Jurnal Kedokteran Hewan September 2025, 19(3):76-80
P-ISSN : 1978-225X; E-ISSN : 2502-5600 DOI: https://doi.org/10.21157/j.ked.hewan.v19i3.28482

SAPROFIT AND PATHOGENIC FUNGI ISOLATED FROM PET CLINICS AND STORES IN BOGOR CITY WEST JAVA

Eko Sugeng Pribadi[1,3]*, Febrina Suci Dwi Kadri[1], Revi Esti Wijayanti[1], Arman Deskiharto[3], and Setyo Widodo[2]
[1]Division of Medical Microbiology Department of Infectious Animal Disease and Veterinary Public Health School of Veterinary Medicine and Biomedical Science Bogor Agriculture University, Bogor, Indonesia
[2]Division of Internal Medicine Department of Cinic, Reproduction and Pathology School of Veterinary Medicine and Biomedical Science Bogor Agriculture University, Bogor, Indonesia
[3]Center for Tropical Animal Studies (CENTRAS) Bogor Agriculture University, Bogor, Indonesia
*Corresponding author: eko.spribadi@yahoo.co.id.

ABSTRACT

The research aimed to observe the occurrence of dermatophyte and other fungal species in grooming rooms and on groomers' clothing in several pet clinics and pet shops in Bogor City West Java. Ten veterinary clinics and five pet stores served as the study sites for this investigation. Five plates containing growth media were placed at five points in each room. Clothing swabs were collected from groomers immediately before they initiated their daily work activities. The result showed ten genus/species identified in grooming room and 16 genus/species isolated from the groomer clothes. *Fusarium* sp. was the predominant fungal isolate in grooming rooms (24.39%), followed by *Candida albicans* (9.76%). Notably, *Fusarium* sp. was also detected on groomers' clothing at a prevalence of 20.00%. Other pathogenic isolates included *Aspergillus flavus* and *A. fumigatus*. Despite the routine use of quaternary ammonium compounds, glutaraldehyde, anionic surfactants, and the ectoparasiticide amitraz in facility hygiene protocols, these disinfectant regimens insufficient in controlling fungal contamination. These findings highlight potential gaps in current disinfection practices within pet care facilities.

Key words: contaminated fungi, groomer clothes, grooming room, pet clinics, pet shops

ABSTRAK

Penelitian ini bertujuan mengidentifikasi keberadaan dermatophyta dan spesies jamur lainnya di ruang perawatan hewan serta pakaian groomer di beberapa klinik hewan dan petshop di Kota Bogor, Jawa Barat. Sebanyak sepuluh klinik hewan dan lima petshop dijadikan sebagai lokasi penelitian. Metode sampling meliputi peletakan lima cawan media pertumbuhan pada lima titik berbeda di setiap ruangan, serta pengambilan sampel swab dari pakaian groomer sebelum memulai aktivitas kerja. Hasil penelitian mengidentifikasi 10 genus/spesies jamur di ruang perawatan dan 16 genus/spesies dari pakaian groomer. Fusarium sp. merupakan kontaminan dominan di ruang perawatan (24,39%), diikuti oleh Candida albicans (9,76%). Pada pakaian groomer, Fusarium sp. terdeteksi pada 20,00% sampel. Isolat patogen lain yang teridentifikasi mencakup Aspergillus flavus dan A. fumigatus. Meskipun fasilitas tersebut telah menggunakan protokol higienitas berupa senyawa amonium kuarterner, glutaraldehid, surfaktan anionik, dan ektoparasitisida amitraz, regimen desinfeksi ini terbukti tidak efektif dalam mengendalikan kontaminasi jamur. Temuan ini mengindikasikan perlunya evaluasi terhadap praktik disinfeksi di fasilitas perawatan hewan.

Kata kunci: jamur yang terkontaminasi, pakaian groomer, ruang perawatan, klinik hewan peliharaan, toko hewan peliharaan

INTRODUCTION

Tropical climates provide favorable conditions for the proliferation of numerous fungal species, such as *Aspergillus flavus*, *Aspergillus niger*, *Aspergillus tubingensis* and *Fusarium* strains (Romero *et al.* 2021; Tischner *et al.* 2022). The fungal community found indoors is largely influenced by outdoor fungal sources (Nevalainen *et al*. 2014; Kim *et al*. 2022), including clinically relevant species such as pathogenic and allergenic fungi that impact human and animal health (Amend *et al*. 2010). Notably, the diversity and concentration of indoor fungi serve as valuable biomarkers for assessing sanitation quality and hygiene maintenance in enclosed spaces (WHO 2009).

Fungi colonize a wide range of substrates, including both organic and inorganic materials, especially in moist environments. For instance, *Aspergillus fumigatus* and *Aspergillus versicolor* are often detected in dust (Samet and Spengler 2003; Er *et al*. 2018), whereas *Trichoderma* spp., *Cladosporium*, and *Penicillium* sp. (*P. brevicompactum* and *P. expansum*) are commonly found on wooden surfaces (Poohphajai *et al*. 2021). Numerous fungal taxa, particularly from the Ascomycota and Basidiomycota phyla, along with anamorphic fungi, have been clinically associated with allergic reactions in humans (Khan and Karuppayil 2012). Of particular veterinary significance are dermatophytes, pathogenic molds capable of infecting companion animals' integumentary systems (Paryuni *et al*. 2020; Ridzuan *et al*. 2021), with documented zoonotic potential for human transmission.

Pet owners become infected with ringworm through direct transmission of fungal spores from contaminated animal fur to human skin (Segal and Elad 2021). Although geophilic dermatophytes have a higher potential to cause dermatophytosis in humans, and pet animals are known carriers of these fungi, reported clinical cases in both human and veterinary practice are infrequent (Dario *et al.* 2022; Gupta *et al*. 2025). Nevertheless, infections caused by zoophilic dermatophytes warrant serious consideration (Walther and Leuthard 2021). The dermatophyte species *Trichophyton mentagrophytes*, *Microsporum gypseum*, and *Microsporum canis* are the most dominant as zoonotic dermatophytes (Neves *et al.* 2018; Chang *et al.* 2022; Moskaluk and Vande Woude 2022).

Pet care facilities, including veterinary clinics and commercial pet stores, are structurally designed with distinct functional zones to deliver comprehensive

services to visiting animals. Examination room and grooming room are rooms that have a high risk of being contaminated by opportunistic and pathogenic fungi, such as *Candida* spp., *Aspergillus* spp., *Mucorales*, and *Fusarium* spp. (Perlroth *et al.* 2007; Pascutti and Walton 2021). This study investigated the prevalence of saprophytic, opportunistic, and pathogenic fungi in veterinary clinics and pet stores located in Bogor City, West Java, which served as the primary research sites

MATERIALS AND METHODS

Ten pet clinics and ten pet shops in Bogor City, West Java were selected as sampling sites. Isolation and identification of fungi were carried out in the laboratory of the Division of Medical Microbiology Department of Infectious Animal Diseases and Veterinary Public Health, School of Veterinary Medicine and Biomedic, Bogor Agricultural University.

Five petri dishes containing each Sabouraud Dextrose Agar® (SDA, CM0041® OXOID®), modified Sabouraud Dextrose Agar (m-SDA) supplemented with chloramphenicol, and phenol, red SDA and Dermatophyte Test Medium® (DTM, OXOID®), were used in a grooming room at pet clinics and pet shops. DTM was used to isolate dermatophytes and was placed in the grooming room, inpatient room, and waiting room of pet clinics. Following room disinfection but preceding grooming operations, five sampling plates were deployed per room (four corners, one center) to assess baseline microbial contamination. Sterile petri dishes were deployed for passive air sampling by removing their lids upon placement on the room floor. All plates remained exposed for a standardized duration of 60 minutes, including periods of active grooming operations. Following exposure, plates were aseptically resealed with their lids and securely fastened to prevent contamination by arthropods (e.g. ants). Samples were immediately transported to the laboratory under controlled conditions to maintain microbiological integrity.

Other samples were collected from groomers' work attire at both veterinary clinics and pet stores. Sampling was performed at five designated locations on the front of each groomer's clothing, with collections taken both prior to initiating grooming procedures and immediately following completion of their daily work activities. Sampling was conducted at five standardized locations on groomers' uniforms: upper left, upper right, lower left, lower right, and center positions. Two complementary techniques were employed: surface swabbing using sterile macrofoam swabs moistened with peptone water, and direct contact plating with m-SDA

For swab sampling, sterile large cotton-tipped applicators were systematically wiped across each predetermined clothing location. Immediately after collection, swabs were aseptically transferred to sterile tubes containing 10 mL of 0.1% peptone water. Concurrently, m-SDA contact plates (with media surfaces flush to the container rim) were firmly pressed onto the corresponding sampling points for standardized microbial transfer.

Following collection, swab samples suspended in peptone water were incubated at 37° C for 24 hours, while m-SDA plates were cultured under identical temperature conditions for 4-7 days (Adzima *et al.* 2013). Upon completion of the designated incubation period, swab samples were streaked onto sterile SDA and m-SDA plates using aseptic technique. All culture media were subsequently incubated at 37° C for 4-7 days, with daily monitoring of fungal colony development. Emerging colonies demonstrating rapid growth that might obscure adjacent colonies were promptly sub-cultured onto fresh SDA and m-SDA media. Growing colonies were examined macroscopically based on growth rate, color, texture, and topography. Microscopic examination was carried out by making native preparations and stained with LPCB dye. Microscopic observations were made on shape of hyphae, spores, and other structures (Anupama 2017; Khan *et al.* 2021; Ridzuan *et al.* 2021).

RESULTS AND DISCUSSION

The study included ten 24-hour veterinary clinics that offered grooming services during scheduled hours (9:00 AM to 9:00 PM). Each clinic employed two groomers working in shifts, with the same individual performing both regular and medicated grooming procedures. Medicated grooming was strictly performed following veterinary diagnosis. Work uniforms were typically changed every 2-3 days, depending on visible soiling. Ten pet shops with operating hours from 9:00 AM to 9:00 PM also participated. While providing both regular and medicated grooming services, the pet shops only performed medicated grooming upon owner request, as they lacked veterinary staff. Groomers at these facilities determined uniform changes subjectively based on perceived dirtiness. Quaternary ammonium and glutaraldehyde, 2-5% pine oil, Amitraz, and anionic surfactants disinfectants were used by both veterinary clinics and pet shops.

Microbiological analysis revealed diverse fungal contamination in the investigated pet care facilities, with multiple mold and yeast species isolated from environmental samples collected at both veterinary clinics and pet stores. The data on the genus/species of isolated molds and yeasts are presented in Table 1. The study focused on isolated molds and yeasts as potential contaminant species in the sampled environments.

As shown in Table 1, *Fusarium* sp. demonstrated the highest prevalence among isolated molds and yeasts. This genus exhibits global distribution, colonizing diverse ecological niches including soil, plant substrates (both living and decaying), animal hosts, and agricultural products. Its spores demonstrate remarkable environmental persistence, surviving in water systems and dispersing aerially as both conidia and chlamydospores If there are spores in the grooming room, it is possible that these spores were also found in other rooms, such as inpatient rooms. Several species of

Fusarium sp. have ability to produce mycotoxins; such as trichothecenes, zearalenone, and fumonisin; if grown in suitable media, such as in pet food (Smith 2007; Witaszak *et al*. 2020; Sandulachi *et al*. 2021; Smaoui *et al*. 2022).

Aspergillus fumigatus is well known as a cosmopolitan fungus. Their spores are found in various places on this earth. *A. fumigatus* is one of the opportunistic mold species found in various climatic conditions, causes diseases including localized infections, fatal diseases, allergic responses, and inhaled conidia in humans and animals, especially those who are experiencing immunosuppression (Cornelison *et al*. 2012; Mousavi *et al*. 2016: Peláez-García de la Rasilla *et al*. 2022). Apart from outdoors, mold spores may come from the water used, or even from the patient (Warris *et al*. 2002; Lemaire *et al*. 2018). Table 1 showed that three *Candida* species have been isolated from the sample: *Candida albicans*, *Candida crusei*, and *Candida parapsilosis*. They are known as commensal microorganisms on body surface so that they were thought to have been carried from outside through a patient body were examined, or by individuals moved in and out of the observed room. *Candida albicans* is one of the opportunists and pathogens that cause nosocomial diseases. As an opportunistic yeast, *Candida albicans* infection usually occurs endogenously. However, the risk of exogenous infection

Table 1. Genus/species of molds and yeast isolated from groomer clothes and grooming room floor

Genus/species of molds and yeast	Groomer' clothes		Grooming room floor	
	Pet clinics	Pet shops	Pet clinics	Pet shops
Aspergillus flavus	3.33%*	13.33%	0	0
Aspergillus fumigatus	10.00%	6.67%	7.32%	4.88%
Aspergillus niger	6.67%	3.33%	4.88%	0
Aspergillus terreus	0	6.67%	0	0
Candida albicans	6.67%	6.67%	9.76%	2.44%
Candida crusei	0	3.33%	2.44%	0
Candida parapsilosis	6.67%	0	4.88%	2.44%
Curvularia sp.	3.33%	0	0	0
Cladosporium cladosporoides	10.00%	6.67%	0	0
Cladosporium sphaerospermum	6.67%	0	0	0
Fusarium sp.	16.67%	20.00%	24.39%	21.95%
Penicillium chrysogenum	3.33%	6.67%	0	0
Penicillium commune	6.67%	10.00%	2.44%	0
Penicillium crustosum	3.33%	6.67%	0	2.44%
Rhizopus oryzae	0	3.33%	0	7.32%
Rhodotorulla sp.	6.67%	13.33%	0	2.44%

The percentage is obtained from the number of pet clinics/pet shops that can be isolated from the genus/species of molds and yeast divided by the number of pet clinics/pet shops that are the research targets

Table 2. The presence of *Microsporum canis* in pet clinics and pet shops isolated using m-SDA and DTM

Source	Target room							
	Waiting room		Grooming room		Inpatient room		Examination room	
	DTM	m-SDA	DTM	m-SDA	DTM	m-SDA	DTM	m-SDA
Pet clinic 1	-	-	-	-	-	+	-	-
Pet clinic 2	-	-	-	-	-	-	-	-
Pet clinic 3	-	-	-	-	NS	NS	-	-
Pet clinic 4	-	-	-	-	-	-	+	-
Pet clinic 5	+	-	-	-	+	-	+	-
Pet clinic 6	-	+	+	-	-	-	+	+
Pet clinic 7	-	-	-	-	-	-	-	-
Pet clinic 8	-	-	-	-	NS	NS	+	-
Pet clinic 9	-	-	-	-	-	-	-	-
Pet clinic 10	-	-	-	-	-	-	-	-
University animal hospital	-	-	-	-	-	-	-	-

NS= No sample, DTM= Dermatophyte Test Medium. M-SDA= Modified Sabouraud Dextrose Agar. + = *M. canis* was isolated and identified

Table 3. Types of disinfectant used by pet clinics and pet shops and genus/species of fungi

Types of disinfectant	Genus/species of fungi
Quaternary ammonium and glutaraldehyde	*Aspergillus fumigatus, Fusarium* sp. *Penicillium crustotum, Rhizopus oryzae, Candida albicans*
Pine oil 2-5%	*Aspergillus niger, Fusarium* sp., *Penicilium communae, Candida parapsilopsis,Candida albicans*
Amitraz	*Aspergillus fumigatus, Fusarium* sp., *Candida parapsilopsis, Rhodotorula* sp.
Anionic surfactant	*Aspergillus fumigatus, Aspergillus niger, Fusarium* sp., *Candida parapsilopsis, Candida crusei, Candida albicans*

also needs to be considered considering that these yeasts are capable of making biofilms on abiotic surfaces (Karacaer *et al*. 2014; Jahagirdar *et al*. 2018; Vieira *et al*. 2018).

Based on observations of colonies growing in DTM, *Microsporum canis* (*M. canis)* was isolated and identified at several pet clinic rooms as presented in Table 2. The detection of *M canis* in examination and grooming areas represents an expected finding, as these locations receive direct contamination from infected animals through shed skin scales and hair follicles during clinical procedures. *M. canis* isolated in the waiting room was an interesting finding.

Visitors in the waiting room and examination room could be infected by *M. canis* (Stilwell 2018). It is well known that *M. canis* is a zoonotic dermatophyte. Dogs, cats, and stray animals infected with *M. canis* could be a potential source of zoonotic infections causing a serious public health problem (Neves *et al*. 2018; Moriello 2020). Pet owners are particularly at risk of getting dermatophytosis from their pets (Murmu *et al*. 2015; Torres–Guerrero *et al*. 2016; Segal and Elad 2021; Chang *et al*. 2022).

Table 3 presents data on disinfectants used by pet clinics and pet shops which were considered ineffective in reducing the presence of contaminant fungi. Quaternary ammonium, glutaraldehyde, pine oil, amitraz, and anionic surfactants are disinfectants that are often used to kill bacterial spores and vegetative cells (Despain 2016; Alqadeeri *et al*. 2019; Falk 2019; Cho and Chung 2020; Yim *et al*. 2021) and fungi (Bundgaard-Nielsen and Nielsen 1995). However, the diversity of fungal species isolated from room air suggests that current disinfection protocols may be insufficient in controlling environmental contamination. While the disinfectants used (quaternary ammonium compounds, glutaraldehyde, etc.) target common pathogens, their limited efficacy against saprophytic and opportunistic fungi highlights a critical gap in infection control. To address this, facility management should consider implementing supplemental measures, such as UV lamps which could provide continuous air and surface decontamination between chemical applications, targeting spores that evade routine cleaning (Hojnik *et al*. 2019).

CONCLUSION

This study identified diverse fungal contaminants in pet care facilities encompassing both environmental saprophytes (e.g., *Aspergillus*, *Fusarium*) and medically relevant pathogens (*Microsporum canis*, *Candida albicans*). These isolates were consistently detected across high-contact zones (grooming stations, examination tables, waiting areas, and groomers' uniforms), demonstrating pervasive environmental colonization. Critically, the failure of standard disinfectant regimens (quaternary ammonium compounds, glutaraldehyde, etc.) to eliminate these contaminants highlights an imperative for evidence-based revisions to decontamination protocols.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the cooperation of participating pet clinics and pet shopsthat served as sampling sites for this study. We extend particular appreciation to the veterinary professionals who provided valuable insights during data interpretation. This work was supported by Bogor Pet Care Management through research funding allocated for microbial culture media and essential laboratory materials.

REFERENCES

Adzima V, Jamin F, Abrar M. 2013. Isolasi dan identifikasi kapang penyebab dermatofitosis pada anjing di Kecamatan Syiah Kuala Banda Aceh. *Jurnal Medika Vet*erinaria, 7(1):46-48.

Alqadeeri F, Rukayadi Y, Abbas F, Shaari K. 2019. Antibacterial and antispore activities of isolated compounds from *Piper cubeba* L. *Molecules*, 24(17):3095. Doi:10.3390/molecules 24173095.

Amend AS, Seifert KA, Samson R, and Bruns TD. 2010. Indoor fungal composition is geographically patterned and more diverse in temperate zones than in the tropics. *Proceedings of the National Academy of Sciences*, 107(31):13748-13753. Doi:10.1073/pnas.1000454107.

Anupama A. 2017. Isolation and Identification of dermatophytes from clinical samples – One year study. *International Journal* of *Current Microbiology* and *Applied* Sciences, 6(11):1276-1281. Doi:10.20546/ijcmas.2017.611.152.

Bundgaard-Nielsen K, and Nielsen PV. 1996. Fungicidal effect of 15 disinfectants against 25 fungal contaminants commonly found in bread and cheese manufacturing. *Journal of Food Protectection*, 59(3):268-275. Doi:10.4315/0362-028X-59.3.268.

Chang, CC, Wechtaisong, W, Chen, SY, Cheng, MC, Chung, CS, Lin, LS, Lien, YY, Tsai, YL. 2022. Prevalence and Risk Factors of Zoonotic Dermatophyte Infection in Pet Rabbits in Northern Taiwan. *Journal of Fungi*, 8:627. Doi:10.3390/jof8060627.

Cho, WI, Chung, MS. 2020. *Bacillus* spores: A review of their properties and inactivation processing technologies. *Food Science and Biotechnology*, 29:1447-1461. Doi:10.1007/s10068-020-00809-4.

Cornelison CT, Stubblefield B, Gilbert E, Crow Jr. SA. 2012. Recurrent *Aspergillus* contamination in a biomedical research facility: A case study. *Journal of Industrial Microbiology and Biotechnology*, 39(2):329-335. Doi:10.1007/s10295-011-1064-y.

Dario CJ, Rodrigo AP, Susana F. One 2022. Health and Dermatophytes, what is the Link Between Them?. *Biomedical Journal of Scientificand and Technical Research*, 44(1):2022. Doi:10.26717/BJSTR.2022.44.006995.

Despain, JT. 2016. The Activity of Alkaline Glutaraldehyde Against Bacterial Endospores and Select Non-Enveloped Viruses. *All Theses and Dissertations. 6510*. https://scholarsarchive.byu.edu/etd/6510.

Er CM, Sunar NM. Leman AM, Khalid A, Ali R, Zaidi E, Azhar ATS. 2018. Indoor and outdoor surface-growing fungi contamination at higher institutional buildings in a Malaysian University. *IOP Conf. Series: Earth and Environmental Science*, 140:012118. Doi :10.1088/1755-1315/140/1/012118.

Falk NA. 2019. Surfactants as Antimicrobials: A brief overview of microbial interfacial chemistry and surfactant antimicrobial activity. *Journal of Surfactants and Detergens*, 22(5):1119-1127. Doi:10.1002/jsde.12293.

Gupta AK, Wang T, Susmita, Talukder M, Bakotic WL. 2025. Global dermatophyte infections linked to human and animal health: A scoping review. *Microorganisms*, 13:575. Doi:10.3390/microorganisms 13030575.

Khan AAH, Mohan Karuppayil S. 2012. Fungal pollution of indoor environments and its management. *Saudi Journal of Biological Sciences*, 19(4):405-426. Doi:10.1016/j.sjbs.2012.06.002.

Hojnik N, Modic M, Yuan N, Filipič G, Cvelbar U, Walsh JL. 2019. Effective fungal spore inactivation with an environmentally friendly approach based on atmospheric pressure air plasma.

Environmental Science and Technology, *53*(4):1893-1904. Doi:10.1021/acs.est.8b05386.

Jahagirdar VL, Davane MS, Aradhye SC, Nagoba BS.2018. Candida species as potential nosocomial pathogens: A review. *Electronic Journal of General Medicine*, 15(2):em05. Doi:10.29333/ejgm/ 82346.

Karacaer Z, Oncul O, Turhan V, Gorenek L, Ozyurt M. 2014. A surveillance of nosocomial candida infections: epidemiology and influences on mortalty in intensive care units. *Pan African Medical Journal*, 19:398. Doi:10.11604/pamj.2014.19.398.4960.

Khan SA, Shamsuzzaman SM, Rahman AKMS, Ashekin NAK, Mahmud R, Sharmin R, Siddique MRU, Khan MA, Sultan S, and Haque F. 2021. Isolation and identification of dermatophytes causing dermatophytosis at a tertiary care hospital in Bangladesh. *Archives of Clinical and Biomedical Research*, 5(2021):437-451. Doi:10.26502/acbr.50170178.

Kim J, Han SJ, Yoo K. 2022. Dust-associated bacterial and fungal communities in indoor multiple-use and public transportation facilities. *Atmosphere*, 13:1373. Doi:10.3390/atmos13091373.

Lemaire B, Normand AC, Forel JM, Cassir N, Piarroux R, Ranque S. 2018. Hospitalized patient as source of *Aspergillus fumigatus*, 2015. *Emerging Infectious Diseases*, 24(8):1524-1527. Doi:10.3201/eid2408.171865.

Moriello KA. 2020. Dermatophytosis in Dogs and Cats (Ringworm). *https://www.msdvetmanual.com/integumentary-system/ dermato-phytosis/dermatophytosis-in-dogs-and-cats.*

Moskaluk AE, and VandeWoude S. 2022. Current topics in dermatophyte classification and clinical diagnosis. *Pathogens*, 11:957. Doi:10.3390/pathogens11090957.

Mousavi B, Hedayati MT, Hedayati N, Ilkit M, Syedmousavi S. Aspergillus species in indoor environments and their possible occupational and public health hazards. *Current Medical Mycology*, 2(1):36-42. Doi:10.18869/acadpub.cmm.2.1.36.

Murmu S, Debnath C, Pramanik AK, Mitra T, Jana S, Dey S, Banerjee S, Batabyal K. 2015. Detection and characterization of zoonotic dermatophytes from dogs and cats in and around Kolkata. *Veterinary World*, 8(9):1078-82. Doi:10.14202/vetworld.2015. 1078-1082.

Nevalainen A, Täubel M, Hyvärinen A. 2014. Indoor fungi: Companions and contaminants. *International Journal of Indoor Environment and Health*, 2014:25(2):125-56. Doi:10.1111/ina.12182.

Neves JJA, Paulino AO, Vieira RG, Nishida EK, Coutinho SDA. 2018. The presence of dermatophytes in infected pets and their household environment. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, 70(6):1747-1753. Doi:10.1590/1678-4162-9660.

Paryuni AD, Indarjulianto S, Widyarini S. 2020. Dermatophytosis in companion animals: A review. *Veterinary World*, 13(6):1174-1181. Doi:10.14202/vetworld.2020.1174-1181.

Pascutti K, Walton SA. 2021. Approaches to Opportunistic Fungal Infections in Small Animals. Today's Veterinary Practice, May/June 2021. *https://todaysveterinarypractice.com/internal-medicine/approaches-to-opportunistic-fungal-infections-in-small-animals*.

Peláez-García de la Rasilla T, González-Jiménez I, Fernández-Arroyo A, Roldán A, Carretero-Ares JL, García-Clemente M, Telenti-Asensio M, García-Prieto E, Martínez-Suarez M, Vázquez-Valdés F, Melón-García S, Caminal-Montero L, Fernández-Simón I, Mellado E, Sánchez-Núñez ML. 2022. COVID-19 associated pulmonary aspergillosis (CAPA): Hospital or home environment as a source of life-threatening *Aspergillus fumigatus* infection? *Journal of Fungi*, 8:316. Doi:10.3390/jof8030316.

Perlroth J, Choi B, Spellberg B. 2007. Nosocomial fungal infections: Epidemiology, diagnosis, and treatment. *Medical Mycology*, (45(4):321-346. Doi:10.1080/13693780701218689.

Poohphajai F, Sandak J, Sailer M, Rautkari L, Belt T, Sandak A. 2021. Bioinspired living coating system in service: Evaluation of the wood protected with biofinish during one-year naturalweathering. *Coatings*, 11:701. Doi:10.3390/coatings 11060701.

Ridzuan P, Proveen K, Siti-Arffah K. 2021. Isolation of dermatophytes from infected stray dogs in Selangor, Malaysia. *Jurnal Berkala Epidemiologi*, 9(2):123-129. Doi:10.20473/jbe. V9I22021.123-129.

Romero IC, Nuñez Otaño NB, Gibson ME, Spears TM, Fairchild CJ, Tarlton L, Jones S, Belkin HE, Warny S, Pound MJ, O'Keefe JMK. 2021. First record of fungal diversity in the tropical and warm-temperate middle miocene climate optimum forests of Eurasia. *Frontiers in Forests and Global Change*, 4:768405. Doi: 10.3389/ffgc.2021.768405.

Samet JM, Spengler JD. 2003, Indoor environments and health: Moving into the 21st century. *American Journal of Public Health*, 93(9):1489-93. Doi:10.2105/ajph.93.9.1489.

Sandulachi E, Ghendov-Mosanu A, Cojocari D, Sturza R. 2021. The Risk of *Fusarium* and their mycotoxins in the food chain. *Advances in Microbiology*, 1(1):541-553. Doi:10.4236/aim. 2021.1110040.

Segal E, Elad D. 2021. Human and Zoonotic Dermatophytoses: Epidemiological Aspects. *Frontiers in Microbiology*, 12:713532. Doi:10.3389/fmicb.2021.713532.

Smaoui S, Agriopoulou S, D'Amore T, Tavares L, and Khaneghah AM. 2022. The control of *Fusarium* growth and decontamination of produced mycotoxins by lactic acid bacteria. *Critical Reviews in Food Science and Nutrion*, 25(4):178-187. Doi:10.1080/10408398.2022.2087594.

Smith SN. 2007. An overview of ecological and habitat aspects in the genus *Fusarium* with special emphasis on the soil-borne pathogenic forms. *Plant Pathology Bulletin*, 16:97-120.

Stilwell N. 2018. Veterinary Involvement in Zoonotic Dermatophytosis Cases. Smarter Vet Financial. *https://www.dvm360.com/view/veterinary-involvement-in-zoonotic- dermatophytosis-cases.*

Tischner Z, Páldy A, Kocsubé S, Kredics L, Dobolyi C, Sebők R, Kriszt B, Szabó B, Magyar Donát. 2022. Survival and growth of microscopic fungi derived from tropical regions under future heat waves in the Pannonian Biogeographical Region. *Fungal Biology*, 126(8):511-520. Doi:10.1016/j.funbio.2022.04.005.

Torres–Guerrero E, González de Cossío AC, Segundo ZC, Cervantes ORA, Ruiz- Esmenjaud J, Arenas R. 2016. Microsporum canis and other dermatophytes isolated from humans, dogs and cats in Mexico City. *Global Dermatology*, 3(2):275-278. Doi:10.15761/GOD.1000173.

Vieira JN, Feijó AM, Bueno ME, Gonçalves CL, Lund RG, Mendes JF, Villarreal JPV, Villela MM, Nascente PS. 2018. Evaluation of the frequency of Candida spp. in hospitalized and non-hospitalized subjects. *Brazilian Journal of Biology*, 78(4):686-690. Doi:10.1590/1519-6984.169623.

Walther M, and Leuthard D. 2021. Geophilic tinea profunda after a stay at a Swiss lake: A case report. *Case Report in Dermatolology*, 13:103-105. Doi:10.1159/000512714.

Warris A, Voss A, Abrahamsen T, Verweij P. 2002. Contamination of hospital water with *Aspergillus fumigatus* and other molds. *Clinical Infectectious Diseases*, 34:1159-1160. Doi:10.1086/ 339754.

WHO [World Health Organization]. 2009. WHO Guidelines for Indoor Air Quality: Dampness and Mould. *https://www.euro.who.int/_data/assets/pdf_file/0017/43325/E926 45.pdf.*

Witaszak N, Waskiewicz A, Bocianowski J, Stepien L. 2020. Contamination of pet food with mycobiota and *Fusarium* mycotoxins: Focus on dogs and cats. *Toxins*, 12:130. Doi:10.3390/toxins12020130.

Yim JH, Song KY, Kim H, Bae D, Chon JW, Seo KH. 2021. Effectiveness of calcium hypochlorite, quaternary ammonium compounds, and sodium hypochlorite in eliminating vegetative cells and spores of *Bacillus anthracis* surrogate. *Journal of Veterinary Science*, 22(1):e11. Doi: 10.4142/jvs.2021.22.e11.