



An Over View of Dermatophytosis in Camels

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Dermatophytosis is a fungal infection of the skin caused by dermatophytes-filamentous fungi which have ability to invade the epidermis and keratinized tissues such as hair, skin or nails. *Trichophyton verrucosum* is the most common dermatophytes species isolated from camel. The disease is characterized by circumscribed crusty hairless lesion, (1-2 cm) distributed over the head, neck, shoulder, limbs and flanks. Dermatophytosis can be diagnosed by direct examination, fungal culture, skin biopsy and molecular diagnosis methods. This review forecast more light of the different aspects of this disease.

Keywords: Dermatophytosis; camel; clinical feature; diagnosis; treatment.

1. INTRODUCTION

Camels in their natural habitat are exposed to severe stress conditions which make them susceptible to many diseases [1,2]. In last decades camels were reported to be resistant to many disease causing agents [3,4], now it has

been realized that they are susceptible like other livestock or even more, to the common disease causing pathogens [5-7].

Dermatophytes are among the most frequent causes of superficial skin infections in man and animals, known as Dermatophytosis (ringworm).

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It caused by fungi of three genera *Microsporum*, *Trichophyton* and *Epidermophyton*. Ecologically, dermatophytes are classified to three groups anthropophilic (mostly associated with humans), zoophilic (associated with animals) and geophilic (found in the soil). Dermatophytosis in camels is the most frequent mycosis worldwide it has public health and economic importance. There are two forms of the disease sporadic as well as epidemic form [8-10]. Ringworm occurs in camels less than 3 year age and is characterized by circumscribed crusty hairless lesion, 1-2 cm in diameter distributed over the head, neck, shoulder, limbs and flanks [1]. *T. verrucosum* is the most common cause of dermatophytosis in camels [11].

2. EPIDEMIOLOGY

Dermatophytosis was reported to be a common disease of camels worldwide [10,12]. Different prevalence rate of the disease of 48% [13] and 43.5% [14] were reported in camels, while [15] reported lower prevalence of 8.58% in camels suffering from dermatophytosis. Camels less than 3 year age were more susceptible to the disease than older animals [1].

Predisposing factors:

1. Age animals less than three years old always get the infection.
2. Breed foreign breed is more susceptible to disease.
3. Production system for example poor and crowded houses.
4. Close confinement.
5. Immunosuppression (including immune-suppressive treatment) [16,17].

3. TRANSMISSION

The transmission of dermatophytosis is usually occurs by direct contact with infected host (animals or humans) or asymptomatic carriers indirect contact with contaminated fomites besides contact with soil [18,19].

4. CLINICAL FEATURES

Ringworm in camels is characterized by circumscribed crusty hairless lesion, 1-2 cm in diameter [1] on the head, the neck and shoulders with a possible extension to the flanks and legs, leading sometimes to emaciation [20] (Figs. 1-8).

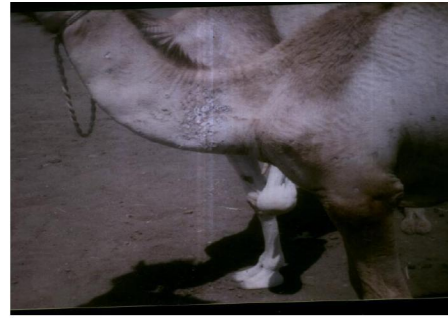


Fig. 1. Localized lesions of ringworm on camel neck [11]

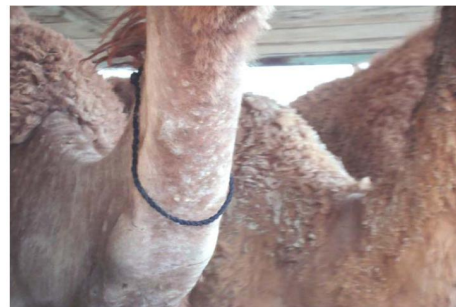


Fig. 2. Circular lesions on the neck of camel [56]



Fig. 3. Alopecic ringworm lesions [57]



Fig. 4. A young camel calf has crusty and hairless lesions on the shoulder [44]

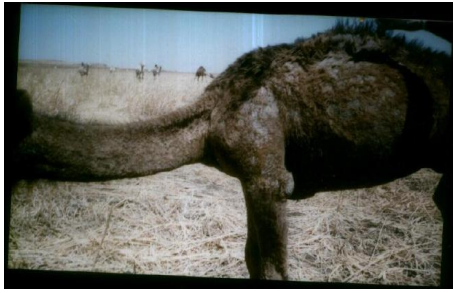


Fig. 5. Acamel from Elobied areas showing generalized lesions of ringworm giving moth-eaten appearance of wool [11]



Fig. 6. Affected camel showed white hairless patches on different parts of the body. The lesions typically consisted of an area of alopecia [44]



Fig. 7. Epidermophyton fast spreading lesions with circular patches [29]



Fig. 8. Epidermophyton lesions giving just burning appearance [29]

5. MIXED INFECTION OF DERMATOPHYTOSIS AND OTHER SKIN DISEASES

Mixed infection of dermatophytosis and *Sarcoptic scabiei* has been reported by [21,22]. Mixed infection of dermatophytosis caused by *M.gypseum* and *Dermatophilus congolensis* in dairy farm camel was recorded by Gitao et al. [15] Fig. 9.

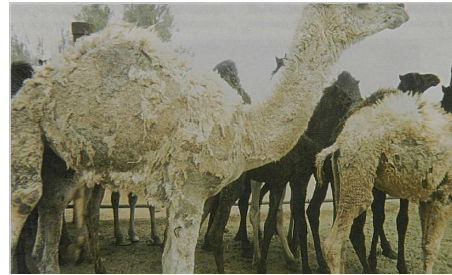


Fig. 9. Hair matting and crusty, hairless lesions on the flanks of a camel calf

6. ETIOLOGY

The disease in camel is mainly caused by *Trichophyton verrucosum* [12,14,23,24,25]. *T. mentagrophytes* has been isolated by Wisal and Salim [11]. [26-28] were able to isolate *T. schoenleinii*. *T. dankaliense* was isolated by Dalling et al. [4]. Tuteja et al. [29] has been isolated *T. equinum*, *T. concentricum*, *T. tonsurans*, *T. violaceum*, *T. soudanense*, *T. rubrum*, *M. canis*, *M. nanum* and *M. ferrugineum*. *M.gypseum* has been isolated by [15,30,31] *Epidermophyton floccosum* has been reported by Tuteja et al. [32].

7. DIAGNOSIS

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 [33].

7.1 Collection of Samples

Skin scraping samples from the cattle that were suspected to be infected with dermatophytes will be collected on the basis of gross lesion on their body. After cleaning with ethyl alcohol 70%, hair and scrapings samples should be collected with forceps or scalpel just behind the extending margin in the infected area. Samples can be kept in polyethylene bags [25].

7.2 Direct Examination

Each Sample from infected camel should be divided into two portions, one portion for direct microscopic examination and the other for culture. Fungal hyphae and/or ectothrix spores are determined to be seen in the direct examination when they appear to make hairs or hair fragments thicker and rough with irregular surface.

Potassium Hydroxide (KOH) 10 or 20% is used as a clearing agent because it has keratolytic activity [34-36]. Infected hairs appear pale, wide and filamentous compared with normal hairs when examined at x4 or x10 magnification, appearing. Arthrospores can be visible on high magnification (x40) (Fig.10).

7.3 Fungal Culture

Fungal culture is considered the 'gold standard' for diagnosis [37]. Sabouraud's dextrose agar (SDA) containing cycloheximide, penicillin and streptomycin were used in most diagnostic laboratories. Plates should be incubated at 25°C for 5 weeks. Dermatophytes test media (DTM) is recommended as the best media for isolation of dermatophytes because the presence of the red color indicated positive result, this can help in early identification of highly suspected cultures [38]. The isolates should be examined macroscopically and microscopically after staining with lactophenol cotton blue using wet mount technique [39] (Figs.11-20).

In addition to technique steps mentioned above, pigment production on corn meal agar, urease activity on urea agar base, growth at 37°C on SDA (Fig. 21).

7.4 Molecular Diagnosis

Diagnosis with conventional methods is time-consuming because it might take up to 4 weeks or longer to give the final results [40]. Furthermore, morphological identification may be confusing due to polymorphism of dermatophytes [41]. During the last decade, a wide variety of molecular techniques has become available as possible alternatives for routine identification of fungi in clinical microbiology laboratories [42,43].

Molecular identification for *Trichophyton* species isolated from camel skin lesions was done using (GACA) 4 all the strains were amplified simply resulting PCR bands ranged from 2-5. Three profiles of *Trichophyton mentagrophytes* have

been detected so *T. mentagrophytes* is known to be a species complex [44] (Fig. 22).

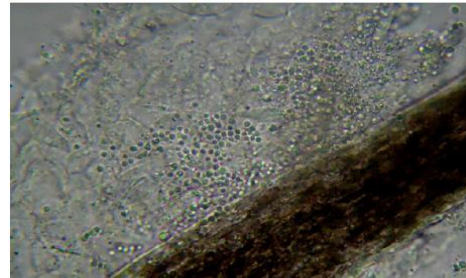


Fig. 10. KOH preparation showing hair surrounded with chain of large ectothrix spores X400 [58]



Fig. 11. Colony of *T. verrucosum* on the modified SDA [55]



Fig. 12. Colony *T. mentagrophytes*: Surface of colony show powder-like shape, white, loose irregular mycelium on the edge [58]

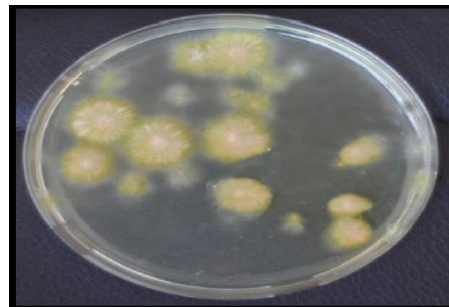


Fig. 13. Colony surface of *M. canis* [59]



Fig. 14. Colony of *Microsporium gypseum* [60]

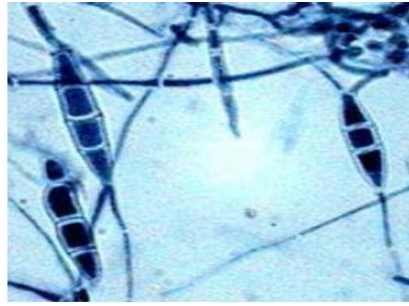


Fig. 18. *Microsporium canis* microscopic observation in lactophenol cotton blue [61]

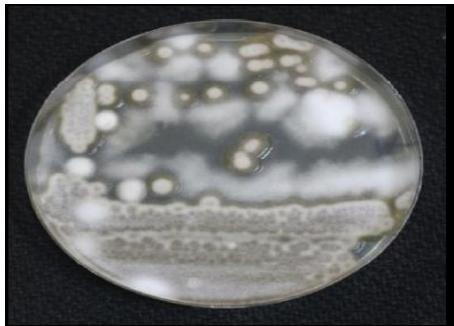


Fig. 15. Colony surface of *E. floccosum* [59]



Fig. 19. *Microsporium gypseum* microscopic observation in lactophenol cotton blue [60]

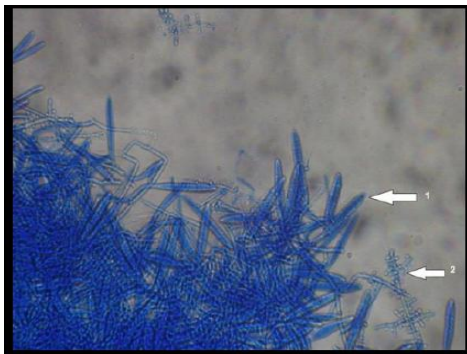


Fig. 16. 1) Macroconidia, 2) Microconidia in *T.mentagrophytes* [59]

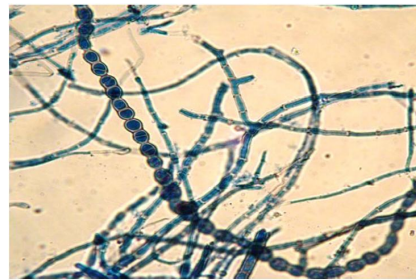


Fig. 20. Microscopic appearance of *T. verrucosum* [52]



Fig. 17. Macroconidia in *E. floccosum* [59]



Fig. 21. Growth of *T. mentagrophytes* on urea agar after 4 days showing hydrolysis of the urea [62]

Trichophyton species isolated from camel and human were identified using restriction fragment length polymorphism (RFLP), *Mva*1 was used as restriction enzyme. Five different patterns of two to four bands were obtained. None of these different species gave the same profile pattern [45] (Fig. 23).

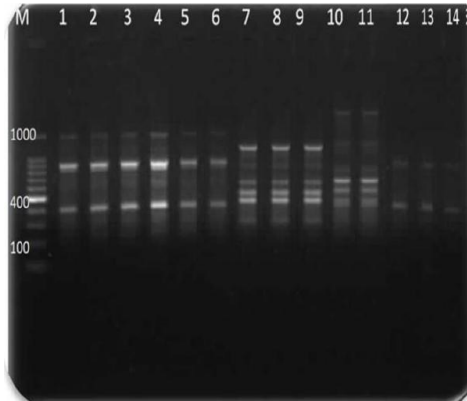


Fig. 22. Agarose gel electrophoresis for PCR using (GACA)₄. M, molecular weight marker. Lanes (1-6) first profile of *T. mentagrophytes* Lanes (7-9) second profile of *T. mentagrophytes*. Lanes (10 & 11) third profile of *T. mentagrophytes* Lanes (12-14) *T. verrucosum* [44]

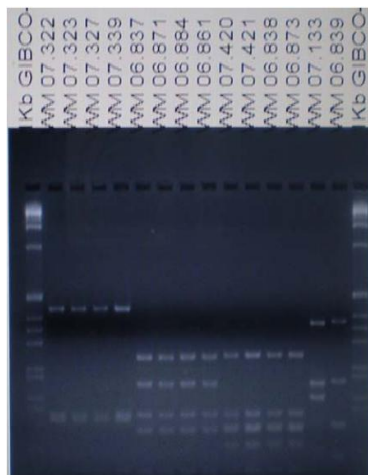


Fig. 23. RFLP profiles of *Trichophyton* spp isolates. WM 07.322, WM 07.323, WM 07.327, WM 07.339 were *T. mentagrophytes* var *mentagrophytes*, WM06.837, WM 06.871, WM 06.884, WM 06.861 were *T. mentagrophytes* var *interdigitale*, WM 07.420, WM07.421, WM 06.838, WM 06.873 were *T. tonsurans*, WM 07.133 *T. mentagrophytes* var *erinacei* and WM 06.839 was *T. rubrum* [45]

7.5 Skin Biopsy

Specimens from infected skin should be taken and fixed in 10% formaline solution then dehydrated, cleared and embedded in paraffin wax, sectioned at 4 µm thickness should be stained by haematoxylin and eosin for microscopical examination [46]. haematoxylin and eosin staining (H&E) may or may not identify dermatophytes and special stains such as periodic acid Schiff (PAS) and Grocott methenamine silver (GMS) are needed.

Microscopically, the hair follicles and sweat glands exhibited cystic dilatation (Fig. 24) and were lined by atrophied epithelium.

Occasionally, perivascular dermatitis, and intra-epidermal pustules characterized by focal aggregation of neutrophils mixed with eosinophil and karyorrhectic debris were reported (Fig. 25).

The branched fungal hyphae were seen when sections stained with PAS (Fig. 26).

The surface as well as intrafollicular hairs was colonised by large numbers of refractile or slightly basophilic arthrospores and hyphae. These were coloured bright magenta with periodic acid-Schiff stain and black with Gomori's methenamine silver stain. The Keratin-filled follicles ruptured leading to prominent furunculosis [22] (Figs. 27,28).

8. TREATMENT

Optimal therapy of dermatophytosis requires a combination of topical antifungal therapy, concurrent systemic antifungal therapy and environmental decontamination. The treatment should be continued until two consecutive negative cultures (at weekly or bi-weekly intervals) are obtained [47]. Topical treatments speed resolution of clinical lesions and may help prevent zoonotic contagion. Systemic therapies that have prolonged residual activity in the skin and hair provide the most effective treatments.

8.1 Topical Therapy

1. 2% solution of tincture iodine [23].
2. 10% iodine ointment daily for three weeks [48].
3. Enilconazole Wash or spray with diluted emulsion (2000 ppm) four times at 3–4-day intervals [49].

8.2 Systemic Therapy

1. Griseofulvin 10 mg/kg body weight for 7 days in mild infections; in severe cases 2–3 weeks [49].

8.3 Environmental Decontamination

Dermatophytes can remain viable in infected soil for many years [50-52], so 10% hypochlorite solution can be used as disinfectant [53].

8.4 Vaccination

Live attenuated vaccine is used for prophylaxis and therapy for dermatophytosis caused by *T. verrucosum* and *T. mentagrophytes* every five years [54].

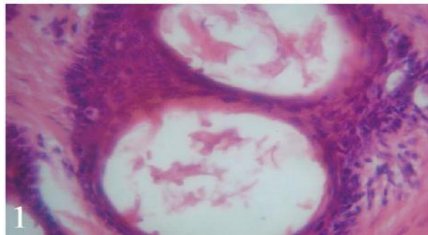


Fig. 24. Ring worm in camels, noticed destroyed hair shaft, perifolliculitis and cystic dilatation of the hair follicles (H&E X650) [46]

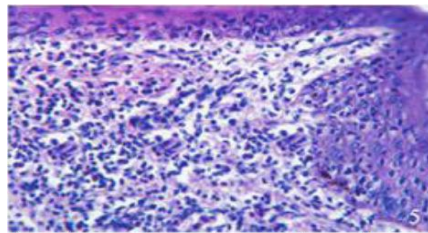


Fig. 25. Ring worm in camels, noticed intra-epidermal pustules and acanthosis (H&E X400) [46]

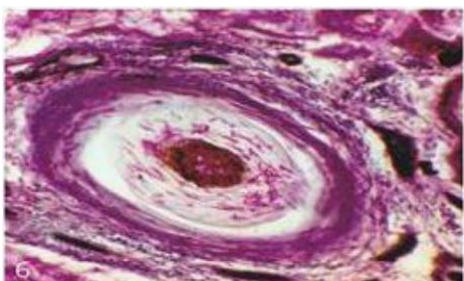


Fig. 26. Ring worm in camels, noticed trichophyton hyphae positive for PAS-reaction (H&E X400) [46]

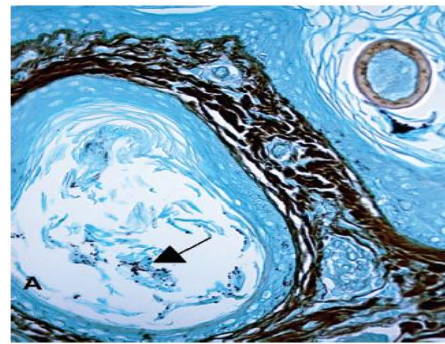


Fig. 27. Refractile arthrospores and hyphae appear: Bright magenta with periodic acid-schiff stain [22]

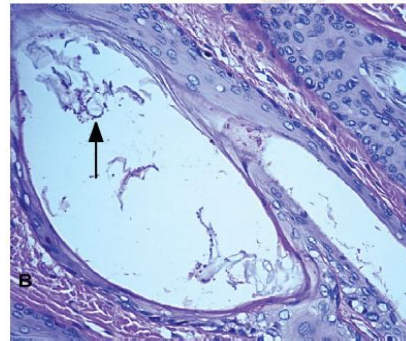


Fig. 28. Refractile arthrospores and hyphae appear black with Gomori's Methenamine silver stain [22]

9. CONCLUSION

Dermatophytoses are the most common fungal infections in camels. Many studies were done considering different aspects of the disease (eg. epidemiology, clinical presentation and diagnosis, treatment, prevention, and control). Infected camel with dermatophytes can be a source of infection to human this can lead to public health problem.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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