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The prevalence of *Microsporum canis* dermatophytosis in symptomatic stray cats in Bogor, Indonesia, 2024

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ABSTRACT

Feline dermatophytosis is one of the most common mycoses and infectious skin conditions affecting cats. Dermatophytosis control in cats might be challenging, especially in unsanitary settings. This study aimed to determine the macroscopic and microscopic dermatophyte identification that occurs in stray cats in Bogor, Indonesia. Methods: Cats suspected of dermatophytosis (with lesions of erythema, alopecia, scaly or crusty skin, hyperkeratosis, and/or dermatitis) were sampled. Sample collection was carried out between March and October 2024. Samples of skin scraping and/or hair plucking were taken from each sampled cat. A total of 40 cats were sampled. These samples were inoculated into Sabouraud Dextrose Agar medium and incubated at 25±3°C for two to four weeks. Isolates suspected of dermatophytes were subcultured in Potato Dextrose Agar for further identification. Macroscopic and microscopic observations of fungal colonies suspected of dermatophytes were carried out. Thirteen samples (32.5%) were positive for *Microsporum canis*, thus confirming the presence of dermatophyte infections in cats in this area. This study focused on stray cats with clinical implications. The prevalence of dermatophytosis in stray cats in the Bogor area reported by this study raises concerns about the zoonotic potential of these cats.

Key words: dermatophytes; dermatoses; feline; *Microsporum canis*; zoonoses

Introduction

Dermatophytosis, tinea, or ringworm is an infection in humans or animals caused by fungi from the dermatophytes group (BEGUM and KUMAR, 2021). Lesions in hosts are in keratinized tissues, including hairs, skins, and nails/claws/hooves. There are 40 species of dermatophytes from 7 genera: *Lophopyton*, *Paraphyton*, *Arthroderma*, *Nannizia*, *Epidermophyton*, *Trichophyton*, and *Microsporum* (CHUPIA et al., 2022). Previous-

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ly, dermatophytes were only the last three genera (DEBNATH et al., 2016), while *Microsporum* was the primary agent in cats (MORIELLO, 2019). According to their life adaptation, dermatophytes are divided into three groups: zoophilic, when there is an association with animals; anthropophilic when their primary hosts are humans; and geophilic when their primary habitats are soil. In humans and animals, infection by dermatophytes is considered a self-limiting disease; however, in some cases, the disease can be fatal. These pathogenic agents, the dermatophytes, are cosmopolitan microorganisms (ŁAGOWSKI et al., 2019).

Cats are the main reservoirs of *Microsporum canis;* in some cases, cat infection is without clinical manifestations. This condition can be a crucial factor in the spread of the disease to humans as a significant zoonotic disease. However, cat infection with clinical manifestations can occur as alopecia, hyperpigmentation, erythema, papules, dandruff, or scaly and crusty skin. Dermatophytosis in cats, strays, or kept as pets is a public health concern as these infected animals are the origin of infection in humans (SIERRA-MAEDA et al., 2024). Studies have reported that cats may have been the source of dermatophytosis outbreaks on a military base (BROSH-NISSIMOV et al., 2018) or intra-family (SIERRA-MAEDA et al., 2024). Several studies reported *Microsporum canis* as the primary agent in pet animals with up to 97% prevalence (FRYMUS et al., 2013; IVASKIENE et al., 2016; INDARJULIANTO et al., 2017). The prevalence in humans was reported to be 20–50% (MURMU et al., 2015; PARYUNI et al., 2020). Reports of dermatophytosis in cats in Indonesia are limited and thus require further exploration. This study aimed to isolate and identify the dermatophytes causing dermatophytosis and determine the prevalence of dermatophytosis in stray cats in the Bogor District, West Java, Indonesia.

Materials and methods

Ethical approval. The IPB University's School of Veterinary Medicine and Biomedical Sciences' Animal Ethics Commission approved the ethical clearance for sample collection and laboratory procedures (Number: 250 KEH/SKE/IX/2024). Operators who take samples or help handle cats when taking samples use standard personal protective equipment (such as latex gloves, masks, and lab coats) to prevent transmission of zoonotic diseases from the animals being sampled to the operator. Personal protective equipment was also used when handling samples in the laboratory to avoid the transmission of zoonotic diseases. In general, animal handling and sample collection were carried out by veterinarians, paramedics, trained students, or animal keepers under the supervision of a veterinarian. Handling was done gently so that the animals feel comfortable. At least one person plays a role in handling, and one person will take samples. If needed, two animal handlers were used to help the operator of the sample collection.

Sample collection. Sample collections were performed between March and October 2024. A total of 40 stray cats from Bogor were sampled. Skin scrapings and/or plucked hair were collected from cats exhibiting symptoms such as alopecia, dry or scaly skin, crusty skin, hyperkeratosis, erythema, and/or dermatitis. Cats were selected using a targeted sampling method. The skin scraping technique was performed gently using the blunt part of a scalpel. Skin-scraping samples and/or plucked hair samples were taken using aseptic techniques. Before skin scraping, the lesion area was wiped with 70% alcohol to disinfect the surface bacteria. Sterilized tweezers were used to take the samples for hair plucking. The samples were stored in a sterile Ziplock plastic bag or sterile envelope and were transferred to the laboratory for further culture and identification. Each sample section was separated: one for direct microscopic examination and the other for fungal culture.

Direct examination of the samples. Part of each sample was processed with direct microscopic observation using a 10% (w/v) potassium hydroxide (KOH) solution using a clean objective lens. Each sample was examined under low

(100x) and high (400x) magnification by a light microscope for fungal elements, such as arthrospores, hyphae, or conidia, and their distribution. An observer carried out the microscopic examination of fungal elements, and trained personnel validated this to ensure consistency in the observation process.

Fungal culture of the samples. The other part of the plucked hair or skin-scraping specimens was inoculated into the Sabouraud Dextrose Agar (SDA) (HiMedia, India) plates supplemented with 0.05% cycloheximide and 0.05% chloramphenicol. Microbial development was fuelled by dextrose, the nitrogenous substances necessary for microbial growth were supplied by mycological peptone, and agar served as the hardening agent. While cycloheximide supplementation was intended to prevent saprophytic fungi, chloramphenicol supplementation is a broad-spectrum antibiotic that inhibits Gram-positive and Gram-negative bacteria. SDA media inoculated with the samples were incubated aerobically at room temperature (25±3°C) for up to 28 days and were observed 2–3 times a week for any growth. A previous study highlighted that 25°C is the optimum temperature for growing dermatophytes (MORIELLO et al. 2010). In addition, that study reported that if the culture was negative for dermatophytes after the first 14 days of incubation, an extension of up to 28 days of primary culture incubation is required to identify the negative culture (STUNTEBECK et al., 2018). Fungal colonies that grew on SDA suspected of dermatophytes were subcultured into Potato Dextrose Agar (PDA) (HiMedia, India) for further identification, and were incubated aerobically at room temperature (25±3°C) for up to 14 days.

Fungal identification and prevalence determination. Identification of the dermatophyte colony: Each fungal strain grown on PDA was further identified on the basis of its macroscopic and microscopic characteristics. Macroscopic observation of the colony included surface and back pigmentation, growth rate, topography, and texture, as described by CAMPBELL et al. (2013) and WESTBLADE et al. (2023). In addition, microscopic observation was carried out by staining with lactophenol cotton blue. Microscopic observation included observing the presence of septate hyphae and the shape of macroconidia and microconidia. The wall thickness of the conidial cells and conidial cell arrangements around the hyphae were also observed (DEBNATH et al., 2016). The formula below was used for calculating the proportion of positive samples relative to the total number of samples:

$$\text{Prevalence} = \frac{\text{number of positive individual s)}}{\text{Number of examined samples}} = / \text{ x } 100\%.$$

Results

All samples tested positive for fungal elements, including hyphae and/or arthrospores. *Microsporum canis* was identified in 22 isolates from 13 samples (13/40 or 32.5%) on the basis of macroscopic and microscopic observations. The macroscopic morphology of the colony is shown in Table 1. The texture of all the *Microsporum canis* colonies was cottony. The surface color of the colonies was white to white-yellow. The color of the colony from the back was deep yellow, deep yellow with a white margin, yellow with a white margin, white, white with a yellow margin, white, light yellow, deep yellow, or deep yellow with a white margin (Fig. 1). Observation of the microscopic structure of the colony was positive for the presence of septate hyphae, small microconidia, and 6–12-celled macroconidia (Fig. 2).

Discussion

This study reported that 32.5% (13/40) of stray cats had dermatophytosis in the Bogor District of Indonesia in 2024. Previously, there have been a few reports on the prevalence of feline dermatophytosis in Indonesia. A study by FAUZIYYAH et al. (2024) reported a lower prevalence (19%) of feline dermatophytosis in a three-year study (2020–2022) in the Go Pet Care Animal Clinic of Bandung Barat District. In comparison, two study groups from a university in Yogyakarta,

Table 1. Macroscopic morphology of the fungal colony

No.	Code of sample	Code of isolate	Species of fungus	Macroscopic morphology of the colony			
				Surface color	Texture	Reverse color	Topography
1.	SC001	M014	*Microsporum canis*	W	Cottony	LY	Flat
2.	SC002	M024	*Microsporum canis*	W	Cottony	W	Flat
3.	SC003	M028	*Microsporum canis*	W	Cottony	DY	Flat
4.	SC004	M032	*Microsporum canis*	W	Cottony	DYWM	Flat
5.	SC005	M061	*Microsporum canis*	WWY	Cottony	DY	Flat
6.	SC021	M131	*Microsporum canis*	W	Cottony	LY	Flat
7.	SC021	M132	*Microsporum canis*	W	Cottony	LY	Flat
8.	SC021	M133	*Microsporum canis*	W	Cottony	LY	Flat
9.	SC024	M134	*Microsporum canis*	W	Cottony	LY	Flat
10.	SC026	M 136	*Microsporum canis*	W	Cottony	WLY	Flat
11.	SC026	M137	*Microsporum canis*	W	Cottony	DY	Flat
12.	SC026	M138	*Microsporum canis*	W	Cottony	LY	Flat
13.	SC028	M139	*Microsporum canis*	W	Cottony	W	Flat
14.	SC028	M140	*Microsporum canis*	W	Cottony	LY	Flat
15.	SC028	M141	*Microsporum canis*	W	Cottony	W	Flat
16.	SC032	M142	*Microsporum canis*	W	Cottony	LY	Flat
17.	SC032	M143	*Microsporum canis*	WWY	Cottony	DY	Flat
18.	SC034	M144	*Microsporum canis*	W	Cottony	LYWM	Flat
19.	SC035	M145	*Microsporum canis*	W	Cottony	LY	Flat
20.	SC035	M146	*Microsporum canis*	W	Cottony	LY	Flat
21.	SC035	M147	*Microsporum canis*	W	Cottony	W	Flat
22.	SC038	M148	*Microsporum canis*	W	Cottony	W	Flat

Note: Y: yellow; DY: deep yellow; DYWM: deep yellow with a white margin; LY: light yellow; LYWM: light yellow with a white margin; W; White; WWY: white with yellow margin; WLY: white to light yellow.

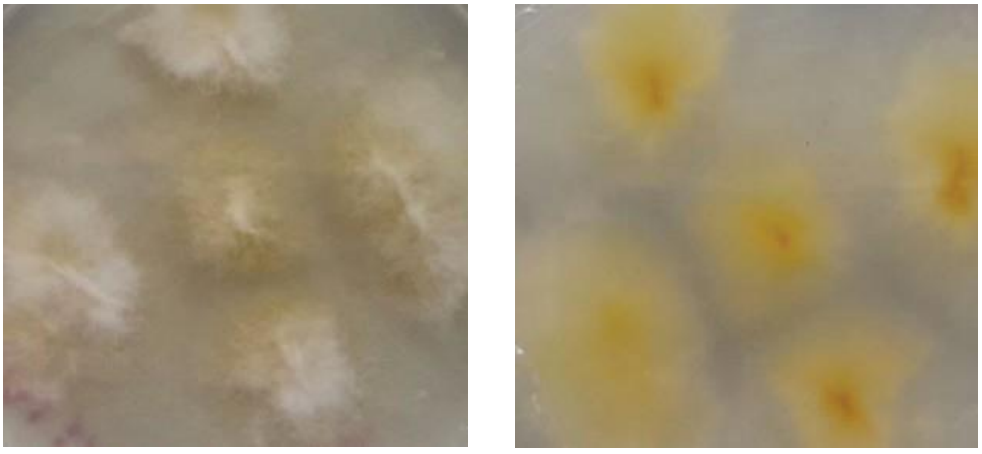

Fig. 1. Macroscopic picture of isolate M131 (*Microsporum canis*)

The texture is cottony, the color on the surface is white (left picture), and the color at the back is light yellow (right picture); the topography is flat. Medium: potato dextrose agar

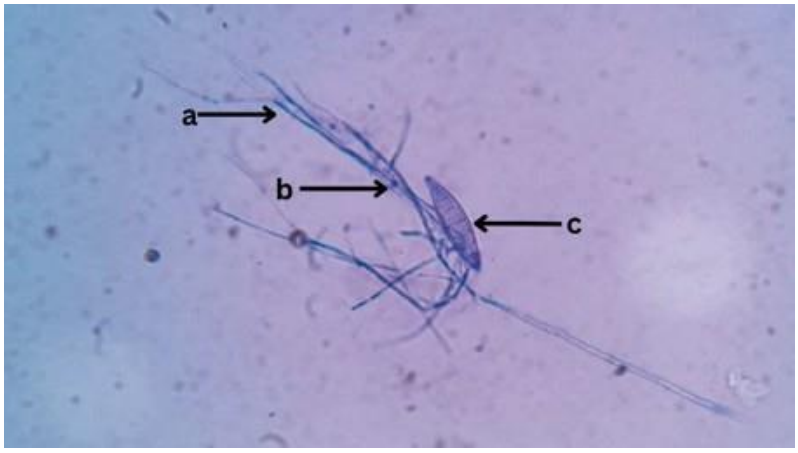

Fig. 2. Microscopic picture of *Microsporum canis* from stray cats, with septate hyphae (a), microconidia (b), and 6–12-celled macroconidia with spindle shape (c)

Magnification: 40×10

namely, INDARJULIANTO et al. (2017) and YEN et al. (2018), reported a higher prevalence of feline dermatophytosis (48%–56.7%). YEN et al. (2018) reported that 48% of the 40 cats examined were positive for dermatophytosis, while one case (2.5%) showed the presence of dermatophytes in both the environment and the cat. A study by YEN et al. (2018) demonstrated the possibility of dermatophytosis transmission through environmental arthroconidia. Their study also reported the presence of arthroconidia in cats without arthrosporic contamination in the environment (2.5%). Predominantly, the presence of cats infected by dermatophytes (45%) occurred without the presence of arthroconidia in the environment (YEN et al. 2018). Another study by INDARJULIANTO et al. (2017) reported that 17 out of 30 cats with dermatitis were diagnosed with dermatophytosis. However, INDARJULIANTO et al. (2017) and YEN et al. (2018) did not mention the origin of the samples. These studies also used different diagnostic methods to confirm dermatophytosis diagnosis. For instance, FAUZIYYAH et al. (2024) used Wood's lamp and direct microscopic fungal identification without fungal culture. In contrast, INDARJULIANTO et al. (2017) and YEN et al. (2018) used a Wood's lamp and fungal culture technique, while this study used the fungal culture technique as the gold standard diagnostic tool.

The dominance of *Microsporum canis* was also reported in this study, as 100% of the isolated dermatophytes from stray cats in Bogor were *Microsporum canis*. However, other studies reported varied species of dermatophytes. For instance, even though the study by MURMU et al. (2015) reported the dominant prevalence of *Microsporum canis* at 61.4%, they also reported *Nannizzia nana* and *Trichophyton mentagrophytes* at 22.5% and 15.8%, respectively. In addition, RIDZUAN et al. (2021) reported the dominance of *Trichophyton* spp. (65.6%) compared to *Microsporum* spp. (2.4%) and *Epidermophyton* spp. (1.6%) in stray cats (n=125) in Selangor, Malaysia. In addition, a study by ILHAN et al. (2016) could not identify *M. canis* from Van cats, but they reported a prevalence of 7.1% (19/264) of dermatophytosis, with the dominance of *Trichophyton terrestre* (4.1%). The study by ILHAN et al. (2016) also reported the presence of *Nannizzia nana*, *Nannizzia gypsea*, and *Trichophyton mentagrophytes* with a prevalence of 1.1%, 1.1%, and 0.7%, respectively. These differences suggest that different areas may have different dermatophyte infections and dominance.

If only research on stray cats is considered, dermatophytosis prevalence varies between different countries. This study reported that 32.5%

of cats with superficial clinical manifestations (alopecia, erythema, dermatitis, scaly or crusty skin, and hyperkeratosis) in the Bogor District of Indonesia were diagnosed with feline dermatophytosis. Other studies described a higher infection rate in stray cats than in this study. For instance, PONOMARENKO (2020) reported a 38.18% (42/110) prevalence of dermatophyte infection among stray cats in Kharkiv, Ukraine. MURMU et al. (2015) reported 55% (158/202) of feline dermatophytosis among stray cats in Kolkata, India. However, the feline dermatophytosis prevalence in stray cats in other areas, such as northern Italy (5.5%; 15/273) and Puerto Rico, the United States of America (29.5%; 13/44), is considered lower compared to this study (PROVERBIO et al., 2014; HERNANDEZ-BURES et al., 2021).

Dermatophytosis, commonly known as tinea or ringworm, is an infection in the skin or other keratinized tissues caused by fungi from the dermatophytes group, in animals and humans, that potentially causes zoonotic disease and public health problems (ŁAGOWSKI et al., 2019; RIDZUAN et al., 2021). The etiological agents, the dermatophytes, including the species of *M. canis*, are pathogenic agents and are not typical skin mycobiota in humans and animals; thus, their appearance in animal or human tissues is not considered natural (ŁAGOWSKI et al., 2019). This study reported the presence of dermatophytes from stray cats in Bogor. Dermatophytosis in cats, even though kept as pets, living as stray animals, or living in animal shelter environments, is a public health concern, as these infected animals are the origin of human infection (SIERRA-MAEDA et al., 2024). For instance, cats have been reported to be the origin of human dermatophytosis outbreaks in a family (SIERRA-MAEDA et al., 2024) and a military base (BROSH-NISSIMOV et al., 2018). This study's results can be used to increase public awareness about the potential of stray cats as a source of dermatophytosis transmission into humans residing in the area.

According to the author, this study is the first prevalence report of stray cat dermatophytosis in the Bogor District of Indonesia. However, this study has limitations as it only reported a small group of stray cats (40 samples). Future studies with more significant animal samples would better represent the area's prevalence (Bogor). In addition, additional surveys are required to determine trends in other cities and districts of Indonesia. Besides, potential further studies that determine the prevalence in different animals, humans, and environments must identify the influencing factors in dermatophytosis occurrence. Also, additional studies can be carried out, including a study that determines the factors that cause prevalence differences in animals in different environmental settings (for instance, urban and other different rural areas) or whether there are any differences in the prevalence in animals with different management, such as strays, domestics, or in shelters. Other studies that could also be carried out include studies that use molecular techniques to determine the genetics of dermatophytes from Indonesia compared to those currently reported in the gene bank.

Conclusions

This study concluded that using the fungal culture technique, the prevalence of *Microsporum canis* dermatophytosis in stray cats in the Bogor District was 32.5% (13/40). Dermatophyte infection is still a public health problem in Indonesia. However, limited studies have reported the role of domestic and stray animals in transmitting the disease. Therefore, more studies should be conducted to accurately present the country's overall disease pattern.

Ethics approval

The IPB University's School of Veterinary Medicine and Biomedical Sciences' Animal Ethics Commission gave ethical clearance for sample collection and laboratory procedures (Number: 250 KEH/SKE/IX/2024).

Authorship contribution statement

Conceptualization: NGB, AI, TST, DUR; Methodology: NGB, AI, TST; Validation: AI, TST;

Investigation: NGB, AI, TST, DUR; Resources: NGB; Writing - Original Draft: NGB; Writing, Review & Editing: AI, TST, DUR; Supervision: AI, TST; and Funding acquisition: NGB.

Declaration of competing interest

The authors have no conflict of interest regarding this article's authorship, research, or publication.

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Novelty statement

The prevalence of feline dermatophytosis in stray cats in the Bogor District is 32.5%, but reports on this disease in Indonesia are scarce. Hence, this study aimed to identify dermatophytosis in stray cats in the Bogor District. *Microsporum canis* is the only species that infects stray cats in the Bogor District.

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SAŽETAK

Dermatofitoza mačaka jedna je od najčešćih mikoza i jedno od češćih infektivnih kožnih stanja koja se pojavljuju u mačaka. Kontrola dermatofitoza u mačaka može biti izazovna, osobito u slučaju nehigijenskih uvjeta držanja. Cilj istraživanja bio je makroskopski i mikroskopski identificirati dermatofite koji se pojavljuju u mačaka lutalica u Bogoru, Indonezija. Uzorci su uzeti od mačaka za koje se sumnjalo da imaju dermatofitozu (mačke s lezijama ili eritemom, alopecijom, ljuskavom ili grubom kožom, hiperkeratozom i/ili dermatitisom). Prikupljanje uzoraka provedeno je između ožujka i listopada 2024. godine. Od ukupno 40 mačaka uzete su strugotine kože i/ili uzorci dlake. Uzorci su inokulirani u Sabouraudovu dekstroznom agaru i inkubirani na temperaturi od 25±3°C tijekom dva do četiri tjedna. Izolati za koje se posumnjalo da su dermatofiti supkultivirani su u krumpirovu dekstroznom agaru radi daljnje identifikacije. Gljivične kolonije promatrane su makroskopski i mikroskopski. Trinaest uzoraka (32,5%) bilo je pozitivno na *Microsporum canis*, što je potvrdilo prisutnost infekcije dermatofitima u mačaka u istraženom području. Ovo je istraživanje bilo usmjereno na mačke lutalice s kliničkim implikacijama. Podaci o prevalenciji dermatofitoza u mačaka lutalica u Bogoru dobiveni u ovom istraživanju povećavaju zabrinutost zbog zoonotskog potencijala uzročnika.

Ključne riječi: dermatofiti; dermatoze; mačke; *Microsporum canis*; zoonoze