



# **A Regional Study on Dermatophytes Infection in Arabian Dromedary Camels (*Camelus dromedaries*) in Al-Hasa Governorate in the Eastern Province of Saudi Arabia**

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## **Authors' contributions**

*This work was carried out in collaboration between all authors. Author MS designed the study. Authors MS, SAB and FH performed the field works. Authors AF and IE carried out the laboratory examinations. Authors MS and SAB wrote the manuscript. All authors read and approved the final manuscript.*

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## **ABSTRACT**

**Aims:** To detect and isolate the dermatophyte species that affect Arabian Dromedary Camels in the Eastern Province of Saudi Arabia and to study its zoonotic potential.

**Methods:** A herd of thirty camels, including ten animals with ringworm, were investigated and were divided into 4 groups based on their age and clinical signs. Faecal samples were collected from all

of the animals for the parasitological examination, while skin samples were collected from the affected animals for the mycological examination. Animals were treated by different lines of treatment to determine the most reliable and cost effective method.

**Results:** Results revealed that the clinical cases were affected by *T. verrucosum*. Some factors such as intestinal nematode infestation, managemental and environmental factors served as underlying causes for ringworm. The disease prevalence is higher in young animals that are less than 3 years old. Animal owners can get infected through direct contact with infected animals or through fomites contamination.

**Conclusions:** This study is considered as the first published study to detect and isolate *T. verrucosum* in Arabian Dromedary Camels in the Eastern Province of Saudi Arabia and thus it could be considered as a database for dermatophytosis detection. Treatment lines and the preventive measures should be taken under consideration when dealing with ringworm to avoid the spread of the disease and to achieve high recovery rate.

**Keywords:** Ringworm; dermatophytes; Arabian dromedary camels; skin affection; Saudi Arabia.

## 1. INTRODUCTION

Since thousands of years camels are considered as an integral portion in the agriculture and the traditional cultures of many countries [1]. Camels have high survival ability and it can tolerate the rough environmental conditions [2].

The skin is considered as the largest organ in the body in which it represents about 12-14% of the body [3]. The skin can be affected by many diseases that can cause dermatitis, alopecia, scales, scabs or crust which depends on the causative agent of the disease [4]. Skin diseases can be caused by many causative agents which include fungal, parasitic, bacterial and viral causes [4,5].

Dermatophytosis is also known as ringworm or tinea is considered as one of the common diseases that affects both of the animals and humans [5,6]. This disease is caused by dermatophytes which include three genera which are *Trichophyton*, *Epidermophyton* and *Microsporum*, which are filamentous fungi that invade the keratinized tissues of the body [3,5,7].

Based on dermatophytes ecology, they have been divided into three groups which include zoophile, anthrophile and geophile [8]. The most common dermatophyte pathogens that affects animals mainly and infect humans occasionally are known as zoophilic dermatophytes while those that are found in the environment and are mainly associated with the keratinized tissues are known as geophilic dermatophytes; they may be transmitted to the animals and humans through direct contact with the soil [9]. Anthropophilic dermatophytes are those that

cause dermatophytosis in humans such as *Tinea capitis* and *Tinea pedis* and rare to infect animals [9-11].

Dermatophytosis is more common in the tropical and subtropical areas due to the high humidity and the temperature [12]. Dermatophytosis diagnosis is based on the clinical signs however in order to confirm the diagnosis culturing and direct microscopic examination of skin scrapings from the periphery of the lesions should be indicated [13].

The current study aims to detect and isolate the dermatophyte species that affect Arabian single humped dromedary camels (*Camelus dromedaries*) in the Eastern Province of Saudi Arabia and to study its zoonotic potential.

## 2. MATERIALS AND METHODS

### 2.1 Ethical Approval

The Ethics Committee at King Faisal University (KFU) approved the current study to be carried out for research purpose.

### 2.2 Animals

In order to carry out the current study, a camel herd was investigated in Al-Hassa region in the eastern province of Saudi Arabia. Al-Hassa is known for its seasonal variation in which it is cold and rainy in the winter while it is dry and hot in the summer. First, a single 2 years old camel calf was admitted to the camel clinic at the KFU Veterinary Teaching Hospital with skin gross lesions mainly on the flanks and the limbs. The owner stated that he has a herd that is

composed of 30 animals in which 10 of them are suffering from the same clinical lesions with the involvement of some human cases amongst animal attendees. A complete clinical examination was performed on the whole herd. Examined camels were divided into four groups after parasitological examination based on their age and according to the clinical signs in order to compare and evaluate the effect of cheap alternative methods for animals treatment (Table 1). Generally, most of the animals in this herd suffered from signs ranging from moderate anorexia and weakness to loss of body weight, loss of body condition, tough hair coat and pica.

The first group consisted of 7 camels in which their age ranged between 1-3 years and they have shown clinical skin lesions and they were infected by internal parasites. The second group composed of 3 camels in which their age ranged between 1-3 years and they have shown clinical skin lesions and they were free from internal parasites. The third group composed of 9 apparently healthy camels in which their age ranged between 3-20 years and they were infected by internal parasites. The last group represented 11 apparently healthy camels in which their age ranged between 3-20 years and they were free from internal parasites.

### 2.3 Sample Collection

Thirty faecal samples were collected from all of the animals in the herd in order to perform the parasitological examinations. Ten skin samples were also collected from the clinically infected animals (Group 1 and 2) to carry out the mycological examinations.

### 2.4 Mycological Examination

Skin scraping samples were collected from the periphery of the lesions by using sterile scalpels then the samples were transferred into sterile petri dishes. Each sample was divided into two part in which the first part was examined microscopically by using 20% KOH preparation according to [14]. The second part of the sample was cultured on Sabouroud dextrose agar after the addition of chloramphenicol and cyclohexidine [15]. The plates were incubated at 27°C for several weeks before the identification of the obtained colonies [16]. The produced dermatophyte colonies were identified according to their colonies and microscopic characteristics as described by [17,18].

### 2.5 Parasitological Examination

For parasitological examination flotation and sedimentation techniques were used according to [19] in order to ensure that the investigated camels were free from internal parasites.

### 2.6 Group Treatment Lines

Group 1 was treated by exposing the animals to direct morning sunlight in addition to treating the animals by anthelmintic drug: Fenbendazole (safe-guard; Intervet Inc., Beaucouzé, France), vinegar and multivitamins (AD3E).

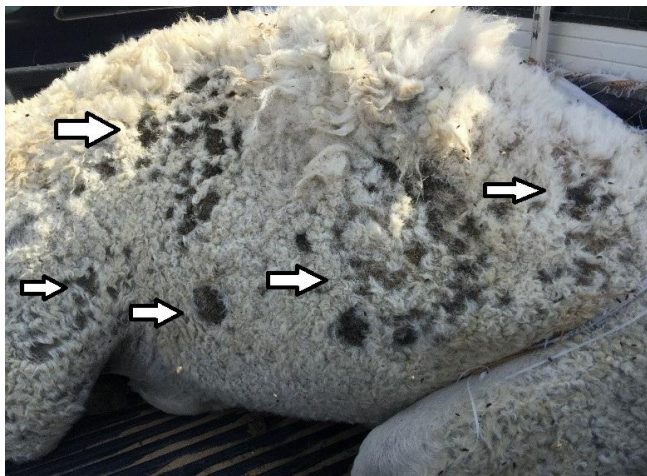
Group 2 animals were treated by anthelmintic drug: Fenbendazole (safe-guard; Intervet Inc., Beaucouzé, France), multivitamins (AD3E) and antifungal: Benzalkonium Chloride (Foot Rot & Ringworm Spray; AGRI LABORATORIES LTD., St. Joseph, Missouri, United States). Group 3 and 4 were treated by anthelmintic drug: Fenbendazole (safe-guard; Intervet Inc., Beaucouzé, France) and multivitamins (AD3E).

## 3. RESULTS

The obtained results revealed that the first group showed clinical signs of poor growth rate, skin lesions, areas of pruritus and alopecia as shown in Figs 1-3. The same clinical signs were observed in the second group except that the growth rate was normal in the second group unlike the animals in the first group. For the third group moderate anorexia and weakness were observed on the examined animals. Finally the fourth group of animals showed signs of general weakness, anorexia, loss of body weight and condition, tough hair and pica. Samples from camels that showed skin lesions (groups 1 and 2) were examined microscopically and they revealed positive results of the presence of dermatophyte spores in all of the examined animals. These skin samples were cultured and the produced colonies were examined microscopically to identify the dermatophytes revealing *T. verrucosum* in all of the infected animals (Fig. 4). Results of parasitological examinations of faecal samples showed that all camels in Groups 1 and Group 3 were infected by gastro-intestinal nematodes "parasitic gastro-enteritis (PGE)". On the other hand, camels in groups 2 and 4 were completely free from these gastro-intestinal nematodes. Also the obtained results showed that six out of seven animals (85.7%) in group 1 responded positively to the treatment line and they completely recovered,

while all camels in the second group completely recovered (100%). The obtained results of clinical signs, microscopic, fungal culture, gastrointestinal nematodes examination,

treatment lines and recovery rate were listed in Table 1. Ringworm lesions were also detected clinically on one of the animal attendees as shown in Fig. 5.

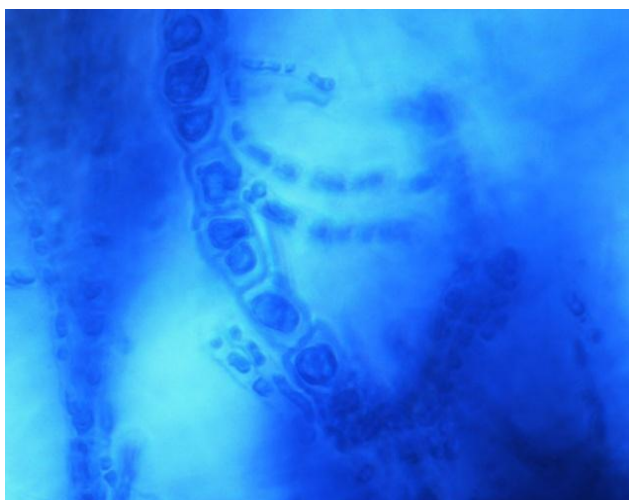


**Figs. 1-3. Clinical lesions of ringworm infestation on the examined animals**

**Table 1. Clinical signs of Dermatophytosis species involved in different age groups of camels in in the Eastern Province of Saudi Arabia and nematodes that associate with the skin disease**

	Animal groups			
	Group 1 (n=7) 1-3 years	Group 2 (n=3) 1-3 years	Group 3 (n=9) 3-20 years	Group 4 (n=11) 3-20 years
<b>Animal ages</b>				
<b>Clinical Signs</b>	-Poor growth -Skin lesions (Size of lesions varies from 3-5 cm in diameter, greyish-white slightly raised scales, ash-like surface, circular outline) -Pruritus -Alopecia	-Skin lesions (Size of lesions varies from 3-5 cm in diameter, greyish-white slightly raised scales, ash-like surface, circular outline) -Pruritus -Alopecia	-Moderate Anorexia, weakness	-Anorexia, weakness, loss of body weight, loss of body condition, tough hair coat and pica
<b>Microscopic Examination (Spores of dermatophytes)</b>	7/7	3/3	ND <sup>1</sup>	ND
<b>Fungal Culture (T. verrucosum)</b>	7/7	3/3	ND	ND
<b>gastro-intestinal nematodes (PGE)</b>	7/7	0/3	9/9	0/11
<b>Treatment Line</b>	-Morning sun exposure -Anthelmintic drug -Vinegar -Multivitamins	-Anthelmintic drug -Antifungal -Multivitamins	-Anthelmintic drug -Multivitamins	-Anthelmintic drug -Multivitamins
<b>Recovery</b>	6/7	3/3		

<sup>1</sup>ND: not done



**Fig. 4. Needle mount preparation from a three-week culture of *Trichophyton verrucosum* on Sabouraud's dextrose agar showing large thick chlamydospores in chain by Lactophenol cotton blue stain (X 400)**



**Fig. 5. Ringworm lesions on one of the animal attendees**

#### **4. DISCUSSION**

Since thousands of years camels are considered as an integral portion in the agriculture and the traditional cultures of many countries [1]. Ringworm or dermatophytosis is considered as a common disease in both animals and humans [3,6]. Ringworm was reported to be a common disease in camels around the world [20]. The current study was carried out in order to detect and isolate the zoophilic dermatophytes species that affected Arabian dromedary camels in the

Eastern Province of Saudi Arabia and to study its zoonotic importance. This work could be considered as the first published report to detect and isolate *Trichophyton verrucosum* in Arabian dromedary camels in the Eastern Province of Saudi Arabia. In the current study the disease was observed in camels that are less than 3 years old which agreed with [21] who stated that there is a statistically significant variation in the disease occurrence among different ages with young camels that are less than 3 years old being the most susceptible. Some other

researches reported similar results concerning age susceptibility to the diseases [22,23]. Clinical signs that were observed on the affected animals included different size of circular areas of alopecia with greyish-white slightly raised scales and crusts especially around the limbs and flank regions. This came in accordance with [21] who mentioned that infected camels could show generalized circular hairless areas with crust mainly over the flanks, neck, limbs and shoulder regions. Other signs were also observed which include general weakness, poor growth, though hair and pica as well as the presence of gastro-intestinal nematodes these are all indicators of poor managemental and environmental factors that could serve as underlying causes to the appearance of the clinical disease. This also agreed with [24] who mentioned that fungal infection appears if there are stress factors that cause weakness of the immune system. Direct microscopic examination of the collected samples from the infected animals (Group 1 and 2) revealed the presence of dermatophytes spores which confirms the presence of fungal infections in these animals.

The obtained results from cultured samples revealed that this outbreak was caused by *T. verrucosum* which agreed with [21] who isolated *T. verrucosum* from an outbreak that was found in camels in Al Qassim, in the Central region of Saudi Arabia. According to [25] most of the ringworm cases in camels are caused by *T. verrucosum*, *T. verrucosum* are characterized by small white to cream colored disk shaped colonies that has a raised middle areas and flat sides and under the microscope the organism has terminal chlamyospores that present in chains at the terminal of the hyphae [21]. For the treatment lines the second group showed 100% recovery rate when compared to Group 1 (85.7%). [26] Found that the application of iodine or chlorine based treatments is highly effective for *Trichophyton* dermatophytes in camels. Multivitamin supplements especially vitamin A can be used to prevent ringworm in young animals [27]. Ringworm lesions were also observed in some of the animal attendees (Fig. 5) that were advised to quickly follow up with a human dermatologist. In recent reports, it was observed that 80% of ringworm infections in human in the animal rearing areas were from animal origin and the infection was transmitted by the direct contact between sick animals and human or through fomites contamination [28,29]

## 5. CONCLUSION

The current investigation was conducted in order to detect and isolate the causative agent of camel dermatophytosis. It could be considered as the first published study to detect and isolate *Trichophyton verrucosum* in Arabian dromedary camels reared in the Eastern Province of Saudi Arabia. Therefore, it can be used as a foundation database for dermatophytosis detection. Treatment lines, management correction and preventive measures should be taken under consideration when dealing with ringworm to avoid the spread of the disease and to achieve high recovery rates in animals. Human at risk (animal owners, animal attendees, and field veterinarians) should follow up immediately with human dermatologists to avoid further complications.

## ETHICAL APPROVAL

The Ethics Committee at King Faisal University (KFU) approved the current study to be carried out for research purpose.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Allen W, Higgins A, Mayhew I, et al . An introduction to the camel in health and disease. Proc 1st Int Camel Conf Dubai. 1992;17-9.
2. Köhler-Rollefson I, Mundy P, Mathias E. A field manual of camel diseases: Traditional and modern health care for the dromedary. South Hampton ROW, London, WCIR 4 HL, UK: ITDG publishing; 2001.
3. Pal M. Dermatophytosis in an adult cattle due to *Trichophyton verrucosum*. Animal Husbandry, Dairy and Veterinary Science. 2017;1(1):1-3.
4. Radostits O, Gay C, Hinchcliff K, et al. A textbook of the diseases of cattle, sheep, goats, pigs and horses. Veterinary Medicine 10th ed. London, UK: Bailliere Tindall; 2007.
5. Pal M. Veterinary and medical mycology. 1st ed. New Delhi, India: Indian Council of Agricultural Research; 2007.
6. Dave P, Pal M. Tinea manuum in a veterinarian caused by *Trichophyton*

- verrucosum*. Ethiopian Int J Multidiscip Res. 2014;1:1-3.
7. Cafarchia C, Figueredo LA, Otranto D. Fungal diseases of horses. Vet Microbiol. 2013;167(1):215-34.
  8. Cafarchia C, Iatta R, Latrofa MS, et al. Molecular epidemiology, phylogeny and evolution of dermatophytes. Infect Genet Evol. 2013;20:336-51.
  9. Weitzman I, Summerbell RC. The dermatophytes. Clin Microbiol Rev. 1995; 8(2):240-59.
  10. Cafarchia C, Romito D, Capelli G, et al. Isolation of *Microsporum canis* from the hair coat of pet dogs and cats belonging to owners diagnosed with *M. canis tinea corporis*. Vet Dermatol. 2006;17(5):327-31.
  11. Graser Y, Scott J, Summerbell R. The new species concept in dermatophytes—a polyphasic approach. Mycopathologia. 2008;166(5-6):239-56.
  12. Jain N, Sharma M, Sharma M, et al. Spectrum of dermatophytoses in Jaipur, India. Afr J Microbiol Res. 2014;8(3):237-43.
  13. Markus R, Huzaira M, Anderson R, et al. A better potassium hydroxide preparation? In vivo diagnosis of tinea with confocal microscopy. Arch Dermatol. 2001;137(8): 1076-8.
  14. Koneman EW, Roberts GD. Practical laboratory mycology. 3rd ed. Baltimore, M.D: Williams & Wilkins; 1985.
  15. Larone DH. Medically important fungi: A guide to identification. 1st ed: Harper and Row publisher; 1976.
  16. Halley L, Standard P. Laboratory methods in medical mycology. 3rd ed. Atlanta: U.S., Department of Health, Education and Welfare, Public Health Service, Center for Disease Control, Bureau of Laboratories, Laboratory Training Section; 1973.
  17. Rippon J. Medical mycology: The pathogenic fungi and the pathogenic actinomycetes. 3rd ed. Philadelphia WB Saunders Co.; 1988.
  18. Larone D. Medically important fungi: A guide to identification. 3rd ed. Washington (DC): ASM Press; 1995.
  19. Barger AM, MacNeill AL. Clinical Pathology and Laboratory Techniques for Veterinary Technicians: John Wiley & Sons; 2015.
  20. Wernery U, Kaaden OR. Infectious diseases in camelids. Berlin: Blackwell Science; 2002.
  21. Almuzaini AM, Osman SA, Saeed EM. An outbreak of dermatophytosis in camels (*Camelus dromedarius*) at Qassim Region, Central of Saudi Arabia. J Appl Anim Res. 2016;44(1):126-9.
  22. Agab H. Epidemiology of camel diseases in Eastern Sudan with emphasis on brucellosis [M.V.Sc thesis]. Khartoum (Sudan): University of Khartoum; 1993.
  23. Baghza NM, Al-Adhroey AH, Ali AD. Isolation and identification of potential zoonotic dermatophytes from domestic camels in Dhamar Area, Yemen. Am J Health Res. 2016;4(3):46-50.
  24. Shokri H, Khosravi A. An epidemiological study of animals dermatomycoses in Iran. J Mycol Med. 2016;26(2):170-7.
  25. Wisal GA, Salim M. Isolation and identification of dermatophytes from infected Camels. Sudan J Vet Res. 2010;25:94-53.
  26. Manefield G, Tinson A. Camels: A compendium Sydney post graduate foundation vade mecum series C no. 22. Sydney: Post Graduate Foundation, Sydney University. 1997.
  27. Radostits O, Gay C, Blood D, et al. Veterinary medicine. 9th ed. London (UK): WB Saunders; 2000.
  28. Dave P, Pal M. Ringworm in a butcher caused by *trichophyton verrucosum*. Ind J Vet Public Hlth. 2017;3(2):33-5.
  29. Bassiri-Jahromi S. Epidemiological trends in zoophilic and geophilic fungi in Iran. Clin Exp Dermatol. 2013;38(1):13-9.

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