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Occurrence of dermatophytosis among sheep and goats in Zaria, Nigeria

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Abstract

Dermatophytes are a group of related fungi in the genera *Tricophyton*, *Microsporum* and *Epidermophyton*. Infection with any member of these genera results in dermatophytosis, an economically important skin disease of man and animals. The aim of this work was to determine the occurrence of dermatophytosis among sheep and goats in Zaria. Ninety-four goats and 63 sheep skin scrapings were aseptically collected. Each specimen was divided into two parts for direct microscopy and culture respectively. The portion for direct microscopic examination was cleared in 10% potassium hydroxide and examined microscopically. The presence of hyaline septate hyphae in skin scales or spores inside or outside the hair shafts was presumptively considered positive for dermatophytes. The part for culture was inoculated onto Sabouraud's dextrose agar incorporated with cycloheximide and chloramphenicol and incubated for 2 to 3 weeks. The isolates were stained in lactophenol cotton blue and identified microscopically based on the size, shape and attachment of their macoconidia and microconidia. Twenty-four (25.5%) and 15 (23.8%) of goat and sheep samples respectively were positive for dermatophytes by direct microscopy. *Trichophyton mentagrophytes* and *T. verrucosum* were the two dermatophytes isolated from both sheep and goats. The isolation rates were 22.3% (21/94) and 20.0% (13/63) in goats and sheep respectively. *Trichophyton mentagrophytes* was more frequently (66.7%) isolated than *T. verrucosum* (33.3%) from goats. Similarly, *T. mentagrophytes* was more frequently (69.2%) isolated than *T. verrucosum* (30.8%) from sheep. Dermatophytosis is a health problem among sheep and goats in Zaria with *T. mentagrophytes* being more commonly isolated than *T. verrucosum* in both species of animals. In view of the high zoonotic potential of the disease, we recommend the use of protective equipment when handling infected animals.

Keywords: Dermatophytosis, Goat, Isolation rate, Sheep, Zaria

Introduction

The dermatophytes are a group of related moulds that have similar appearance, physiology, growth requirements and pathology (Abd-Elmegeed *et al*., 2020). They have the capacity to digest keratin *in vitro* in their saprophytic state as well as *in vivo* in their parasitic state to cause a skin disease condition called dermatophytosis also known as tinea or ringworm (Weitzman & Summerbell, 1995; Verma *et al*., 2021). The agents of dermatophytosis in humans and animals are categorized into three anamorphic genera as *Trichophyton, Microsporum* and *Epidermophyton* (Emmons, 1934). The dermatophytes are also categorized into three groups based on host preference and natural habitat as anthropophilic, zoophilic and geophilic species (Hubka *et al*., 2018). Anthropophilic dermatophytes are almost exclusively in humans and transmitted among humans, but very seldom transmitted to animals. Zoophilic species are mainly animal pathogens but can be transmitted to humans whereas geophilic dermatophytes are soil-associated organisms that can cause both human and animal infections (Hubka *et al*., 2018).

Dermatophytosis is transmitted either by direct contact with an infected or carrier host or indirectly by contact with fomites contaminated with arthrospores (asexual spores formed in the hyphae of the parasitic stage) or conidia (sexual or asexual spores formed in the "free-living" environmental stage) (Haggag *et al*., 2017). Although the disease has a worldwide distribution, the type and occurrence of dermatophyte species may vary from one geographical location to another (Weitzman & Summerbell, 1995; Dalis *et al*, 2019).

Dermatophytosis is highly contagious and could spread easily from an index case to affect an entire herd (Pal, 2017). Animals are reservoirs of zoophilic fungi and they may be sources of infection in humans (Gnat *et al*., 2019). Whereas the literature is replete with information on human mycoses, there is a paucity of data on animal dermatophytosis particularly within the study area. This paper describes the occurrence of dematophytosis of sheep and goats in Zaria, Nigeria.

Materials and Methods

Study area

The study was conducted on sheep and goats in Zaria, located in Kaduna North Senatorial District, Kaduna State, Nigeria. Its geographical coordinates are 11° 4' 0" North and 7° 4'0" East

Study design and sample collection

This was a cross-sectional study following the method described by Martin *et al*. (1994) whereby only animals showing observable skin lesions such as circumscribed alopecia, erythema, scaling or thickly-crusted, greyish-white skin lesions suggestive of dermatophytosis were included in the sample. Sample locations including Dogarawa, Samaru, Shika and Zango villages were selected by a simple random sampling method described by Martin *et al*. (1994) by balloting. Samples were obtained from animals in small ruminant markets, slaughter slabs and farms. These areas were selected because they were more likely to have a high concentration of the target animal species under study.

Assuming an expected prevalence of 8.9% for goats and 7.0% for sheep (Nweze, 2011), the number of specimens to be collected for each animal species was determined using the formula: $n= Z^2pq/L^2$ where n= required sample size, Z = 1.96, p = expected prevalence, q = (1-p) and L = allowable error of 5% (Thrusfield, 1997). One hundred and fifty-seven skin scrapings including 94 from goats (56 males and 38 females) and 63 from sheep (34 males and 29 females) were collected between January 2019 and December 2020. The site with lesions on each animal was disinfected with methyl alcohol, after which skin scales including hair were collected in sterile containers and labeled. Species and sex of animals including the season (rainy or dry) of sample collection were noted. The samples were taken to the Microbiology Laboratory, Department of Veterinary Microbiology, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria and kept at room temperature until used.

Identification of dermatophytes

Each of the specimens was divided into two portions. One part was used for direct microscopic examination while the second portion was used for culture. Direct microscopic examination was performed by placing the specimen in two drops of 10% potassium hydroxide on a clean, grease-free glass slide. A coverslip was applied to the preparation and allowed to stand on the bench for 10 to 15 minutes to ensure adequate clearing of the specimens after which they were examined microscopically for the presence of fungal elements according to standard techniques described previously (Larone, 2011; Hameed *et al*., 2017).

Isolation of the dermatophytes was carried out by inoculating each of the specimens into plates containing Sabouraud's dextrose agar (OXOID CM0041; Oxoid Ltd, Basingstoke Hampshire-England)

to which chloramphenicol and actdione had been added at the rate of 16µg/mL and 0.5mg/mL respectively. Chloramphenicol was included to prevent the growth of bacteria while cycloheximide prevented the growth of unwanted saprophytic fungal contaminants (Robert & Pihet, 2008). The plates were incubated at approximately 25 to 28°C for 3-4 weeks (Robert & Pihet, 2008). The isolated fungi were identified using the technique of Frias-De-Leon *et al*. (2020). Briefly, a portion of the colony was emulsified in a drop of lactophenol cotton blue stain on a grease-free glass slide. A cover glass was applied to the preparation, pressed down gently to remove air bubbles and allowed to stand on the bench for 10 minutes for proper staining of the fungal structures before they were examined microscopically for fungal elements particularly the macroconidia, microconidia, spiral hyphae and other fungal structures consistent with dermatophyte microscopic morphology as described by Larone (2011).

Data analyses

Data are presented in percentages using tables and graphs. The Chi-square test was used to determine the association of possible predisposing factors. p≤ 0.05 was considered significant.

Results

Clinical dermatophytosis in sheep and goats were circumscribed alopecia, scaling and thickly crusted greyish white lesions that were either localized or generalized involving a significant part of the body. Ninety-four goats and 63 sheep were observed with skin lesions consistent with dermatophytosis.

In goats, lesions of dermatophytosis occurred more, 11 (46%) on the head region than on the trunk, 5 (21%), neck 3 (13%) and legs 3 (13%). Generalized skin lesions were observed in 2 (8%) of the goats examined. Similarly, in sheep, skin lesions were found mostly 6 (40%) on the head region than on the trunk 4 (27%), neck 2 (13%) and legs 2 (13%). Generalized lesions were seen in 1 (7%) of the sheep examined (Figure 1).

Out of the 94 goat samples processed, 24 (25. 5%) were positive. Similarly, (23.8%) of the 63 sheep samples were positive for direct microscopic examination. There was no significant difference (p-0.9556) in the dermatophyte detection rate between sheep and goats (Table 1).

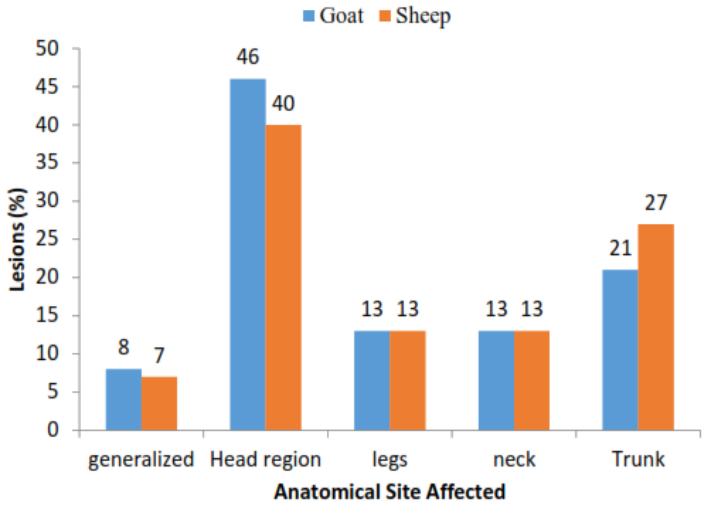

Figure 1: Anatomical distribution of dermatophytosis lesions on sheep and goats in Zaria, Nigeria

Table 1: Direct microscopic detection rates of dermatophytes in hair and skin samples from sheep and goats in Zaria

Animal species	No of the samples examined	No positive for dermatophytes (%)
Goats	94	24 (25.5)
Sheep	63	15 (23.8)
Total	157	39 (24.8%)

χ^2= 0.0031; p = 0.9556

Out of the 157 samples collected, 94 were from goats and 63 from sheep. Of the 94 goat samples processed for culture, 21 (22.3%) were positive for dermatophytes of which 14 (66.7%) were identified as *T. mentagrophytes* while 7 (33.3%) were *T. verrucosum*. Similarly, of the 63 sheep samples cultured, 13 (20.6%) were positive for dermatophytes including 9 (69.2%) *T. mentagrophytes* and 4 (30.8%) *T. verrucosum.* There was no significant difference (p = 0.9857) in dermatophyte isolation rate between sheep and goats (Table 2).

Similarly, of the 94 goat samples processed, 56 were males while 38 were from female animals. Sixteen (28.6%) and 5 (13.6%) males and females respectively were positive for dermatophytes. However, there was no significant (p= 0.078) difference in the isolation rate between male and female goats.

Out of the 63 sheep samples examined, 34 were from males whereas 29 were from females. Seven (20.6%) males and 6 (20.7%) femaleswere positive for dermatophytes. There was no significant (p = 0.9920) difference in the occurrence of the disease between male and female sheep.

Table 2: Isolation rates of dermatophytes from sheep and goats in Zaria, Nigeria

Animal (no. of samples collected)	Dermatophyte species		Isolated no. (%)	Total no. (%)
	T. mentagrophytes	*T. verrucosum*		
Goats (94)	14 (66.7)	7 (33.3)		21 (22.3**)**
Sheep (63)	9 (69.2)	4 (30.8)		13 (20.6)
Total (157)	23	11		34

χ^2- 0.00321; p = 0.9857

Table 3: Isolation rates of dermatophytes in sheep and goats based on species, sex and season in Zaria

Factor	Total	Positive	Isolation rate (%)	X^2	OR	P-value
Species						
Goats	94	21	22.3	0.0650	1.0830	0.7990
Sheep	63	13	20.6			
Sex						
Goats						
Male	56	16	28.6	3.1000	2.1710	0.078
Female	38	5	13.2			
Sheep						
Male	34	7	20.6	0.0000	1.000	0.9920
Female	29	6	20.7			
Season						
Goats						
Rainy season	51	14	27.5	1.6780	1.6860	0.1950
Dry season	43	7	16.3			
Sheep						
Rainy season	34	8	23.5	0.3780	1.3650	0.5390
Dry season	29	5	17.2			

Out of the 94 goat samples examined, 51 were obtained during the rainy season while 43 were collected during the dry season. Fourteen (27.5%) and 7 (16.3%) were positive for dermatophytes in the rainy and dry seasons respectively. There was no significant (p= 0.1950) difference in the isolation rates between the rainy and dry seasons.

Of the 63 sheep samples processed, 34 were collected during the rainy season whereas 29 were obtained in the dry season. Eight (23.5%) and 5 (17.2%) were positive in the rainy and dry seasons respectively. There was no significant (p=0.5390) difference in the occurrence of the disease between the rainy and dry seasons in sheep (Table 3).

Discussion

Trichophyton mentagrophytes and *T. verrucosum* were isolated from goats and sheep in Zaria. The isolation rates were 22.3% and 20.6% in goats and sheep respectively. In goats*, T. mentagrophytes* was more commonly (66.7%) than *T. verrucosum* (33.3%). Similarly*, T. mentagrophytes* was more commonly (69.2%) isolated than *T. verrucosum* (30.8%) in sheep. Clinical dermatophytosis of sheep and goats as presented in this study is consistent with the reports of Haggag *et al*. (2017) and Hubka *et al*. (2018). However, the clinical signs are not always specific and may be confused with non-dermatophyte skin diseases such as dermatophilosis which is caused by the Gram-positive bacterium, *Dermatophilus congolensis* (Dalis *et al*., 2021) and mange which may be caused by a variety of mites (Fesseha *et al*., 2021). The presence of arthrospores occurring in chains inside the hair shafts and/or hyaline septate hyphae in skin scales of 25.5% of goats and 23.8% of sheep samples in this study concurs with the findings of Bhagra *et al*. (2014); Moriello *et al.* (2017) and Hubka *et al*. (2018). This method has been described as a rapid and effective method for the diagnosis of dermatophytosis (Wisselink *et al*., 2011; Bhagra *et al*., 2014). According to Moriello *et al.* (2017), dermatophytes have a characteristic pattern on infected hairs. Whereas hairs infected with

Trichophyton species form chains of arthrospores, hair infections due to *Microsporum* species form spores in clusters. Although the direct examination is able to identify dermatophytes to the genus level based on the pattern of hair infection (Hubka *et al*., 2018), however, the technique is not able to identify dermatophytes at the species level (Robert & Pihet, 2008). Therefore, further tests need to be performed to determine the infecting dermatophyte species and enable proper management of the disease (Bhagra *et al*., 2014).

The higher dermatophyte detection rates by direct microscopic examination than the isolation rates in both sheep and goats in the present study indicates that the direct examination is more sensitive than the culture technique and confirms the reports of Abdelrahman *et al*. (2006). It is however, contrary to the report of Gupta *et al*. (2014) who found higher (100%) sensitivity for culture than direct examination (73.33%).

The distribution of lesions of dermatophytosis on the body of both sheep and goats in the present study concurs with the findings of Abdallah (2019) who reported that, although lesions of dermatophytosis can occur on any site on the body of small ruminants, they are however, mostly found on the head region such as the face, head, pinnae and neck.

We could not find any good reason for the occurrence of more dermatophyte lesions on the head region of small ruminants. However, Abd-Elmegeed *et al*. (2020) speculated that because the skin of the face and particularly around the eye is softer than other parts of the body, it is more susceptible to infection by dermtophytes. Nevertheless, we believe that more work is needed to substantiate this claim.

The 20.6% dermatophyte isolation rate in sheep in the present study was higher than the 7% reported by Nweze (2011) but lower than the 74.4% in the report of Abd-Elmegeed *et al*. (2020) and the 78% obtained by Haggag *et al*. (2017) who conducted their research in Egypt. The variation in the isolation rates may due to differences in geographical location (Abdallah, 2019).

It may be for the same reason that the 22.3% isolation rate in goats in this study was higher than the 8.9% in the findings of Nweze (2011) but lower than the 70.9% obtained by Abd-Elmegeed *et a1*.(2020) who examined 13 animals in Egypt. It is difficult to explain why only *T. mentagrophytes* and *T. verrucosum* were isolated as the only causative agents of dermatophytosis among sheep and goats in this study. However, it is pertinent to mention that there is a consensus among researchers (Bhagra *et al*., 2014; Gupta *et al*., 2014; Hubka *et al*., 2018) that the incidence and etiologic agents of dermatophytosis in both humans and animals vary according to climate and natural reservoirs. For example, while *T. verrucosum* has been cited as the most commonly isolated dermatophyte from ringworm lesions of cattle in Egypt (Abd-Ehmegeed *et al*., 2020), Ranganathan *et al*. (1997) found that *T. mentagrophytes* was the predominant cause of bovine dermatophytosis in India.

In this report, *T. mentagrophytes* were more frequently (66.7%) isolated in goats than *T. verru*cosum (33.3%). This finding is at variance with the report of Abd-Elmegeed *et al*. (2020) who found *T. verrucosum* more commonly (20%) than *T. mentagrophytes* (0%) among goats in Egypt. Similarly, the higher (69.2%) isolation rate of *T. mentagrophytes* than *T. verrucosum* (30.8%) in sheep differs from the report of Abd-Elmegeed *et al* (2020) who isolated more (17.3%) of *T. verrucosum*m than *T. mentagrophytes* (0%) from sheep. We believe that this may also be attributed to locational differences (Abdallah, 2019).

The higher isolation rate in males (28.6%) than female (13.2%) goats in this study concur with the report of Abd-Elmegeed *et al*. (2020) who found a higher isolation rate in male than female goats This may be because males are more active than the female animals and may travel long distances in search of feed and mating partners and thus, are more exposed to skin injuries and other environmental factors that predispose to dermatophytosis. However, this finding is in contrast with the report of Biswa *et al*. (2015) who found a higher infection rate in females than male kids.

The slightly higher isolation rate was obtained for female (20.7%) than male (20.6%) sheep which is similar to the findings of Biswas *et al*. (2015) who reported a higher prevalence in females than male lambs. It is, however, contrary to the findings of Abd-Elmegeed *et al*. (2020) who reported a higher isolation rate in males than female sheep. In this study, the dermatophyte isolation rate in both goats and sheep was higher in the rainy than dry season which is consistent with the report of Biswa *et al*. (2015) and Dalis *et al*. (2019) who found a higher prevalence of dermatophytosis in the rainy than dry seasons.

Dermatophytes are the most common causes of dermatologic problems among domestic and wild animals (Hubka *et al*., 2018). The economic importance of animal dermatophytosis is attributed to its ability to spread rapidly among susceptible

flocks with attendant high cost of treatment, prevention and control as well as its public health consequences because the majority of dermatophytes that affect animals are also infectious to humans. These zoophilic dermatophytes produce clinical lesions in humans that are highly inflammatory and more severe than those caused by typical anthropophilic fungi normally transmitted from human to human.

It was concluded that dermatophytosis is a health problem among sheep and goats in Zaria with *T. mentagrophytes* being more commonly isolated than *T. verrucosum* from both species of animals. In view of the contagious nature of the disease, we recommend the wearing of personal protective equipment when handling infected animals.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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