

Prevalence of dermatophytes isolated from domestic animals in Ankara within a three-year period (2014-2017)

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ABSTRACT

Dermatophytosis is an infectious and zoonotic disease caused by species belonging to the genera *Microsporium*, *Trichophyton*, and *Epidermophyton* that affects the hair follicles, nails, and keratin layer of the epidermis. The aim of this study was to determine the prevalence of dermatophytosis in different animal species with clinical lesions. To this aim, a total of 395 skin scraping and hair samples taken from cat, dog, horse, parrot, and calf with dermatophytosis suspicion, presented to the Department of Microbiology of Faculty of Veterinary Medicine Ankara University between 2014 and 2017 in different seasons were investigated. A mycological analysis of the samples was conducted involving direct microscopy and a fungal culture test. Of the 395 samples tested, 117 (29.62%) were positive for dermatophytosis with the following distribution: *Microsporium* spp., 34 of 195 (17.44%) cats, 24 of 181 (13.26%) dogs, two of 11 (18.18%) horses; *Trichophyton* spp., 26 of 181 (14.36%) dogs, 25 of 195 (12.82%) cats, one of 11 (9.09%) horses, one of three (33.33%) calves, and two of five (40%) parrots; *Epidermophyton* spp. two of 195 (1.02%) cats. The dermatophyte isolation rate was relatively higher in the summer (36.06%) and spring (29.51%) for cats, and in fall (30%) and spring (26%) for dogs. As a conclusion, the data contribute to the literature regarding the local epidemiology of dermatophytosis and define potential etiological agents in different animal species, especially cats and dogs.

INTRODUCTION

Dermatophytosis (ringworm) is the superficial infection of such keratinized tissue as the nails/claws, hair and stratum corneum caused by the *Microsporium*, *Trichophyton*, and *Epidermophyton* genera of fungi (1-4). Affecting several mammalian species, including humans and poultry, dermatophytes are classified as anthropophilic (mostly human-associated), zoophilic (animal-associated) and geophilic (soil-dwelling) based on their natural habitat and host preferences (2,3,5). Mostly zoophilic and geophilic species, and more rarely anthropophilic species, have been reported to cause infections in animals (1,5-7). Dermatophytes are known to be among the most common causes of dermatological problems in domesticated animals, and have also been reported to cause serious infections especially in the immunocompromised (AIDS, organ transplantation, diabetes mellitus, etc.) in many countries around the world (4,8-10). Dermatophytosis is considered a significant disease in veterinary medicine, due to its contagiousness and zoonotic potential, and in pet veterinary medicine in particular. Several mammals and poultry species

are susceptible to infection, regardless of age, gender or breed, although it is inclined to occur more often in young, sick, and elderly patients. The incidence of dermatophytosis varies in terms of the natural host, climatic conditions, and geographical differences (1-3,6).

While there are more than 30 species that are known to cause dermatophytosis, it is believed that *Microsporium* (*M*) *canis*, *M. gypseum*, and *Trichophyton* (*T*) *mentagrophytes* are responsible for dermatophytosis in cats and dogs, *T. verrucosum* in cattle and other ruminants, *M. canis* and *T. equinum* in horses and *M. gallinae* in poultry (1,3,5,11). Transmission occurs primarily through direct contact with dermatophyte-infected animals or with contaminated fomites (via brushes, soil, etc). Germination occurs through the adherence of dermatophyte arthrospores to the cells of the stratum corneum, producing hyphae that then invade the stratum corneum through keratinases. Invasion induces an immune response, and the typical clinical presentation emerges within 1–3 weeks of exposure to the agent (5,10,12). Clinical presentations that may indicate dermatophytosis include such symptoms as

alopecia, erythema, papules, scaling, and crusting, either individually or in combination (2,3,13). The clinical course and clinical signs of dermatophytosis contribute substantially to laboratory diagnosis, which is established through the direct microscopy of suspected samples and the subsequent isolation and identification of dermatophytes in cultures (9,13).

This study aimed to examine the samples of different animal species sent to the Department of Microbiology of Faculty of Veterinary Medicine Ankara University with suspected dermatophytosis between 2014 - 2017 and to determine the seasonal isolation rates.

MATERIAL and METHODS

A total of 395 skin scrapings and hair samples from 195 cats, 181 dogs, 11 horses, five parrots, and three calves that presented to the Department of Microbiology of Faculty of Veterinary Medicine Ankara University with suspected dermatophytosis in various seasons were investigated between 2014 and 2017.

Direct microscopic examination

The suspected skin scraping and hair samples were mixed with 10% potassium hydroxide (KOH) (Merck, Germany) in preparation for analysis. After being kept at room temperature for 15–20 minutes, the preparations were examined by light microscope at 40x magnification to screen for hyphae and dermatophyte spores (9,14).

Mycological isolation

The suspected dermatophyte suspected samples were cultured in a Sabouraud Dextrose Agar (SDA) medium (Oxoid, UK) supplemented with chloramphenicol (Oxoid, UK) (0.05 mg/ml), after being embedding using a sterile pen or lancet. The media was incubated under aerobic conditions and at 25°C for 1–4 weeks, and checked on a daily basis (9,14).

Macroscopic and microscopic examination of fungal colonies

The macroscopic examination was completed upon the evaluation of growing status and the time, shape, and pigmentation characteristics of the front and rear surfaces of the colonies, within and at the end of the incubation period. A microscopic examination was made to identify dermatophyte species in the hyphae, macroconidia, and microconidia on

preparations made through the cellophane band method using a lactophenol cotton blue solution (Merck, Germany) (13,14).

Statistical analysis

The chi-square (χ^2) test was used to examine the statistical significance of distribution of dermatophyte species and dermatophytosis prevalence in the population analyzed, distribution of dermatophyte species according to animal species, and dermatophytosis prevalence by seasons. $p < 0.001$ was considered statistically significant. The IBM SPSS Statistics V21.0 software package for Windows was used for the statistical analyses.

RESULTS

Of the 395 examined samples obtained from the various animal species, 117 (29.62%) were positive for dermatophytosis, and 60 (51.29%) isolates were identified as *Microsporum* spp., 55 (47%) as *Trichophyton* spp., and two (1.71%) as *Epidermophyton* spp., being the difference significant [χ^2 (df=3, n=395)=454,752 ($p < 0.001$)] (Table 1). The distribution isolated dermatophytes and animal species was presented in Table 2. No statistically significant difference ($p < 0.001$) was detected among the animal species in terms of the identified dermatophyte species. The seasonal distribution of dermatophytosis indicated a proportionate increase in the summer months in cats (36.06%) and calves (100%), and in fall in dogs (30%) and horses (66.67%), while it was equally distributed across the fall and winter months for parrots (Table 3). No statistically significant association ($p < 0.001$) was found in the seasonal distribution of animal dermatophytoses.

Table 1. Distribution of results of samples examined according to animal specie.

Animal species	Materials (%)	Positive (%)
Cat	195 (49.37)	61 (31.28)
Dog	181 (45.82)	50 (27.62)
Horse	11 (2.79)	3 (27.27)
Parrot	5 (1.26)	2 (40)
Calf	3 (0.76)	1 (33.33)
Total	395 (100)	117 (29.62)

Table 2. Number and frequency of dermatophytes isolated from different animal species.

	Cat	Dog	Horse	Parrot	Calf	Total
Dermatophytes	n (%)					
<i>Microsporum</i> spp.	34 (55.74)	24 (48)	2 (66.67)	-	-	60 (51.29)
<i>Trichophyton</i> spp.	25 (40.98)	26 (52)	1 (33.33)	2 (100)	1 (100)	55 (47)
<i>Epidermophyton</i> spp.	2 (3.28)	-	-	-	-	2 (1.71)
Total	61 (52.14)	50 (42.74)	3 (2.56)	2 (1.71)	1 (0.85)	117 (100)

Table 3. Seasonal distribution of dermatophytes isolated from different animal species.

Seasons	Cat	Dog	Horse	Parrot	Calf	Total
	n (%)					
Winter	8 (13.11)	10 (20)	-	1 (50)	-	19 (16.24)
Spring	18 (29.51)	13 (26)	1 (33.33)	-	-	32 (27.35)
Summer	22 (36.06)	12 (24)	-	-	1 (100)	35 (29.91)
Fall	13 (21.31)	15 (30)	2 (66.67)	1 (50)	-	31 (26.49)

DISCUSSION

Dermatophytes are known to be among the most common causes of dermatological problems in domesticated animals and dermatophytosis are common in many countries around the world. Several studies are available on dermatophytosis in various animal species as varying. In a study in Finland, Aho (1980) reported a positivity rate of 10.9% for dermatophytes in 331 samples collected from various animals (3.9% of dogs, 21.3% of cats, 14.8% of cows, and no cage birds) with suspected dermatophytosis (15). Cabanes et al. (1997) reported a positivity rate of 33.7% for dermatophytes in 270 samples (38.9% of dogs, 33.9% of cats, 23.1% of horses, 25% of cows, and no parrots) in Spain (16). The several researchers indicated that 31.4% of 790 and 35.7% of 487 samples to be positive for dermatophytosis (55% of feline, 8% of canine, 38% of bovine, 19% of equine and 21.6% of canine, 43.5% of feline, 100% of bovine, 40% of equine samples, respectively) in Iran (17, 18). In Nigeria, Nweze (2011) reported that 39.8% of 538 samples were positive for dermatophytosis, with an animal origin-based rate of dermatophyte positivity of 22% in cats, 24.3% in dogs, 12.6% in cows, and 5.1% in horses (7).

The isolation of *Microsporum* spp. and *Trichophyton* spp. in various animal species (cat, dog, horse, and cow) ranges between 71-90 % and 52-74 %, respectively (7, 17-19). Cabanes et al. (1997) reported that *Microsporum* spp. and *Trichophyton* spp. isolation rates were 48.27% and 20.41% in same animal species (16). A comparison of the isolation rates established in the present study with those reported by the abovementioned studies reveals higher rates than those reported by Cabanes et al. (1997) and lower rates than those reported by Khosravi and Mahmoudi (2003), Yahyaraeyat et al. (2009), Nweze (2011), and İlhan (2015) (7, 17-19). In addition, the study findings were determined to be similar to the study findings (50% for *Microsporum* spp. and 41.67% for *Trichophyton* spp.) reported by Aho (1980) (15). It was considered that the differences in dermatophyte isolation rate might have resulted from the variability in animal breeds, and the quantities of samples collected.

It is reported that more than 95% of cases of dermatophytosis in cats are caused by *Microsporum* and *Trichophyton* species, and in particular, *M. canis*. *Epidermophyton* species among the anthropophilic dermatophytes have been reported to cause infections in animals on rare occasions (1,4,6). In the study, 55.74% of the 61 (31.28%) dermatophyte agents isolated from 195 suspected cat samples were identified as *Microsporum*

spp. and 40.98% as *Trichophyton* spp. When compared with studies conducted in different regions of Turkey and the other countries, these rates are lower for *Microsporum* spp. and higher for *Trichophyton* spp. (19-29). Furthermore, 3.28% of the dermatophyte isolates were identified as *Epidermophyton* spp. in present study. The isolation of *Epidermophyton* spp. from animals reflected the human flora rather than the infection, while there are rare cases indicating infections in immunocompromised dogs (2). In our knowledge there was no reports of *Epidermophyton* spp. in animals in Turkey.

As with the case for cats, reports indicate that the causative agent of dermatophytosis in dogs are such *Microsporum* and *Trichophyton* species as *T. mentagrophytes* and *M. gypseum*, and in particular, *M. canis* (1,2,4). In the study, 48% of the 50 dermatophyte agents (27.62%) isolated from 181 dermatophytosis suspected dog samples were identified as *Microsporum* spp. and 52% as *Trichophyton* spp. Unlike cats, the rate of *Microsporum* spp. isolates in dogs was found to be lower than the rate of *Trichophyton* spp. isolates in the present study. *Trichophyton* spp. is known to be dominant in the back of dogs (27). It was considered that high *Trichophyton* spp. isolation in dogs may be related to the sampling area in this study. It has been ascertained from the studies carried out in several different parts of Turkey and around the world that species of the genus *Microsporum* account for the majority of dermatophytes isolated from dogs (21,24,26,28-32). In this regard, the findings of the present study differ from those of the aforementioned studies, while our study findings share similarities with those reported by Derincegöz and Parin (2016) in Turkey (*Trichophyton* spp. in 57.14% and *Microsporum* spp. in 42.86% of the isolates) and by Beraaldo et al. (2011) in Brazil (*Trichophyton* spp. in 57.89% and *Microsporum* spp. in 42.11%) (23,27).

It is reported that dermatophytosis in horses is caused by *Trichophyton* and *Microsporum* species, and in particular, such as *T. equinum*, *M. canis*, *T. mentagrophytes*, and *T. verrucosum* (3,4,11). It has been indicated that the isolation of *Trichophyton* spp. and *Microsporum* spp. in suspected horse samples ranges between 50-100% and 25-50%, respectively (7, 15, 16, 33-36). The isolation rate of *Microsporum* spp. in the present study was higher and the isolation rate of *Trichophyton* spp. was lower than those reported by the mentioned studies, but similar to those reported in the study by Khosravi and Mahmoudi (2003) conducted in Iran involving 79 horses (33.33% for *Trichophyton* spp., 66.67% for *Microsporum* spp.) (17). We believe that this difference might be a result of limited number of horse-origin

samples assessed.

It has been indicated that dermatophytosis in ruminants is caused by *Trichophyton* and *Microsporum* species, such as *T. mentagrophytes*, *T. equinum*, *M. canis*, and *M. gypseum*, and in particular *T. verrucosum* (1,2,4). In many studies, the researchers reported that all of the dermatophytes isolated from calf- and cow-origin samples were species belonging to the genus *Trichophyton*, and in particular, *T. verrucosum* (15,17,19,37-41). In addition, Neweze (2011) reported that *Trichophyton* spp. and *Microsporum* spp. isolation rates were 59.26% and 40.74% in 55 samples collected from cows in a study in Nigeria (7). It was used a small number of samples calf in the study. However, it can be considered that the study findings (100% for *Trichophyton* spp.) similar to the mentioned study findings in terms of the *Trichophyton* spp. isolation.

Literature indicates that dermatophytosis is rare in poultry, and is usually reported only as sporadic cases. It is thought that *M. gallinae* is responsible for dermatophytosis in poultry, in addition, *T. simii*, *T. mentagrophytes* and *T. terrestre* have also been reported to cause infection (1,2). *Trichophyton* spp. from two (40%) of the five parrot-origin samples were isolated in present study. The dermatophytosis studies in domesticated or wild birds are limited. The study by Cabanes et al. (1997), conducted with different animal species in Spain, reported that no dermatophyte agent was isolated from the samples collected from a parrot, while Gungnani et al. (2012) from Saint Kitts and Nevis reported isolating *M. gypseum* from samples collected from brown doves, pigeons, and ducks, but no isolation of dermatophyte agents from parrot-origin samples (16,42). Furthermore, the study by Mandeel et al. (2009), conducted with clinically healthy birds in Bahrain, reported the collection of two *T. terrestre* isolates from five Alexandrian parrot samples (43). Alteraş and Cojoca (1970) reported the isolation and identification of *M. canis* from a parakeet and the owner of the bird in Romania (44). The fact that dermatophytes were isolated from parrot samples in this study and that these isolates belong to the *Trichophyton* species are similar to be the findings of Mandeel et al. (2009) (43). In addition, it is considered to the findings provide a significant contribution to literature given the limited number of studies in this field to date.

The prevalence of dermatophytosis in cats and dogs is known to vary by location and season due to differences in climatic conditions (26,29). There have been several reports in this regard in many countries around the world and different parts of Turkey (16,17,21,22,24,26,29,31). Although the seasonal distribution did not indicate a significant association with dermatophytosis, the present study established an increased rate of feline dermatophytosis in summer (36.06%) and spring (29.51%), and canine dermatophytosis in fall (30%) and spring (26%), differing from the study by Çiftçi et al. (2005) that was carried out in the same region, but in a different year (22).

CONCLUSION

In the present study, it was determined that *Microsporum* spp. was the most common species isolated from the samples belong to different animal species and the isolation rates of

dermatophytes may differ according to the season and animal species. It was considered that *Epidermophyton* spp. isolation from cats is valuable finding in terms of transmission of dermatophytes to animal from human. There have been a number of studies of feline and canine dermatophytoses in Turkey, but few reports about the other animal species as poultry etc. Based on the results, it is suggested that the identification of other animal species that are prone to dermatophytosis infection, and that are in close contact with humans, is important for both animal and human health. Furthermore, laboratory diagnoses should be obtained in cases of suspected dermatophytosis, and it would be beneficial to raise awareness among animal owners and animal keepers of this issue due to the potential for zoonotic transmission.

DECLARATIONS

Ethics Approval

Not applicable.

Conflict of Interest

The authors declare that they have no competing interests.

Author Contribution

Idea, concept and design: N Karacan-Sever,

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Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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