National University, with approval number [SNU/ANIMAL RESEARCH 23/2/2024]. All procedures involving animals were conducted in accordance with the ethical standards of the institution or practice and the relevant ethical guidelines, such as those established by the Institutional Animal Care and Use Committee (IACUC).

AUTHOR'S CONTRIBUTION

MOSHM was responsible for the conceptualization and study design of the study. AAA and IAA collected the data. MOSHM and JBM carried out the methodology. MOSHM, JBM and AAA performed the data analysis. MOSHM, AAA, and IAA drafted the manuscript. All authors edited and approved the final manuscript.

REFERENCES

Ahmed, M., Ibrahim, M., and Mahamed, S., 2023. Study on Prevalence of One Humped Camel Mange and Its Associated Risk Factors in Selected Kebeles of Kebribeyah District of Fafan Zone, Somali Regional State, Ethiopia. *Research Square*, 1, 1-12.

Ahmed, M.A., Ibrahim, A.S., Bashir, B.M., and Mahamed, S.A., 2024. Prevalence of One Humped Camel Mange and Its Associated Risk Factors in Selected Kebeles of Kebri-Beyah District of Fafan Zone, Somali Regional State, Ethiopia. *International Journal of Tropical Disease & Health,* 45(1), 40-47.

Al-Owaimer, A.N., Suliman, G.M., Sami, A.S., Picard, B., and Hocquette, J.F., 2014. Chemical Composition and Structural Characteristics of Arabian camel *(Camelus dromedarius)* m. Longissimus Thoracis. *Meat Science,* 96(3), 1233-1241.

Ame, M.K.M., Mohamed, K., Usman, M., and Aliyi, A., 2023. Assessment of Camel Mange Mite Prevalence in Kumbi Woreda, Eastern Harergae, Ethiopia. *Pesticide Science,* 2(1), 1-12.

Ashraf, S., Chaudhry, H.R., Chaudhry, M., Iqbal, Z., Ali, M., Jamil, T., Sial, N., Shahzad, M.I., Basheer, F., Akhter, S., Ur Rehman, S.H., and Yasin, A., 2014. Prevalence of Common Diseases in Camels of Cholistan Desert, Pakistan. *Journal of Infection and Molecular Biology,* 2(4), 49-52.

Awol, N., Kiros, S., Tsegaye, Y., Ali, M., and Hadush, B., 2014. Study on Mange Mite of Camel In Raya-Azebo District, Northern Ethiopia. *Veterinary Research Forum,* 5(1), 61-64.

Dinka, A., Eyerusalem, B., and Yacob, H.T., 2010. A Study On Major Ectoparasites of Camel In and Around Dire Dawa, Eastern Ethiopia. *Revue de Médecine Vétérinaire,* 161(11), 498-501.

Elias, M., Yacob, H., and Jio, K., 2020. Prevalence, Risk Factors and Species Diversity of Ixodid Ticks that Parasitize Dromedary Camel in Yabello District of Borana Zone, Southern Ethiopia. *Journal of Parasitology and Vector Biology,* 12(2), 52-59.

Farah, K., Nyariki, D.M., Ngugi, R.K., Noor, I.M., and Giluye, A.Y., 2004. The Somali and the Camel: Ecology, management and economics. *The Anthropologist,* 6(1), 45-55.

Feyera, T., Admasu, P., Abdilahi, Z., and Mummed, B., 2015. Epidemiological and Therapeutic Studies of Camel Mange in Fafan zone, Eastern Ethiopia. *Parasites & Vectors,* 8(1), 1-6.

Feyera, T., Kebeta, M.M., Maalin, K., and Gizaw, Y., 2017. Major ectoparasites Infesting *Camelus dromedarius* in Three Districts of Somali Regional State, Eastern Ethiopia. *World Applied Sciences Journal,* 35(1), 96-103.

Frumkin, M., 2019. Camel Leasing: Impacting Somali Lives. https://agrilinks.org/post/camel-leasing-impacting-somali-lives . Accessed: 5 July 2024.

Giro, A., and Jilo, K., 2020. Prevalence of Camel Trypanosomosis and Associated Risk Factors in Arero district, Borena Zone, Southern Ethiopia. *International Journal of Veterinary Science and Research,* 6(1), 14-22.

Jarso, D., Birhanu, S., Wubishet, Z., 2018. Review on Epidemiology of Camel Mange Mites. *Biomedical Journal of Scientific & Technical Research,* 8(1), 6313-6316.

Jilo, K., 2016. Medicinal Values Of Camel Milk. *International Journal of Veterinary Science and Research,* 2(1), 18-25.

Lawal, M. D., Ameh, I.G., and Ahmed, A., 2007. Some Ectoparasites of Camelus dromedarius in Sokoto,

Nigeria. *Journal of Entomology,* 4(2), 143-148.

Lioyd, S., 1983. Effect of Pregnancy and Lactation Up on Infection. *Veterinary Immunology and Immunopathology,* 4(2), 153-176.

Madalcho, A. B., Tadesse, B.A., Gebeyew, K., and Gebresilassie, G., 2019. Camel Feed Characterization Of Ethiopian Somali Region Rangelands Through Traditional Knowledge. *Journal of Agriculture and Ecology Research International,* 19(3), 1-15.

Megersa, B., Demena, A., Bekele, A., and Sgeferaw, D., 2012. Ticks and Mange Mites Infesting Camels of Boran Pastoral Areas and The Associated Risk Factors, Southern Ethiopia. *Journal of Veterinary Medicine and Animal Health,* 4(5), 71-77.

Mume, J.A., 2020. Study on The Prevalence of Camel Mange Mite in Kumbi Woreda, Eastern Harergae, Ethiopia. [Thesis]. Jimma University. Ethiopia

Prior, J., 1994. Pastoral Development Planning. Oxam Library, 12-54.

Rabana, J.L., Kumshe, H.A., Kamani, J., Hafsat, G., Turaki, U.A., and Dilli, H.K., 2011. Effects of Parasitic Infections on Erythrocyte Indices of Camels in Nigeria. *Veterinary Research Forum,* 2(1), 59-63.

Schwartz, H.J., and Dioli, M., 1992. The One-Humped Camel In Eastern Africa. A Pictorial Guide To Diseases, Health Care And Management. Berlin: Verlag Joseph Margraf.

Teshome, Y., Jilo, K., Kararsa, N., Zegeye, Z., Guyo, Z., and Duba, T., 2021. Prevalence of Camel Mange Mite and Associated Risk Factors in Gomole district, Borana zone, Southern Ethiopia. *Animal and Veterinary Sciences,* 9(4), 88-92.

Wosene, A., 1991. Traditional Husbandry Practices and Major Health Problems of Camels in The Ogaden (Ethiopia). Nomadic Peoples, 29, 21-30.

Yifat, D., Menna, Y., and Sheferaw, D., 2013. Mange Mite Infestation of Small Ruminants and Associated Factors, School of Veterinary Medicine, Hawassa Ethiopia. *World Journal of Zoology,* 8(3), 299-302.

Zahid, M., Maqbool, A., Anjum, S., and Ashraf, K., 2015. Prevalence of Sarcoptic Mange in Camels in Punjab, Pakistan. *The Journal Of Animal and Plant Sciences,* 25(5), 1259-1263.