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ORIGINAL RESEARCH

ISOLATION OF DERMATOPHYTES FROM INFECTED STRAY CATS IN SELANGOR

Isolasi Dermatofita dari Kucing Liar yang Terinfeksi di Selangor

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ABSTRACT

Background: Dermatophytosis is the most prevalent fungal infection found in cats and one of the most serious infectious skin diseases that affect this species. Dermatophytosis can be endemic in cats, particularly in poor environments, and it is difficult to eradicate in such cases. **Purpose:** The aim of this research was to determine the macroscopic and microscopic identification of various types of dermatophytes present in stray cats. **Methods:** The research was designed as a laboratory-based study. The sample was determined through physical examination of stray cats infected with fungi and was selected based on the infection site (nail, hair, and skin) of infected cats. A total of 125 samples were collected from infected stray cats through skin scraping, haircutting, and nail clipping. The collected samples were then cultured in Sabouraud Dextrose Agar (SDA) medium and incubated for two weeks at 26°C. Following incubation, fungi were stained using Lacto-phenol Cotton Blue (LPCB) for microscopic identification. **Results:** The identification showed that *Trichophyton spp.* is the most common isolated fungal species on the hair, nails, and skin of stray cats. This is followed by *Aspergillus spp.* and *Microsporum spp.* The least common dermatophytes include *Curvularia spp.*, *Absidia spp.*, *Epidermophyton spp.*, *Neosytallidium spp.*, *Alternaria spp.*, *Scopulariopsis spp.*, *Mucor spp.*, and *Penicillium spp*. **Conclusion:** The research focussed exclusively on stray cats with clinical evidence of mycotic lesions and confirmed the role of stray cats in transmitting dermatophytosis through their hair, nails, and skin. The prevalence of dermatophytes on stray cats was identified in the Selangor region.

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ABSTRAK

Pendahuluan: *Dermatofitosis adalah infeksi jamur yang paling umum pada kucing dan salah satu penyakit menular yang paling signifikan pada spesies ini. Dermatofitosis dapat bersifat endemik pada kucing, terutama di lingkungan yang buruk dan dalam kasus seperti itu sulit untuk diberantas.* ***Tujuan:*** *Tujuan dari penelitian ini adalah untuk mengidentifikasi secara makroskopis dan mikoskropis berbagai jenis dermatofita pada kucing liar.* ***Metode:*** *Desain penelitian ini adalah penelitian berbasis laboratorium. Sampel ditentukan dengan mengevaluasi hasil pemeriksaan fisik kucing liar yang terinfeksi oleh jamur dan dipilih berdasarkan lokasi infeksi (kuku, rambut, dan kulit) kucing yang terinfeksi. Total 125 sampel dari kucing liar yang terinfeksi dikumpulkan melalui pengikisan kulit, pemotongan rambut, dan pengguntingan kuku. Sampel yang dikumpulkan kemudian dikultur dalam medium Sabouraud Dextrose Agar (SDA) dan diinkubasi selama dua minggu pada suhu 26°C. Setelah waktu inkubasi, jamur diwarnai menggunakan Lactophenol Cotton Blue (LPCB) untuk identifikasi mikroskopis.* ***Hasil:*** *Identifikasi menunjukkan bahwa Trichophyton spp. Adalah jamur yang paling umum diisolasi pada rambut, kuku, dan kucing liar. Ini diikuti oleh Aspergillus spp. dan Microsporum spp. Dermatofit yang paling tidak umum termasuk Curvularia spp., Absidia spp., Epidermophyton spp., Neosytallidium spp., Alternaria spp., Scopulariopsis spp., Mucor spp. dan penicillium spp.* ***Kesimpulan:*** *Penelitian ini hanya melibatkan kucing liar dengan bukti klinis lesi mikotik dan mengkonfirmasi peran kucing liar yang membawa dermatofitosis melalui rambut, kuku, dan kulit mereka. Tingkat prevalensi beban dermatofita pada kucing liar diidentifikasi di wilayah Selangor.*

INTRODUCTION

Early humans began and maintained contact through social activities that included food gathering and then developed agriculture and domestication of animals. With the passage of time, scientific and technological advancements brought about incredible improvements and changes to human lifestyles, which were a boon to humanity. Throughout evolution, humans have had numerous opportunities to come into close contact with their environment, which included animals. This has resulted in the spread of infections in both humans and animals. The most prevalent of mycotic zoonosis is dermatophytosis, which frequently occurs in humans and a variety of animals (Hayette & Sacheli, 2015).

Dermatophytosis is an important shelter-associated infection that can cause widespread infection of animals (especially cats), human health risks, and profound disruption of shelter operations, including shelter closure and high economic costs associated with disease control measures. Dermatophytosis is an integumentary infection caused by a cluster of closely related fungi known as dermatophytes. While the disease is typically self-limiting, it can be prolonged and, due to its high trasmissibility, infected cats and subclinical carriers can pose a risk to humans and animals (Mozes, Pearl, Rousseau, Niel, & Weese, 2017). Dermatophytes are categorized based on their habitat, with anthrophilic species associated with humans, zoophilic species associated with animals, and geophilic species associated with soil (Magdum, Gadgil, Kulkarni, Rajmane, & Patil, 2016).

The prevalence of dermatophytes in cats has been reported to be highly variable. This variability depends on geographic location, sampling season, and clinical and living conditions. There are few data on the prevalence of *Microsporum canis* in stray cats. The worldwide

prevalence of dermatophytes varies between 5% to 50% in asymptomatic stray cats or randomized. In Italy, dermatophytes were isolated from 27% to 50% of feral cats regardless of clinical signs (Proverbio et al., 2014).

In most worldwide and Italian studies, *M. canis* is the most isolated dermatophyte in stray cats, with a prevalence ranging from 0% to 47.40%, while *Trichophyton mentagrophytes* is rarely isolated and has a prevalence ranging from 0% to 11.9%. It is critical to understand the health status of free-roaming stray cats to assess animal welfare and to obtain information about pathogens and diseases prevalent in each environmental region (Proverbio et al., 2014).

Zoophilic dermatophytes often cause superficial mycoses in mammals worldwide. They are composed of about ten specialized parasitic fungi belonging to the genera *Trichophyton* and *Microsporum*. Due to the disease's highly contagiousness, most species have the potential to cause outbreaks in at least one of their primary hosts while also infecting a diverse range of mammals, including humans (Hubka, Peano, Cmokova, & Guillot, 2018).

Dermatophytosis is a skin disease that affects the skin's outer layer and other keratinized structures such as hair and nails. This disease is caused by fungi known as dermatophytes. Dermatophytes are considered pathogens. There are more than 50 species of dermatophytes classified in the genera *Trichophyton*, *Epidermophyton*, *Nannizzia*, *Arthroderma*, *Lophophyton*, and *Paraphyton*. A review of the scientific literature revealed significant variations in the prevalence of infection. The two main factors that are most often considered to have the greatest epidemiological significance are animal origin and type of infection. In this regard, interesting data are provided by investigations of the fungal microbiota present in the fur of cats and dogs. Interestingly, the anthropophilic species *Trichophyton rubrum* was one of the dermatophyte species that infect the skin of animals that exhibit no symptoms of infection. This carries the risk of transmitting dermatophytes to humans who serve as their masters (Łagowski, Gnat, Nowakiewicz, Osińska, & Zięba, 2019).

The results of research conducted by Vineetha et al (2018) showed that the majority of human dermatophytosis is chronic, with tinea corporis being the most prevalent presentation. *Trichophyton rubrum* and *Trichophyton mentagrophytes* were the most commonly detected species, although rare species such as *Trichophyton tonsurans*, *Trichophyton schoenleinii*, *Epidermophyton floccosum*, and *Microsporum* were also found.

Previous research showed that a randomized study conducted in 2017 on various types of cats in Shah Alam, Malaysia found dermatophytes in as many as 6.23% or 98 of the 155 samples, with *Penicillium* being the most prevalent type (Tuah & Tiwari, 2019).

Dermatophytes can infect humans when they come into contact with infected animals. In domestic cats, environmental conditions and cleanliness are maintained to minimize the risk of dermatophytosis in cats, let alone transmission to their masters, however, this does not apply to stray cats whose conditions and environment are different, increasing the risk of dermatophyte infection and impacting transmission to humans who care about animals that come into contact with them. Therefore, further research on the incidence of dermatophytosis in stray cats is necessary; thus, one of the objectives of this study was to identify the types of fungi that colonize stray cats in the Selangor area. This study confirms its likelihood and establishes the need for additional research in a similar setting; additionally, this study placed an emphasis on larger samples to allow for a more thorough discussion of the infection's epidemiological background and public health significance.

METHODS

This research was conducted from January to May 2019 in Selangor, Malaysia. It was designed as laboratory-based research. The sample was determined through physical examination of stray cats infected with fungi and was selected based on the infection site (nail, hair, and skin) of infected cats. Direct physical examination was conducted using a random sampling method.

This study focused on stray cats that had various types of dermatophytosis. A total of 125 samples were collected from stray cats through skin scraping, and hair and nail clipping. The collected samples were then cultured in SDA for two weeks at 26°C. Macroscopic identification was made by evaluating the colony structure, color, and texture, while microscopic identification was made by staining the fungi with Lepto-phenol cotton blue and examining the fungi's morphology under a light microscope. Mycological investigations, including direct microscopy, cultural isolation, and identification, were carried out in Microbiology Laboratory of Management

and Science University (MSU), Shah Alam, Selangor, Malaysia.

The collected data were grouped and analyzed univariably. The univariate analysis was presented descriptively using frequency tables; the data were interpreted and compared to existing theories, standards, guidelines, and provisions.

RESULTS

In general, all 125 clinical specimens were obtained from stray cats. The highest number of dermatophytes isolated was *Trichophyton spp*., followed by *Aspergillus spp.*, *Microsporum spp.*, *Curvularia spp.*, *Absidia spp.*, and *Epidermaphyton spp*. *Trichophyton spp*. was isolated from 65.60% of stray cat hair samples, followed by *Aspergillus spp*. and *Absidia spp.*, which were isolated from 25.60% and 2.40% of stray cats hair samples, respectively (Figure 1). Trichophyton spp. was the most isolated dermatophyte from stray cat's nail with 63.20%, followed by *Aspergillus spp*. (24.00%), *Curvularia spp*. (4%), *Absidia spp*. (3.20%), and *Microsporum spp*. and *Penicillium spp*, each with 2.40%. Figure 2 demonstrates all dermatophytes isolated from the cats' nails.

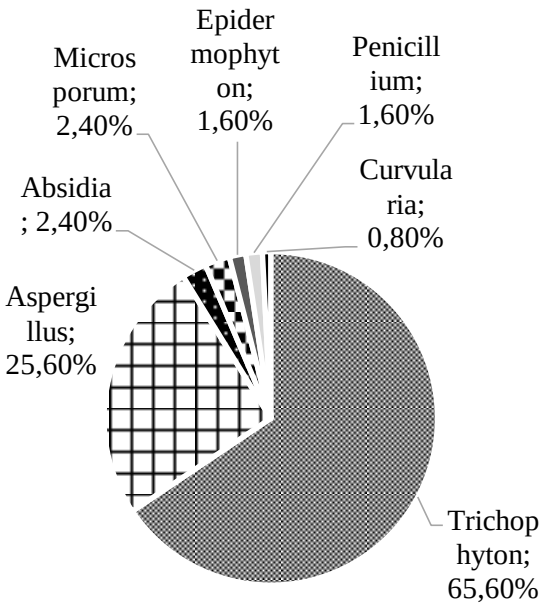

Figure 1. Dermatophytes Isolated from Stray Cats' Hair

Epidermaphyton spp. was isolated from stray cats' skin samples and revealed that 1.60% of cats' skins were infected with this fungus. Additionally, 0.80% *Mucor spp.*, *Alternaria spp.*, *Scopulariopsis spp.*, and *Penicillium spp*. were isolated from this sample (Figure 3).

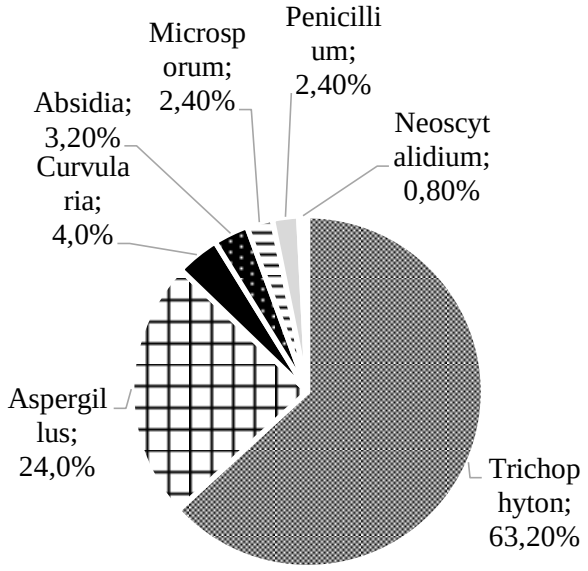

Figure 2. Dermatophytes Isolated from Stray Cats' Nail

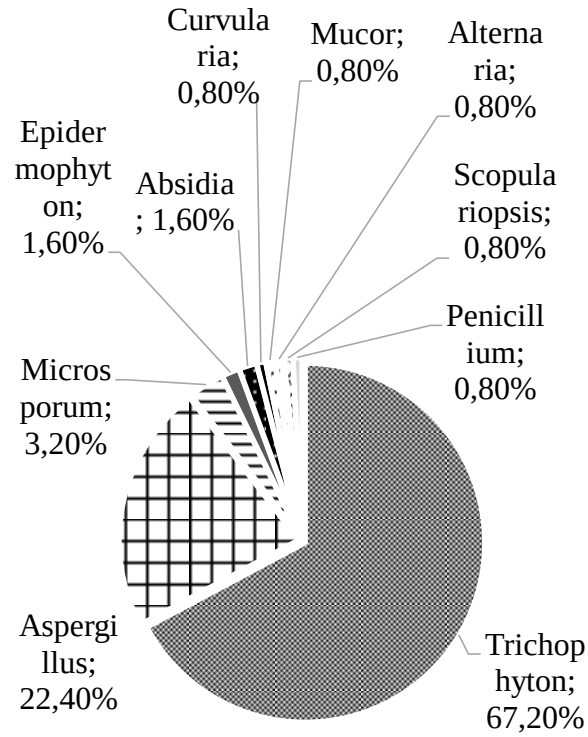

Figure 3. Dermatophytes Isolated from Stray Cats' Skin

DISCUSSION

Dermatophytosis disease, more commonly referred to as ringworm, is a disease that affects animals and has the potential to spread zoonotic infection, posing serious public health problems. It

is a disease caused by a fungus that lives on the skin and fur of animals (Day, 2016; Łagowski, Gnat, Nowakiewicz, Osińska, & Zięba, 2019). Dermatophyte infections can affect anybody, and one of the most significant risks factors is the coexistence of humans and animals (Rodríguez, Guzmán, García, Asz-Sigall, & Arenasa, 2018). Breeders and pet owners are at an increased risk of contracting this disease due to close contact with their pets. Skin infections are common in developing countries, especially in the tropics, where dermatophytosis is of particular concern. Most fungal infections are located in the outermost layer of the skin (epidermis). Fungal infections of the lower layers of the skin, internal organs, and blood are uncommon. Dermatophyte infections are one of the earliest known fungal infections in humans and are very common worldwide. Dermatophytosis consists of a group of superficial fungal infections that affect the hair, nails, and epidermis. Dermatophytosis is more commonly found in humans and animals that live in hot and humid environments with poor hygiene conditions (Baumgardner, 2017; Parmar et al., 2018). The epidemiology of dermatophytosis diseases is dynamic, and future changes are difficult to predict. One common observation is the fact that climate change directly affects the ability of fungi to cause harm to human hosts, increasing both the geographic range of the pathogen and the prevalence of infection (Clancy & Nguyen, 2017; Shriber, Conlon, Benedict, McCotter, & Bell, 2017).

Cats are a species of animal that frequently come into contact with humans. In the current study, detailed mycological investigations were carried out on a sample of 125 stray cats, which included skin scraping and hair and nail clipping, as mentioned previously. These samples were suspected of having been infected with dermatophytosis. Direct microscopy of samples revealed that *Trichophyton spp.* is the most prevalent fungus on stray cats' skin, hair, and nails, ranging between 63% to 68%. This was followed by *Aspergillus spp.*, which had the second-highest percentage of isolated dermatophytes, ranging between 22.40% to 26%. The findings are consistent with the results of a study conducted by Ilhan et al (2016), which also revealed that *Trichophyton spp.* was the most frequently isolated dermatophytosis in cats through direct microscopy. This agrees with a study conducted by Debnath, Mitra, Kumar, & Samanta (2016), which found that *Trichophyton spp.* is one of the most frequently isolated dermatophytes in cats.

Trichophyton is a genus of fungi that includes the parasitic responsible for tinea infections, such as athlete's foot, ringworm, jock itch, and similar conditions of the nail, beard, skin, and scalp. Trichophyton fungi are molds that are characterized by the development of both smooth-walled macro-and microconidia. Macroconidia are mostly borne laterally directly on the hyphae or short pedicels. They have thin or thick walls, clavate to fusiform, and range from 4–8 μm by 8–50 μm. They are rare or absent in many species, are of spherical, pyriform to clavate or irregular shape, and range in size from 2–3 μm by 2–4 μm (K. Moriello, 2019). *Trichophyton* is a type of fungus that has the potential to infect humans. Research conducted by Vineetha on humans also revealed that *Trichophyton rubrum* and *Trichophyton mentagrophytes* were the most frequently isolated species in culture, but that rare species such as *Trichophyton tonsurans*, *Trichophyton schoenleinii*, *Epidermophyton floccosum*, and *Microsporum audouinii* were isolated from chronic cases as well (Reis et al., 2019; Vineetha et al., 2018). The results of a human study by Haggag, Samaha, Nossair, & Mohammad (2017) showed that *Trichophyton verrucosum* was the most isolated dermatophyte (28%), followed by *Epidermophyton flocosum* and *Microsporum canis* (16% and 14%, respectively). *Trichophyton mentagrophytes* and *Trichophyton violaceum* were the least isolated (each 12%).

Most of the stray cats in Selangor had positive cultures for *Trichophyton spp.* and *Aspergillus spp.*, but very few had positive cultures for *Mucor spp.*, *Alternaria spp.*, *Scopulariopsis spp.*, and *Penicillium spp.* This is consistent with other studies that vary by country, and the cat population studied (unhealthy, pets, and stray cats). Most studies showed that *Trichophyton spp.* and *Microsporum canis* are the principal fungi found in stray cats. For instance, the study conducted by Nitta, Daniel, Taborda, Santana, & Larsson (2018) demonstrated that *M. canis* and *Trichophyton spp.* were frequently isolated dermatophytes on male cats as a result of their sex; however, in the present study, the sex of the cats was not found to be a risk factor for the status of dermatophytosis transmission. On the other hand, the cases of tinea capitis caused by *Trichophyton spp.* contracted from cattle was detected by K. A. Moriello, Coyner, Paterson, & Mignon (2017) . Debnath, Mitra, Kumar, & Samanta (2016) reported and discovered the prevalence of *M. canis*, *Microsporum gypseum*, and *Trichophyton*

mentagrophytes in semi-arid regions and eastern parts of India.

The overall findings highlight that *Trichophyton spp.*, *Aspergillus spp.*, and *Epidermophyton spp.* are the most frequently isolated dermatophytosis in stray cats in Selangor, Malaysia. Similar findings were reported by Chah, Majiagbe, Kazeem, Ezeanyika, & Agbo (2012), which revealed that anthropophilic dermatophytes were among the fungal agents associated with dermatophytosis in animals in Nsukka Agricultural Zone. The discovery of the majority of dermatophytes species in these stray cats varied according to geographical distribution and habitat (Debnath, Mitra, Kumar, & Samanta, 2016; Magdum, Gadgil, Kulkarni, Rajmane, & Patil, 2016).

These dermatophytes may pose health risks to humans who come into contact with animals. The results of studies conducted on children showed that 62% and 31% of children infected with tinea capitis had regular contact with two critical reservoirs of *Microsporum*, one of which was a cat, despite chronic malnutrition, poor hygienic conditions, and limited access to water being also considered risk factors for dermatophyte infections in children (Nweze & Eke, 2018). The results of a study conducted by Nitta, Daniel, Taborda, Santana, & Larsson (2018) showed that of the 18 people who had close contact with infected cats, eight (44.40%) admitted to having experienced typical tinea corporis lesions in the past, while three (16.70%) reported having skin lesions while grooming a cat.

Research Limitations

The study's limitations include a time constraint due to the limited time available for conducting the research and a financial constraint imposed by the high cost of molecular analysis.

CONCLUSION

According to this study, *Trichophyton spp.* is the most prevalent fungus type found in the hair, nails, and skin of stray cats in Selangor, Malaysia. The unhygienic conditions in which the stray cats were found in this study are likely to be a factor in the increased occurrence of dermatophytes, as most of the street cats lack proper care. It has been noticed that most cats infected with dermatophytes have few lesions and that most of them exhibit no symptoms. Thus, the public health officers must investigate the conditions of cats and, in the future, conduct awareness programs about stray cats in the Selangor area.

CONFLICT OF INTEREST

There is no conflict of interest

AUTHOR CONTRIBUTIONS

All authors declare that they actively participated in the research and writing of the article and that they were each partly responsible for the article's content, including in the preparation and writing of concepts, designs, analysis, or revision of the article. PR: conceptualization, methodology, software, data curation, writing, original draft preparation. KP: visualization, investigation, supervision KS: software, validation, writing, reviewing, and editing.

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REFERENCES

Baumgardner, D. J. (2017). Fungal infections from human and animal contact. *Journal of Patient-Centered Research and Reviews*, *4*(2), 78–89. https://doi.org/10.17294/2330-0698.1418

Chah, K. F., Majiagbe, K. A., Kazeem, H. M., Ezeanyika, O., & Agbo, I. C. (2012). Dermatophytes from skin lesions of domestic animals in Nsukka, Enugu State, Nigeria. *Veterinary Dermatology*, *23*(6), 1–4.

https://doi.org/10.1111/j.1365-3164.2012.01089.x

Clancy, C. J., & Nguyen, M. H. (2017). Emergence of candida auris: an international call to arms. *Clinical Infectious Diseases*, *64*(2), 141–143. https://doi.org/10.1093/cid/ciw696

Day, M. J. (2016). Pet-related infections. *American Family Physician*, *94*(10), 794–802.

Debnath, C., Mitra, T., Kumar, A., & Samanta, I. (2016). Detection of dermatophytes in healthy companion dogs and cats in eastern India. *Iranian Journal of Veterinary Research*, *17*(1), 20–24. https://doi.org/10.22099/ijvr.2016.3598

Haggag, Y., Samaha, H., Nossair, M., & Mohammad, A. (2017). Prevalence of dermatophytosis in some animals and Human in Behera Province, Egypt. *Alexandria Journal of Veterinary Sciences*, *53*(2), 64–71. https://doi.org/10.5455/ajvs.203688

Hayette, M. P., & Sacheli, R. (2015). Dermatophytosis, trends in epidemiology and diagnostic approach. *Current Fungal Infection Reports*, *9*(3), 164–179. https://doi.org/10.1007/s12281-015-0231-4

Hubka, V., Peano, A., Cmokova, A., & Guillot, J. (2018). *Common and emerging dermatophytoses in animals: well-known and new threats BT – emerging and epizootic fungal infections in animals* (S. Seyedmousavi, G. S. de Hoog, J. Guillot, & P. E. Verweij, eds.). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-72093-7_3

Ilhan, Z., Karaca, M., Ekin, I. H., Solmaz, H., Akkan, H. A., & Tutuncu, M. (2016). Detection of seasonal asymptomatic dermatophytes in Van cats. *Brazilian Journal of Microbiology*, *47*(1), 225–230. https://doi.org/10.1016/j.bjm.2015.11.027

Łagowski, D., Gnat, S., Nowakiewicz, A., Osińska, M., & Zięba, P. (2019). The prevalence of symptomatic dermatophytoses in dogs and cats and the pathomechanism of dermatophyte infections. *Postępy Mikrobiologii – Advancements of Microbiology*, *58*(2), 165–176. https://doi.org/10.21307/pm-2019.58.2.165

Magdum, R. J., Gadgil, S. A., Kulkarni, S. A., Rajmane, V. S., & Patil, S. S. (2016). Clinico mycological study of superficial mycoses. *Journal of Krishna Institute of Medical Sciences University*, *5*(4), 37–44.

Moriello, K. (2019). Dermatophytosis in cats and dogs: a practical guide to diagnosis and treatment. *In Practice*, *41*(4), 138–147. https://doi.org/https://doi.org/10.1136/inp.l1539

Moriello, K. A., Coyner, K., Paterson, S., & Mignon, B. (2017). Diagnosis and treatment of dermatophytosis in dogs and cats.: clinical consensus guidelines of the world association for veterinary dermatology. *Veterinary Dermatology*, *28*(3), 266–268. https://doi.org/10.1111/vde.12440

Mozes, R., Pearl, D. L., Rousseau, J., Niel, L., & Weese, J. S. (2017). Dermatophyte surveillance in cats in three animal shelters in Ontario, Canada. *Journal of Feline Medicine and Surgery*, *19*(1), 66–69. https://doi.org/10.1177/1098612X15615656

Nitta, C. Y., Daniel, A. G. T., Taborda, C. P., Santana, A. E., & Larsson, C. E. (2018). Isolation of dermatophytes from the hair coat of healthy persian cats without skin lesions from commercial catteries located in São Paulo Metropolitan Area, Brazil. *Acta Scientiae Veterinariae*, *44*, 1–7. https://doi.org/10.22456/1679-9216.81298

Nweze, E. I., & Eke, I. E. (2018). Dermatophytes and dermatophytosis in the eastern and southern parts of Africa. *Medical Mycology*, *56*(1), 13–28. https://doi.org/10.1093/mmy/myx025

Parmar, B. C., Nayak, J. B., Brahmbhatt, M. N., Chaudhary, J. H., Patel, S. A., & Gida, H. K. (2018). Prevalence of dermatophytosis in animal and human population with special reference to its zoonotic significance. *International Journal of Pure & Applied Bioscience*, *6*(5), 687–691. https://doi.org/10.18782/2320-7051.6991

Proverbio, D., Perego, R., Spada, E., Bagnagatti De Giorgi, G., Della Pepa, A., & Ferro, E. (2014). Survey of dermatophytes in stray cats with and without skin lesions in Northern Italy. *Veterinary Medicine International*, *2014*, 1–4. https://doi.org/10.1155/2014/565470

Reis, A. P. C., Correia, F. F., Jesus, T. M., Pagliari, C., Sakai-Valente, N. Y., Júnior, W. B., … Sousa, M. G. T. (2019). In situ immune response in human dermatophytosis: possible role of langerhans cells (CD1a+) as a risk factor for dermatophyte infection. *Revista Do Instituto de Medicina Tropical de Sao Paulo*, *61*, 1–6. https://doi.org/10.1590/s1678-9946201961056

Rodríguez, P. A., Guzmán, G., García, P., Asz-Sigall, D., & Arenasa, R. (2018). Human dermatophytosis acquired from pets: report of three cases. *Journal of Dermatology & Cosmetology*, *2*(4), 38–41. https://doi.org/10.15406/jdc.2018.02.00080

Shriber, J., Conlon, K. C., Benedict, K., McCotter, O. Z., & Bell, J. E. (2017). Assessment of vulnerability to coccidioidomycosis in Arizona and California. *International Journal of Environmental Research and Public Health*, *14*(7), 1–16. https://doi.org/10.3390/ijerph14070680

Tuah, N. F. B. H. M., & Tiwari, K. (2019). Prevalence of dermatophytic fungi in cats of Shah Alam, Selangor, Malaysia. *Asian Journal of Biological Sciences*, *12*(2), 291–294. https://doi.org/10.3923/ajbs.2019.291.294

Vineetha, M., Sheeja, S., Celine, M. I., Sadeep, M. S., Palackal, S., Shanimole, P. E., & Das, S. S. (2018). Profile of dermatophytosis in a tertiary center. *Indian Journal of Dermatology*, *63*(6), 490–495. https://doi.org/10.4103/ijd.IJD