



Phenotypic Identification of Fungi Isolates from Goats in FCT Nigeria.

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Abstracts

Dermatophytes are a group of closely related pathogenic fungi that have the capacity to invade the keratinized tissues of humans and animals. This study was undertaken to ascertain the level of dermatophytosis in goats in the study area. One hundred and twenty-four samples were aseptically collected from goats showing clinically suggestive lesions from August, 2015 to January, 2016 in Gwagwalada Area Council, of the Federal Capital Territory, Nigeria. Direct microscopic examination was carried out before primary culture on Sabouraud Dextrose Agar (SDA) and secondary culture on Potato Dextrose Agar (PDA). Dermatophyte isolates were identified by macro morphology which included surface and reverse pigmentation, topography, texture and growth rate and microscopic features such as shape, size and arrangement of macro and micro conidia. *Trichophyton* spp had 13 isolates (10.48%), *Microsporum* spp had 6 isolates (4.84%) and *Epidermophyton* spp had 1 isolate (0.81%). 7 species of dermatophytes were identified namely *Microsporum audouinii* (4), *Trichophyton verrucosum* (6), *Trichophyton tonsurans* (5), *Epidermophyton floccosum* (1), *Trichophyton mentagrophytes* (1), *Microsporum gypseum* (2) and *Trichophyton ajelloi* (1). *Trichophyton verrucosum* had the highest number of isolates followed by *Trichophyton tonsurans*, *Microsporum audouinii*, *Microsporum gypseum* and *Trichophyton mentagrophytes*, *Trichophyton ajelloi* and *Epidermophyton floccosum* with 1 isolate each. The isolation of different fungal pathogens from affected areas as observed in this study from goats indicates the public health significance of these organisms in goat diseases. Therefore, farmers and goat owners should always present their animals to the nearest

Veterinary clinics whenever they observe any abnormality in their goats. As a result of absence of vaccine for the treatment of dermatophytosis in the country, control should be directed towards the improvement of simple management practises such as deworming, dipping, spraying and proper housing. Public health awareness and education of all stakeholders is required to aid the prevention and control of the disease in Nigeria.

Key words: Dermatophytes, dermatophytosis, goats, fungi, pathogen.

I. INTRODUCTION

A class of closely related pathogenic fungi known as dermatophytes can infiltrate human and animal keratinized tissue, such as skin, hair, and nails (Moskaluk *et al.*, 2022). According to Kushwaha *et al.* (2000), they possess two essential characteristics: they are keratinophilic and keratinolytic agents (Adah *et al.*, 2015). Although dermatophytosis is the term for the superficial mycoses produced by dermatophytes, "tinea" or "ring-worm" infections are more frequently used (Lakshmipathy *et al.*, 2010). The three genera of dermatophytes are *Epidermophyton*, *Microsporum*, and *Trichophyton* (Joel *et al.*, 2025). Only a small number of species in the genera *Microsporum* and *Trichophyton* are often responsible for dermatophytosis in domestic animals (Cabanes, 2000).

Dermatophytes are a group of closely related pathogenic fungi that have the capacity to invade keratinized tissue (skin, hair and nails) of humans and animals (Maraki *et al.*, 2007). They hold two imperative properties: they are keratinophilic and keratinolytic agents (Kushwaha *et al.*, 2000). The superficial mycoses caused by dermatophytes



are called dermatophytosis but more commonly referred to as “tinea” or “ring-worm” infections (Lakshmipathy *et al.*, 2010). Dermatophytes consists of three genera namely: *Epidermophyton*, *Microsporum* and *Trichophyton*, with only a few species belonging to the genera *Microsporum* and *Trichophyton* being the usual cause of dermatophytosis in domestic animals (Cabanes, 2000).

Based on their host specificity dermatophytes are classified into three ecological groups namely geophiles (soil), anthropophiles (man) and zoophiles (animals) (Segal and Elad, 2021). The geophilic dermatophytes are generally saprophytic and derive nutrients from keratinous substrates (Swai and Sanka, 2012). Rarely these pathogens cause infection in animals and man (Mailafia *et al.*, 2016). Geophilic dermatophytes include *Trichophyton ajelloi*, *Trichophyton terrestre*, *Microsporum fulvum*, *Microsporum gypseum*, *Microsporum cookie* and *Epidermophyton stockdaleae* (Borman and Summerbell, 2015; Summerbell, 2011). Zoophiles are pathogens with animal hosts and grow as saprophytes on animal materials (Adah *et al.*, 2024). Zoophiles are also reported to infect human beings who acquire the infection through contact (Swai and Sanka, 2012). *Trichophyton simii* (monkeys), *Trichophyton verrucosum* (ruminants), *Trichophyton mentagrophytes* (rodents), *Trichophyton equinum* (horses), *Microsporum canis* (cats) and *Microsporum nannum* (pigs) (Kindo and Dami, 2024; Manoyan *et al.*, 2024). The primary hosts of anthropophilic dermatophytes are human beings but they may also cause infection in animals (Adah *et al.*, 2025). Examples include *Trichophyton rubrum*, *Trichophyton kanei*, *Trichophyton schoenleini*, *Trichophyton concentricum*, *Trichophyton tonsurans*, *Microsporum gypseum*, *Microsporum audouinii*, *Microsporum ferrugineum* and *Epidermophyton floccosum* (Pin, 2021; Paryuni *et al.*, 2020).

The incidence of dermatophytosis varies according to climate and natural reservoirs (Joel *et al.*, 2025). The infections are mostly common in developing countries due to poor hygienic conditions, close proximity to animals, poor socio-economy (Adah *et al.*, 2025) and the climate which supports the growth of dermatophytes (Borman and Summerbell, 2015; Peerapur *et al.*, 2004). Hot, humid environments predispose to infection (Adah and Olabode, 2017) and young animals tend to be more commonly affected (Adah *et al.*, 2015). Dermatophytosis is more common in housed animals, rather than animals turned out to pasture and the highest incidence of the disease occurs

during the winter months (Papini *et al.*, 2009) although it may resolve spontaneously in the spring and summer (Adah *et al.*, 2022). However, the pattern of the species of dermatophytes involved in dermatophytosis may be different in similar geographical conditions, both in humans and animals (Madubuike *et al.*, 2022). It has been related, among other factors, to the decline in the incidence of animal ringworm in the areas or the degree and closeness of animal to human contact (Segal and Elad, 2021). However, the disease appears to be more common in tropical than temperate climates, and particularly in countries or areas having hot and humid climatic conditions (Tidman *et al.*, 2021).

Infections caused by dermatophytes have increased dramatically (Nweze, 2001). They have gained prominence due to their rising incidence in patients with immunocompromised states such as cancer, diabetes mellitus, HIV/AIDS and organ transplantation (Los *et al.*, 2008; Adah *et al.*, 2025). Prior to this development, dermatophytosis 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 (Nweze, 2001; Nweze *et al.*, 2005). Human beings are usually infected from animals, mostly through direct contact or via fungus-bearing hair and scales from infected animals. Dermatophytes have been cited among the most frequent cause of dermatological problems in domestic animals (Cabanes, 2000; Moreira *et al.*, 2020).

Goats are domestic animals which are of great importance in Nigeria's economy (Ugwu, 2007). Ugwu stated that goats do not only serve as a source of food, but also as sources of income, hides and skin, manure for agriculture and for social or recreational purposes (Nweze, 2010). The National Bureau of Statistics of the Federal Ministry of Agriculture and Rural Development carried out in 2010 a National Agricultural Sample Survey which indicated that Nigeria was endowed with a population of 72.5 million goats, which was more than the population of cattle and sheep at 19.5 million and 41.3 million respectively (Osue *et al.*, 2023). Goats are constantly in contact with man, the soil and other animals which makes them susceptible to infection from these sources (Moreira *et al.*, 2020). *T. verrucosum* has been cited as the major agent encountered in cases of ruminant ringworm. Other species such as *M. canis*, *T. mentagrophytes* and *T. equinum* have been isolated from some of these ruminants (Tidman *et al.*, 2021).



Dermatophytes cause dermatological problems in domestic animals which in turn can spread to humans (Anselm *et al.*, 2025). In sheep and goats, dermatophytes cause damages to their skin and hide and also affect their productivity (Mailafia *et al.*, 2016). Sheep and goats may be involved in the spreading of pathogenic fungi in the environment, representing a source of infection for humans and other animals (Segal and Elad, 2021). In Nigeria, many small ruminants are housed in the same compound or very close to their human handlers. Animal handlers and nomads are at higher risk of infection by zoophilic dermatophytes because they are in regular and direct contact with the animals (Azeez, 2021; Nwofor *et al.*, 2021). In a study carried out in Borno State by Nweze, (2001), *T. verrucosum* ranked second among seven different species of dermatophytes recovered from school children. Incidentally, the major occupation of the inhabitants of Borno State is rearing of animals. It thus follows that animal dermatophytosis has an important implication for human dermatophytic infection (Ogunbiyi *et al.*, 2005). Fungal diseases are assuming new importance because of the inappropriate use of antibacterials that eliminate the natural beneficial microflora which otherwise suppress the growth of fungi (De Lucca, 2007).

II. MATERIALS AND METHODS

Study Area

The study was carried out in Gwagwalada area council, Abuja. Gwagwalada is the second largest Area Council in the Federal Capital Territory (FCT), Abuja. The major occupation of the local indigenes is subsistence farming which includes the rearing of animals like goats (Ajah, 2020; Anselm, 2025). It is one of the semi-urban settlements in the F.C.T and is located between latitude and longitude N 8° 56' 29" and E 7° 5' 30" respectively (Adah and Olabode, 2017).

Sampling method

Purposive sampling technique was used and images of sampled goats were taken using a digital camera.

Sample Collection and Processing

Skin samples were collected from any goat with clinically suggestive lesions in goat flocks in Fulani camps, live goat markets and rural homesteads between the months of August, 2015 to January, 2016. Using protective gloves, a sterile scalpel blade was used to obtain skin scrapings from the margins of lesions suggestive of dermatophytosis after disinfecting the area with alcohol, according to the method described by

Madubuike *et al.*, (2022). Samples were placed in clean paper envelopes and in separate polythene bags and appropriately labeled. For each sample, a different scalpel was used to avoid contamination. Collected samples were transported as dry packs to the Microbiology Laboratory of the Department of Veterinary Microbiology, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria.

Laboratory Isolation of Dermatophytes from Goat Skin

Direct Examination

Direct examination of the samples was first carried out by the method described by Hainer, (2003). Small samples of each scraping were placed on a clean slide and 1 to 2 drops of 10% potassium hydroxide (KOH) solution was added. A cover slip was placed on top and the slide gently heated over a flame as Each slide was examined first using 10x low power objective lens then 40x high power objective lens in order to observe for the presence of diagnostic fungal forms.

Laboratory Culture of Dermatophytes

The samples were cultured on Sabouraud Dextrose Agar (SDA) (Oxoid, U.K, Hampshire) following manufacturer's instructions with the addition of chloramphenicol (0.05 mg/ml) and cyclohexamide (5 mg/ml), to aid the selective isolation of the fungi (Sharma *et al.*, 2011). The cultures were incubated at room temperature (25°C) for one to four weeks. The resultant cultures were appropriately discarded after 4 weeks following Laboratory Standard Operating procedures (SOPs) for culture disposals.

Laboratory Identification of Isolates

Suspected growths from Sabouraud Dextrose Agar were sub cultured onto Potato Dextrose Agar to facilitate distinctive spore formation for identification and pigment production. They were incubated at room temperature for one to four weeks (Balogun *et al.*, 2017). Identification was based on colonial and microscopic characteristics using the fungal colour atlas (Evans and Richardson, 1989; Baron *et al.*, 2003).

Slide culture preparation

In a situation where dermatophyte identification was inconclusive due to lack of sporulation, the isolates were subjected to slide cultures. This was done in order to observe the precise arrangement of the conidiophores and conidial ontogeny (i.e. the way the spores are produced). A modification of Oliveira *et al.*, method of slide culturing (2005) was used for the identification. Below is a brief description:



A sterile plate of Potato Dextrose Agar was used. Another plate of Potato Dextrose Agar was used to cut out an agar block (1x1 cm) small enough to fit under a cover slip. This was cut using a sterile blade. The agar block was flipped onto the surface of the first sterile plate of Potato dextrose. The four corners of the agar block were inoculated with spores or mycelia fragments of the fungi. The cover slip was then placed centrally on the agar block and incubated at room temperature and daily observed till growth and sporulation occurred. The cover slip was then gently removed from the agar block and put on a clean glass slide with a small drop of lacto phenol cotton blue stain and observed under the microscope for conidia.

Statistical analysis

The data obtained from this study was analysed using Statistical package for social science (SPSS) version 21.0 and the results obtained were presented

in tables and charts. Statistical level of significance was fixed at P<0.05.

III. RESULTS

Results of Isolation and Identification of Dermatophytes from Goats in Gwagwalada

From August 2015 to January 2016, a total number of 124 samples were collected from 124 goats showing suggestive clinical signs of dermatophytosis. After culturing and microscopy, a total of 20 dermatophytes were isolated. From the 20 isolates Microsporium (6) Trichophyton (13) and Epidermophyton (1) were identified. Seven species were identified namely: Microsporium audouinii (4), Trichophyton verrucosum (6), Trichophyton tonsurans (5), Epidermophyton floccosum (1), Trichophyton mentagrophytes (1)), Microsporium gypseum (2) and Trichophyton ajelloi (1).

Other non dermatophytic fungi were also isolated from all the 124 samples namely *Rhizopus*, *Aspergillus*, *Mucor*, *Fusarium* and *Yeast*.

Table 1: Dermatophyte Isolates from Goats with Skin Lesions in Gwagwalada

DERMATOPHYTES (n=124)	NO. ISOLATED (%)	
<i>Microsporium</i>	6 (4.84)	65.0
<i>Trichophyton</i>	13 (10.48)	30.0
<i>Epidermophyton</i>	1 (0.81)	5.0
TOTAL	20 (16.13)	100

Table 2: Dermatophyte Species isolated from Goats in Gwagwalada

DERMATOPHYTES	NO. OF ISOLATES (%)	SOURCE OF SAMPLES
<i>Microsporium audouinii</i>	4 (3.23)	Fulani goat flock and Live goat markets
<i>Microsporium gypseum</i>	2 (1.61)	Live Goat Markets
<i>Trichophyton verrucosum</i>	6 (4.84)	Fulani goat flock, Live Goat markets, rural homesteads
<i>Trichophyton tonsurans</i>	5 (4.03)	Fulani goat flock, Live Goat markets, rural homesteads
<i>Trichophyton ajelloi</i>	1 (0.81)	Rural homestead
<i>Trichophyton mentagrophytes</i>	1 (0.81)	Fulani goat flock
<i>Epidermophyton floccosum</i>	1 (0.81)	Live Goat Market
TOTAL=7	20 (16.13)	

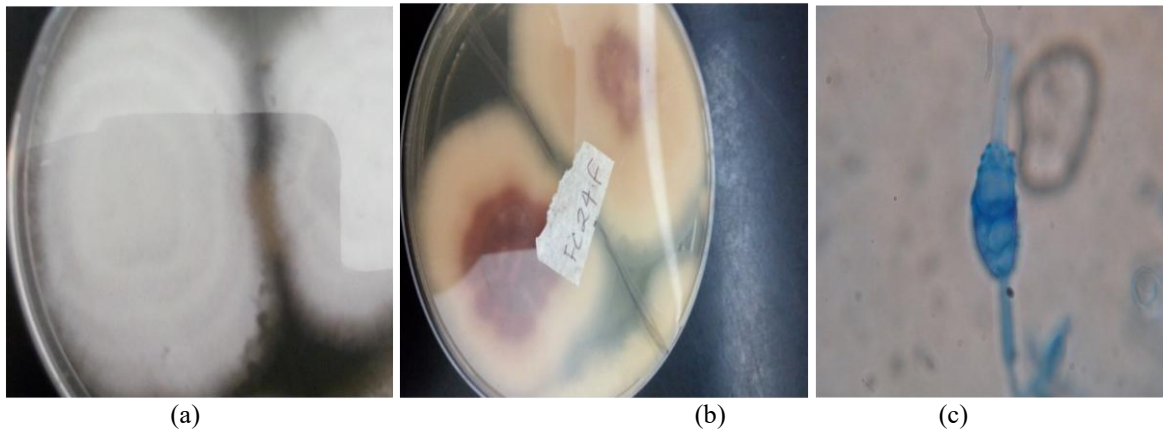


PLATE III: (a) Colony of *Microsporium audouinii* on PDA showing white, downy texture after 12 days growth, (b) Reverse of colonial growth of *Microsporium audouinii* with peach pigmentation (c) Microscopy of *Microsporium audouinii* showing deformed spindle shaped macroconidia (X400) (LCB Stain)

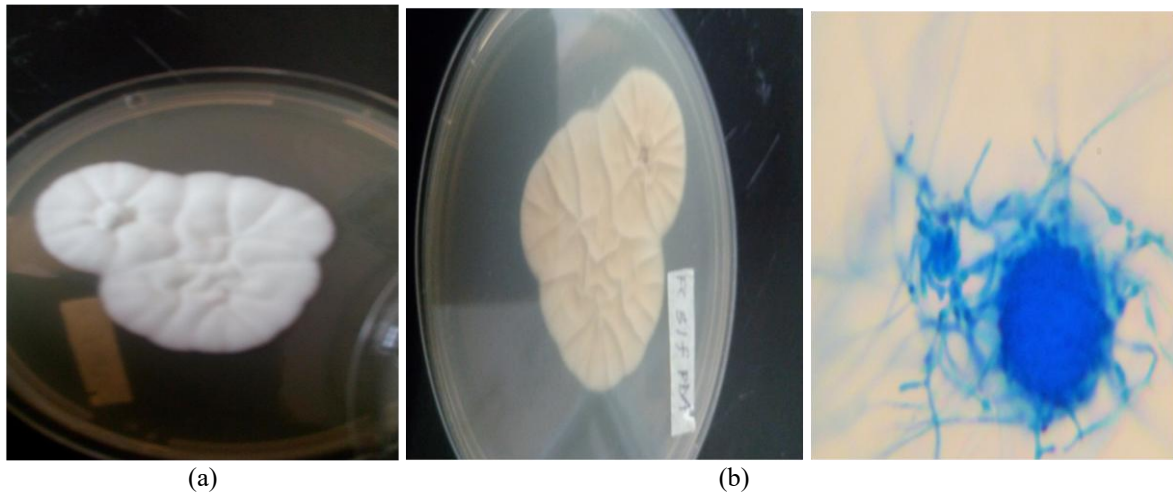


PLATE III:(a) Colony of *Trichophyton verrucosum* showing white velvet heaped texture, growth 14days (b) Reverse of *Trichophyton verrucosum* colonial growth colourless (c) Microscopy of *Trichophyton verrucosum* with arrow pointing at chlamydiospores (x400) LCB stain

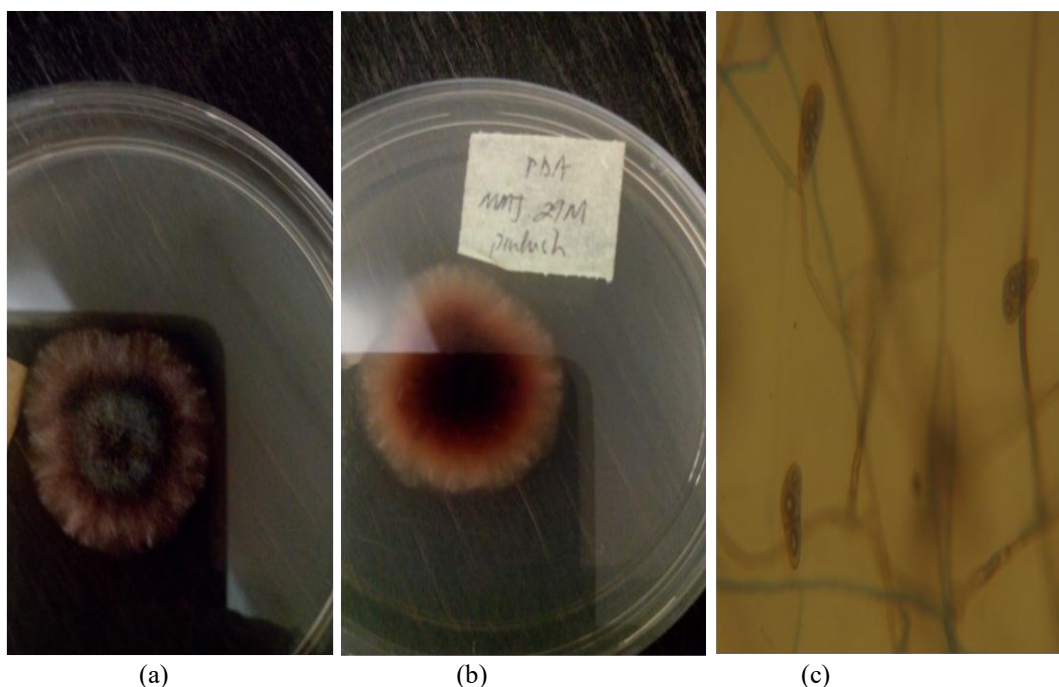


PLATE IV: (a) Colony of *Epidermophyton floccosum* showing greenish brownish pigmentation (14days) on PDA (b) Reverse of colonial growth of *Epidermophyton floccosum* showing reddish brown pigmentation (c) Microscopy of *Epidermophyton floccosum* showing smooth walled macroconidia attached directly to hyphae singly(x400) LCB stain

Table 3: Non – Dermatophyte isolates from Goats in Gwagwalada, Abuja

Non-Dermatophyte	No. Isolated (%)
<i>Aspergillus spp</i>	49 (39.52)
<i>Rhizopus spp</i>	36 (29.03)
Yeast	16 (12.90)
<i>Fusarium spp</i>	3 (2.42)
TOTAL	104 (83.87)

Table 4: Sources of Dermatophytes isolated from Goats in Gwagwalada

Source	No.of Samples Collected	No.Positive (%)
Fulani Goat herds	36	7 (5.65)
Live Goat Markets	60	9 (7.26)
Rural homesteads	28	4 (3.23)
TOTAL	124	20 (16.13)

P=0.9604, df=2, $\chi^2=0.2982$

Table 4.5: Distribution of Dermatophytes Based on Anatomical Location

Anatomical Site	No.of Samples Collected	No.Positive (%)
Udder	15	4 (3.23)
Leg	20	4 (3.23)
Ear	35	8 (6.45)
Face	10	3 (2.42)
Neck	10	1 (0.81)



Others (shoulders,chest,stomach) 34 0 (0)

TOTAL 124 20 (16.13)

P=0.1264, df=5, $\chi^2=8.593$

Table 6: Seasonal Distribution of Dermatophytes in Goats in Gwagwalada, Abuja

Month of The Year	No. of Samples Collected	No. Positive (%)
August	6	0 (0)
September	35	6 (4.84)
October	21	0 (0)
November	29	9 (7.26)
December	18	0 (0)
January	15	5 (4.03)
TOTAL	124	20 (16.13)

P=0.0298, df=5, $\chi^2=12.95$

Table 7: Age distribution of dermatophytes in Goats from Gwagwalada

Age	No.Sampled	No. Positive (%)
Adult Goats	56	13 (10.48)
Young Goats	68	7 (5.65)
TOTAL	124	20 (16.13)

P=0.1469

Table 8: Sex Distribution of Dermatophytes isolated in Goats from Gwagwalada

Sex	No. Sampled	No.Positive (%)
Female	65	9 (7.26)
Male	59	11 (8.87)
TOTAL	124	20 (16.13)

P=0.6324

IV. Discussion

Dermatophytes from the genera *Microsporum*, *Trichophyton* and *Epidermophyton* were isolated and identified in goats from the study area with *Trichophyton* species having the highest frequency of 13 isolates (10.5%) as seen in Table 4.1, and *Trichophyton verrucosum* being the dermatophyte with the highest frequency of 6 (4.8%) as seen in Table 4.2. This is in line with what was reported by Nweze (2011), where *T. verrucosum* was the most common species isolated in goats though at a higher frequency with a total of 10 (7.7%).

The dermatophytes isolated are both of veterinary and medical importance because of the disease they cause in animals and their zoonotic potentials (Madubuike *et al.*, 2022). *Trichophyton* and *Microsporum* species are the dominant species colonizing 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 these organisms have a significant importance in the animal industries where they lead to decreased production yield and

economic losses especially in the food animal industries (Adah *et al.*, 2024).

Nweze (2011), who conducted research on several domestic animals in several Nigerian states, including Enugu, Anambra, Ebonyi, Abia, Imo, Kogi, and Delta, also identified *Microsporum* and *Trichophyton* from goats, which is consistent with the findings of this study.

Dermatophytes isolated in this study were *Trichophyton tonsurans*, an anthropophilic fungus with a global distribution, *Trichophyton ajelloi*, a geophilic fungus with a global distribution that has been described as a saprophytic contaminant on humans and animals (Madubuike *et al.*, 2022), and *Trichophyton mentagrophytes*, a zoophilic fungus with a global distribution that affects a wide range of hosts and is therefore a major public health concern because trichophytosis can spread from person to person, animal to animal, or from the environment. Although this is less frequently reported, it is theoretically possible for it to spread from humans to animals (Stose, 2025).



Depending on the diseased species, trichophytosis in large animals manifests itself in different ways. Although adults can contract the disease, lesions are more frequently observed in calves. Because this disease is underreported and underdiagnosed, it can lead to delayed treatment, increased morbidity and mortality, increased infection spread, inefficient use of health care resources, and potential treatment failures (Stose, 2025). Calves often present with nonpruritic lesions around the eyes, as well as lesions on the head and neck, and in addition to skin lesions, the fingernails and toe nails may be affected (Madubuike *et al.*, 2022).

Microsporum audouinii accounted for four of the twenty dermatophytes that were isolated (Plate II) and it has been reported that Africa is home to the anthropophilic dermatophyte *Microsporum audouinii*. Which was isolated from market places and herds of Fulani goats in this present study from goats which may have contracted the fungi from interaction with infected human workers (Madubuike *et al.*, 2022).

Microsporum gypseum is a geophilic fungus that has been identified from ruminants and infects animals that live in close proximity to dirt (Adah *et al.*, 2015). Treatment options range from systemic antifungal therapy to over-the-counter medications. Sharing clothes, towels, hairbrushes, sporting goods, and other personal objects is crucial because fomites can be a major source of infection, hence the need for public health awareness (Nweze, 2010).

Epidermophyton floccosum is reportedly a human pathogen but was isolated in this study from goats as seen in Plate IV. This is of significance showing a possibility of cross infections from humans to animals. Few previous studies on the isolation of *Epidermophyton* from animals are on record from work done by Efuntoye and Fashanu (2002). Philpot and Smith, isolated *Epidermophyton floccosum* from goats along with a wide variety of other dermatophytes including *M. gypseum*, *Trichophyton mentagrophytes*, and *T. verrucosum*, which were also isolated in this study. Compared to Fulani goat flocks and rural homesteads, more samples were isolated from markets which is probably because animals from various origins are gathered and kept in close quarters, which facilitates the infection's transfer from infected to vulnerable animals.

The ears yielded a higher number of positive isolates than any other anatomical site as seen on Table 4.5. which agrees with the report of Ellabib and Khalifa (2001) who reported that the distribution of dermatophytes depends on the

availability of keratin and this could explain why a large number of dermatophytes were isolated from the ears. The ear has thickened skin and is rich in keratinized tissues with minimal flesh and less hair (Adah *et al.*, 2024). Also, the ears are more vulnerable to contact and injuries predisposing them to infection by dermatophytes as dermatophyte infections are known to be facilitated by breaks/abrasions on the skin (Hainer *et al.*, 2003).

Skin samples were collected during both the rainy and dry seasons and the results showed a higher incidence of the infection in November followed by August and lastly January irrespective of the number of samples collected. The results show that because of the constant high temperatures and humidity in Gwagwalada, dermatophytes can readily be isolated and can cause disease at any time of the year, either rainy or dry seasons, which agrees with the previous report of Bhutia *et al* (2019) and recent reports by Adah *et al* 2024; Joel *et al.*, 2025, who all stated that dermatophytosis is more common in tropical climates or areas having hot and humid climates.

Similarly, there was a high incidence of the infection in adult goats than the young goats despite the fact that more young goats were sampled. This report disagrees with findings by Cam *et al* (2007) and Begum *et al* (2021) who reported that young animals are particularly more susceptible to infection by ring worm fungi. This study shows that adult goats are equally susceptible to dermatophytes as young goats which could be due to the way most of the adult goats sampled were housed in close proximity to each other aiding the easy spread of dermatophytosis.

This study further showed a higher incidence of dermatophytosis in male goats than female goats, which could be due to the mating behaviour of male goats which makes them wander around more on extensive farming system practiced by small scale backyard farmers (Adah and Olabode, 2017) However, male goats are more engaged in fighting which could lead to bruises and skin abrasions which has been reported to be a major predisposing factor to dermatophyte infection (Mailafia *et al.*, 2016).

V. CONCLUSION

In this study, it has been established that a wide range of dermatophytes cause infections in goats in Gwagwalada area council, F.C.T, Abuja. All the dermatophytes isolated are potential risks to other animal species and humans who handle them as food animals, patients for treatment, for recreational purposes and for sports. The incidence of dermatophyte infection from goats in



Gwagwalada, F. C. T was found to be 16.13%. The highest number of dermatophyte infections were isolated from markets (7.26%) followed by Fulani goat herds (5.64%) and finally rural households (3.23%). Males had more ringworm lesions (8.87%) than females (7.26%). More adults goats (10.48%) were affected than younger goats (5.65%) with ringworm lesions. Most lesions were found on the ears (22.8%), the udder (26.6%) and legs (20%) the face (30%) and the neck (10%). Trichophyton species were the highest dermatophyte species isolated (13) followed by *Microsporum* (6) and Epidermophyton (1). *Trichophyton verrucosum* was the species with the highest isolates (30%) followed by *Trichophyton tonsurans* (25%), *Microsporum audouinii* (20%), *Microsporum gypseum* (10%). *Trichophyton ajelloi*, *Trichophyton mentagrophytes* and *Epidermophyton floccosum* had a frequency of 5% percentage isolation.

Since this disease is zoonotic and causes significant economic and production losses in the animal industries, this study has demonstrated the necessity for sufficient public health awareness and policy making to achieve effective prevention and control measures.

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