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DERMATOPHYTOSES IN DOMESTICATED ANIMALS

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SUMMARY

Dermatophytes are among the most frequent causes of ringworm infections in domesticated animals. They are known to serve as reservoirs of the zoophilic dermatophytes and these infections have important zoonotic implication. In Nigeria and probably West Africa, there are not many studies on the incidence of dermatophytosis in domesticated animals. In the current study, 538 domesticated animals with clinically suggestive lesions were investigated for dermatophytes. Identification of dermatophyte species was performed by macro- and micro morphological examination of colonies and by biochemical methods. In the cases of isolates that had atypical morphology and/or biochemical test results, the rDNA internal transcribed spacer region 2 (ITS 2) sequencing was performed. Out of this number, 214 (39.8%) were found to be colonized by a variety of ten species of dermatophytes. *M. canis* was the most frequently isolated species (37.4%), followed by *T. mentagrophytes* (22.9%) and *T. verrucosum* (15.9%). *M. persicolor* and *T. gallinae* were jointly the least species isolated with a frequency of 0.55% respectively. The recovery of dermatophyte isolates previously shown to be common etiological agents of dermatophytosis especially from children in the same region suggests that animal to human transmission may be common. Possible implications and recommendations are discussed.

KEY WORDS: Dermatophytes; Animals; Nigeria; Infection; Pets; Domesticated.

INTRODUCTION

Dermatophytosis is caused by fungi in the genera *Microsporum, Trichophyton* and Epidermophyton[21]. There are three ecological groups of dermatophytes: anthropophilic (mostly associated with humans), zoophilic (associated with animals) and geophilic (found in the soil). However, anthropophilic species have been found to cause infections in animals[28]. In the last couple of years, the infections caused by dermatophytes have increased dramatically[19,20]. They have also recently gained prominence due to their rising incidence in patients with immunocompromised states such as cancer, diabetes mellitus, AIDS and organ transplantation[29]. Prior to this development, dermatophytoses have been recognized as a public health problem in many parts of the world and have even reached endemic proportions in some countries especially in Africa[20-22]. For instance, in some African countries such as Nigeria, many surveys have confirmed this finding, especially among children[2,16,20-23,31]. Furthermore, in some countries in Europe, Asia, South America and even in the United States, the problem caused by dermatophytes is well recognized[1,14,15,35]. Dermatophytes are also reportedly cited among the most frequent cause of dermatological problems in domestic animals[7,27]. Human beings are usually infected from animals mostly through direct contact or via fungus-bearing hair and scales from infected animals. In the last few years, the interest in having animals as pets has increased dramatically in Nigeria and many other countries with increasing number of such pets co-habiting and feeding with their owners and members of their households in the majority of cases. This is even more common especially in the rural areas of many developing countries. Owing to such close contact between pets and their owners on one hand, and pets and the rest of the household members on the other, a high possibility of transmission of dermatophytic infection to humans exist especially from pets that are asymptomatic carriers.

It has been noted that the delineation of the natural foci of zoophilic dermatophytes in each state, country or geographical region may be very important for the understanding of the epidemiology of human dermatophytic infections and help in designing preventive strategies[5]. Owing to the high prevalence of dermatophytic infection in Nigeria and elsewhere, there is therefore urgent need to update our knowledge of the epidemiology of ringworm infection in domestic animals/pets. Despite the high prevalence of dermatophytoses in Nigeria, there are few studies specifically carried out among a large species spectrum of animals aimed at identifying the fungal species associated with the carrier state of dermatophytes and their prevalence. Out of about four older studies that screened animals for dermatophytes, three were conducted in Nigeria's western State of Oyo which comprised about 3.5% of Nigeria´s population[3,11,12], while the fourth one investigated dermatophytes amongst rodents in eastern Nigeria[24]. Apart from the fact that these studies are relatively old and may not reflect the current trend, the spectrum of animal species investigated was also narrow. For instance, none of these studies investigated cats or dogs which are among the most common domesticated pets in Nigeria. Furthermore, none of these studies has specifically screened animals for dermatophytoses from any of the remaining 35 States in Nigeria with a human population of more than 135 million. Therefore, the incidence and the current spectrum of dermatophytes affecting domesticated animals

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in these Nigerian States are unknown. This study was therefore conducted to screen ten different species of animals sampled across seven States in Nigeria in order to ascertain their incidence and species spectrum in animals with clinically suggestive lesions.

MATERIALS AND METHODS

Study population: The study, performed between August 2006 and January 2009, consisted of 538 different animals made up of 55 cows, 40 sheep, 40 pigs, 105 dogs, 77 cats, 130 goats, 25 horses, 18 rabbits, 66 chickens and 22 ducks. Some of the animals were sampled from their domestic abode, while others were however sampled from the people who sell these animals in the various local markets. Samples were collected from seven states in Nigeria namely, Enugu, Anambra, Ebonyi, Abia, Imo, Kogi and Delta. Relevant socio-demographic data such as age and sex were obtained by observation or from the owners through a structured questionnaire. Only animals that had no history of antifungal or antibacterial therapy in the previous months were included in the study.

Mycological examination: The animals were screened for the presence of dermatophytes by subjecting them to clinical examination to check for clinically suggestive lesions. Scaling, crusts, annular plaques and hair loss were observed in majority of cases.

Specimen collection and study protocol: Specimen collection and study protocol used in the study were as described in a previous investigation with some modifications[20,22]. Briefly, the affected skin was cleaned with alcohol and the advancing border of the lesion was scraped with the blunt edge of a sterile disposable scalpel. Hairs and scales were plucked with sterile tweezers. Clean, dry and sterile paper envelopes were used for transport of specimens. Portions of specimens were treated with 10% KOH for microscopic identification of typical hyphae or arthroconidia at x/100 -/400 magnifications. Dermasel agar (Oxoid, UK) slants, supplemented with cycloheximide (Sigma, Steinhim, Germany), 0.4 mg/L, chloramphenicol (Fluka, UK) 0.05 mg/L and gentamicin (Sigma) 0.16 mg/L were used as a standard substrate for the cultures. Cultures were incubated for 4-6 weeks at 30 ^{0}C and were observed at intervals for the growth of dermatophytes. Identification of dermatophyte species was performed by macro- and micro morphological examination of colonies and by biochemical methods[10]. In the cases of isolates that had atypical morphology and/or biochemical test results, the rDNA internal transcribed spacer region 2 (ITS 2) sequencing was performed[34].

Statistical Analysis: Statistical analysis was done using the statistical package SPSS version 10.0 for Windows.

RESULTS

The study successfully examined 538 animals with clinically suggestive lesions. Out of this number, 214 animals were proved to be positive for dermatophytes either by microscopy, culture or both. This gives an incidence of 39.8% with respect to the total number of samples investigated that is 538. In detail, 180 samples were positive by microscopy and culture, 20 by microscopy alone and 14 by culture alone. The frequency of isolated dermatophytes is shown in Table 1. There was no significant difference ($p > 0.05$) in the spectrum of the species colonizing domestic animals according to the States where samples were collected (data not shown).

A large spectrum of dermatophytes consisting of 10 species was recovered in the study (Table 1). They were mostly zoophilic species and include *M. canis, T. mentagrophytes, T. verrusosum, M. gypseum, M. gallinea, T. equinium, M. nanum, M. equinium, M. persicolor* and *T. gallinae*. Out of these, *M. canis* was the most predominant species consisting of 37.4% of all positive samples. This was followed by *T. mentagrophytes* (22.9%), *T. verrucosum* (15.9%), *M. gypseum* (7.0%), *M. gallinae* (6.1%), *T. equinium* (5.6%), *M. nanum* (3.3%) and *M. equinium (1%), M. persicolor* and *T. gallinae* jointly recorded the least prevalence (0.5%) in the study.

There was no significant difference ($p > 0.05$) between the occurrence of dermatophytes species according to sex (data not shown) but, there

Table 1
Frequency of dermatophytes in various animal species tested in Nigeria

Dermatophytes	Cat	Dog	Sheep	Goat	Cow	Pig	Horse	Rabbit	Duck	Chicken	Total n (%)
T. mentagrophytes	17	9	3	3	5	5	2	4	-	1	49 (22.9)
T. verrucosum	2	-	7	10	9	5	1	-	-	-	34 (15.9)
T. equinium	1	-	1	3	2	-	5	-	-	-	12 (5.6)
T. gallinae	-	-	-	-	-	1	-	-	-	-	1 (0.5)
M. canis	25	39	-	3	7	3	1	2	-	-	80 (37.4)
M. gallinae	-	-	-	-	1	-	-	-	3	9	13 (6.1)
M. gypseum	1	3	4	-	3	1	1	-	-	2	15 (7.0)
M. persicolor	-	1	-	-	-	-	-	-	-	-	1 (0.5)
M. nanum	-	-	-	-	-	7	-	-	-	-	7 (3.3)
M. equinium	1	-	-	-	-	-	1	-	-	-	2 (1.0)
Total No. (%)	47 (22)	52 (24.3)	15 (7.0)	19 (8.9)	27 (12.6)	22 (10.3)	11 (5.1)	6 (2.8)	3 (1.4)	12 (5.6)	214(100)

was a significant difference in the distribution of certain species of dermatophytes among the species of animals investigated ($p < 0.05$). For instance, the occurrence of both *T. mentagrophytes* in cats and *M. canis* in cats/dogs were respectively significant ($p < 0.05$) when compared to the other animal species investigated. Similarly, the occurrence of *M. gallinae* in chickens was significant ($p < 0.05$) when compared to other animals screened. One isolate of *M. persicolor* and *T. gallinae* was recovered from a dog and a pig respectively.

Dermatophytes recovered from cats Out of a total of 77 cats examined in the study, 47 (61%) were confirmed positive. Six species were recovered. *M. canis* was the most common species (25, 53.2%), followed by *T. mentagrophytes* (47, 36.2%) and *T. verrucosum* (two, 4.3%). *T. equinium* (one, 2.1%), *M. gypseum* (one, 2.1%) and *M. equinium* (one, 2.1%) were also recovered.

Dermatophytes recovered from dogs: Dermatophytes were proved to be present in 52 (49.5%) samples of the total of 105 dogs screened. They were made up of four species. *M. canis* was the dominating species with 39 (75%) positive samples, followed by *T. mentagrophytes* with only nine (17.3%) positive samples. Only three (5.8%) samples were positive for *M. gypseum* and one (1.9%) positive sample of *M. persicolor*.

Dermatophytes recovered from sheep: Fifteen (7.0%) of the forty samples examined were positive for four species of dermatophytes. *T. verrucosum* was the dominating species (seven, 17.5%), followed by *M. gypseum* (10.0%) and *T. mentagrophytes* (7.5%). Only one isolate (2.5%) of *T. equinium* proved positive.

Dermatophytes recovered from goats: Nineteen (8.9%) of the 130 samples collected from goats were shown to be positive. In total, only four species of dermatophytes infected goats studied. *T. verrucosum* had the highest frequency with a total of 10 (7.7%) positive cases. Others were three (2.3%) positive cases each of *T. mentagrophytes*, *T. equinium*, and *M. canis*.

Dermatophytes recovered from cows: Of the 55 samples taken from cows, 27 (49.0%) were positive. Six different species were successfully identified. *T. verrucosum* had the highest frequency (nine, 16.4%), followed closely by *M. canis* (seven, 12.7%). Others were *T. mentagrophytes* (five, 9.1%), *M. gypseum* (three, 5.5%), *T. equinium* (two, 3.6%) and *M. gallinae* (one, 1.8%).

Dermatophytes recovered from pigs: Six different species were proved to have infected a total number of 40 samples screened. *M. nanum* was the dominating species (seven, 17.5%). Interestingly, out of the total 214 positive cases spanning across ten different animals, this is the only animal where this species was recovered. This is expected as *M. nanum* is almost restricted to pigs. Five (12.5%) positive cases were respectively positive for *T. mentagrophytes* and *T. verrucosum.* Others were *M. canis* (three, 7.5%), *T. gallinae* (one, 1.25%) and *M. gypseum* (one, 1.25%)

Dermatophytes recovered from horses: Of the 25 horses screened, 11 (44.0%) were proved to be positive. *T equinium* had five (45.5%) positive cases, followed by *T. mentagrophytes* with only two (18.2%). *T. verrucosum*, *M. canis, M. gypseum* and *M. equinium* had one (9.1 %) positive case respectively.

Dermatophytes recovered from rabbits/ducks and chickens: Six (33.3%) of 18 samples collected from rabbits were positive for dermatophytes. Out of these, *T. mentagrophytes* was confirmed in four (22.2%) and *M. canis* in two (11.1%) respectively. For ducks sampled, only three (13.6%) positive cases of *M. gallinae* were proved. For chickens, 12 (18.2%) of the 66 samples screened were positive. Out of the three species identified, *M. gallinae* was more dominating (nine, 13.6%), compared to *M. gypseum* (two, 3.0%) and *T. mentagrophytes* with only one (1.5%) positive sample.

DISCUSSION

The current study successfully screened 538 animals comprising 10 different species sampled across seven States in Nigeria. This is probably the first large scale investigational study of animals in Nigeria and perhaps in the West African sub-region involving up to 10 different species with a view to understanding the spectrum of dermatophytes colonizing them. Infections of the skin caused by dermatophytes are known to be very common in both humans and animals throughout the world[7,14,15,19,20,29]. Dermatophytes are known to grow best in warm and humid environments and are therefore more common in tropical and subtropical regions. However, the geographic distribution varies with the organism[20,22]. In this study, a large spectrum of dermatophytes made up of ten different species was recovered. They include *M. canis* which was the most predominant, *T. mentagrophytes, T. verrucosum, M. gypseum, M. gallinae, T. equinium* and *M. nanum* among others.

Of the three genera that make up the dermatophytes, it is evident that the *Trichophyton* and *Microsporum* species are the dominant species colonizing the animals and have often been classified as both human and animal pathogens. Animals serve as reservoirs for the zoophilic dermatophytes and the infections caused by them have a significant zoonotic importance. *Epidermophyton,* the third genera, is reportedly a human pathogen but there are scanty reports of its isolation from animals[11,30]. Epidemiological data in literature on dermatophytosis in animals published by other authors show variability in the proportion of positive samples compared to the examined samples with suspected dermatophytosis in other countries[4,7,8,13,18,27,32,33] and in Nigeria too[11,12]. However, it would appear that geographical location may be the most important factor affecting these findings. The author had previously demonstrated that pattern changes in the etiology of dermatophytoses are possible with the passage of time and human population migration[20,22]. For instance, despite the two previous older studies having been performed in Oyo State, both of them and the current study found *M. gypseum* as the predominant species affecting six species of animals[12] and four species of birds[11] with percentage occurrence of 14.1% and 35% respectively. However, the authors reportedly isolated only two species of dermatophytes in the later study.

The finding of *M. canis* as the predominant species colonizing cats agrees with the view of CABAÑES[9] that cats are accepted reservoirs for this species. This author also found that *T. mentagrophytes* and *M. gypseum* are also common in cats. This concurs with the findings in this study. However, the frequency of 53.2% of *M. canis* recovered from cats disagrees with the view of CABAÑES[9] who stated that the frequency is always higher than 90% in cats with suspected lesions. Unfortunately, the earlier studies in Nigeria did not screen cats and dogs[3,11,12] making comparisons difficult. The reason for this observed difference in

the findings from other countries could be geographical. There are contradicting reports on the prevalence of dermatophytes in dogs. While some authors reported low prevalence of between four and ten percent, other authors found higher values[9,27]. This study found that 49.5% of all samples with suggestive lesions were positive for dermatophytes. The reason for this is unknown, however most of the sampled dogs despite being domesticated are freely allowed to move around the neighborhood and return to their owners at intervals to feed. This could have exposed them to more dermatophytic infections compared to the dogs sampled in the other studies in literature which were mostly restricted and confined to the household of their owners[5,7,27]. Another interesting observation in this study is the fact that *M. canis* constitutes a total of 75% of all isolates recovered from dogs. Although the frequencies are different, other studies have also reported high recovery rates of *M. canis* in this animal[9].

When taken together, *T. verrucosum* was the predominant species affecting the ruminants. This is followed by *T. mentagrophytes* and *M. canis* in that order. Though the frequency rates are different from those of other authors who carried out such studies, the finding in this study is consistent with their reports[5,7,9,27]. For instance, studies in Norway[33], Iran[17] and other countries[25,27] reported similar findings. In a previous survey carried out by the author in northern Nigeria's State of Borno, *T. verrucosum* and *T. mentagrophytes* ranked second and third among the seven different species of dermatophytes recovered from school children[22]. Incidentally, the major occupation of the inhabitants of this area is rearing of animals. It thus follows that animal dermatophytosis has important implication for human dermatophytic infection[25]. Another striking observation is the large spectrum of six different dermatophytes recovered from cows, pigs and horses. This has a serious implication on human health, considering the closeness of humans to these animals especially in countries like Nigeria. *T. equinium* was the dominating species in horses with a frequency of 45.5%. This is in agreement with several reports from other countries[9]. The lesions were markedly pruritic and exudative with areas of hairless, thickened skin. Strange as it may seem, this species was not recovered in several studies in Nigeria involving humans with suggestive lesions[20,22]. It is possible that its transmission from animal to human is rare. Despite not being the dominating species, *T. equinium* was also recovered from cows and goats. These two kinds of animals are more commonly domesticated in Nigeria than horses, thereby suggesting that our initial proposal of rare transmission from animal to human may be correct.

Only three, two and one species were recovered from chickens, rabbits and ducks, respectively. The reason for this reduced number and frequency of the species in these animals is not known but could be attributed to earlier reports that dermatophytosis is generally rare in poultry[27]. However, it could also be due to the life styles of these animals in the area under study. Another striking observation is the fact that of the 13 positive samples of *M. gallinae* recorded in the whole study, nine (69.2%) came from chickens. BRADLEY *et al.*[6] had previously documented this species as the major cause of ringworm in chickens and other fowl. Surprisingly, this species was the third most common species recovered from children in a previous Nigeria study[22] and it is possible that animal to human transmission among this species is high. The literature is scanty on reports of dermatophytoses from animals in West Africa in particular and Africa in general and this is a further justification for this study.

In conclusion, this study has clearly demonstrated that animal dermatophytoses is a public health problem especially in Nigeria. This has important implications for animal to human transmission especially in a country with a high prevalence rate for dermatophytosis. Routine screening of all animals and fungal treatment where an infection is proven to exist could be very useful in managing this situation and reducing infection and subsequent transfer from animals to humans.

RESUMO

Dermatofitoses em animais domésticos

Dermatófitos estão entre as causas mais frequentes de infecções tipo larva migrans em animais domésticos. Eles são conhecidos como reservatórios de dermatófitos zoófilos e estas infecções têm implicações zoonóticas importantes. Na Nigéria e provavelmente no Oeste da África não existem muitos estudos sobre a incidência de dermatofitose em animais domésticos. No presente estudo, 538 animais domésticos com lesões clinicamente sugestivas foram investigados para dermatófitos. Identificação de espécies de dermatófito foi feita pelo exame macro e microscópico morfológico de colônias e por métodos bioquímicos. No caso de isolados com morfologia atípica e/ou resultados de testes bioquímicos, sequenciamento da região 2 transcrita (ITS-2) do rDNA foi feita. Dos casos, 214 (39,8%) foram colonizados por uma variedade de 10 espécies de dermatófitos. *M. canis* foi a espécie isolada mais frequente (37,4%) seguida por *T. mentagrophytes* (22,9%) e de *T. verrucosum* (15,9%). *M. persicolor e T. gallinae* foram juntos as menos frequentes espécies isoladas (0,55% respectivamente). O isolamento destes dermatófitos que são agentes etiológicos comuns de dermatofitoses especialmente de crianças da mesma região sugere que a transmissão de animais para humanos possa ser comum. Possíveis implicações e recomendações são discutidas.

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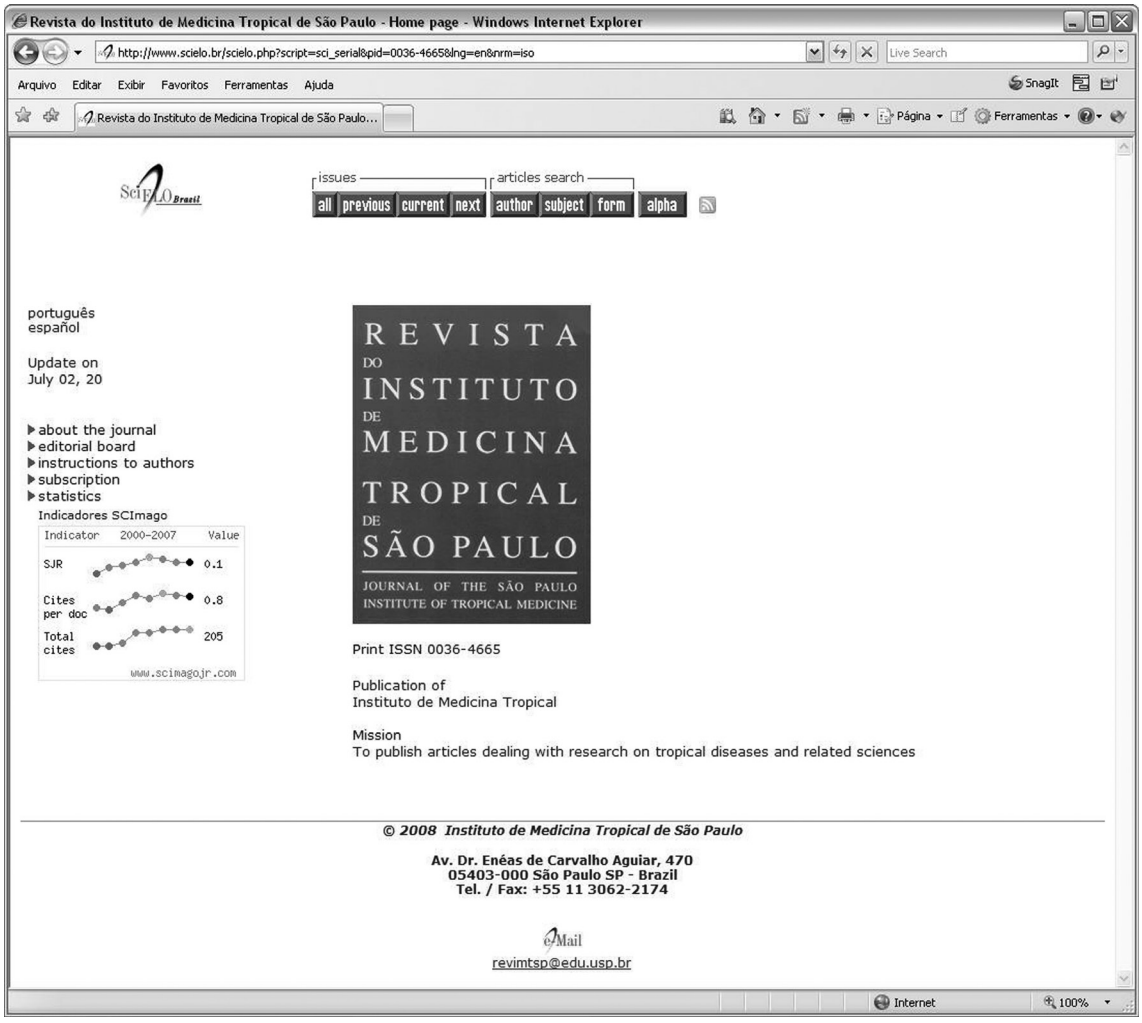

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