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EUROPEAN SCIENTIFIC COUNSEL COMPANION ANIMAL PARASITES

Superficial Mycoses in Dogs and Cats

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ESCCAP Guideline 2

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INTRODUCTION

Dermatophytosis, and *Malassezia* otitis and dermatitis, represent the superficial mycoses of greatest significance in companion animals. Although the dermatophytes and *Malassezia*[1] yeasts both exist in the stratum corneum of mammalian skin, there are important differences in the epidemiology, pathogenesis, and clinical consequences of infection.

Dermatophytes are significant due to their zoonotic potential and the concern of owners of pets with sometimes severe inflammatory skin diseases. Dermatophytes are filamentous fungi, which are able to use keratin as a source of carbon. Some of these organisms are true parasites; they develop in skin and hair and cause cutaneous lesions. The disease is called dermatophytosis or ringworm and is recognized as one of the most common infectious dermatoses in pets. More than 20 different dermatophyte species have been isolated from dogs and cats. In Europe, the most commonly isolated pathogens are *Microsporum canis* (especially in cats), *Microsporum gypseum, Microsporum persicolor* and *Trichophyton mentagrophytes* (Table 1).

Malassezia yeasts are normal commensals and occasional pathogens of the skin for many animal species. The non lipid-dependent species *M. pachydermatis* is a very common cause of otitis externa and pruritic dermatitis in dogs. The same species is regularly recovered from the skin of cats along with other *Malassezia* species (that may be part of the normal cutaneous flora of humans) (Table 2).

This guideline aims to give an overview of dermatophytes and *Malassezia* yeasts, their significance and, importantly, suggests rational control measures in order to treat pet cats and dogs and prevent animal and/or human infection.

The guideline is divided into six sections:

1. Consideration of pet health and lifestyle factors
2. Control of dermatophytosis in dogs and cats
3. Environmental control of dermatophyte transmission
4. Control of *Malassezia* dermatitis in dogs and cats
5. Owner considerations in preventing zoonotic diseases
6. Staff, pet owner and community education

[1] The name *Malassezia* is used to designate all the yeasts of the genus

1. CONSIDERATION OF PET HEALTH AND LIFESTYLE FACTORS

The occurrence of dermatophytosis or *Malassezia* dermatitis is influenced by a vast number of factors relating to the animals themselves and environmental issues including overcrowding. Some factors may dictate more intensive monitoring and/or treatment, while others may suggest a less aggressive approach.

When recommending a management programme for dermatophytosis, veterinarians should consider the following elements:

- Kittens, puppies and aged animals are at greater risk than other animals. Pregnant or lactating bitches and queens are frequently infected by dermatophytes and may transmit the infection to the offspring. The number of antifungal drugs that can be used safely in pregnant animals is limited.
- Any breed is susceptible to the infection. However, Dr Peter J. Ihrke and colleagues indicate in a recent review that the Dalmatian, Poodle, Jack Russell Terrier, Manchester Terrier, and Yorkshire Terrier may be at increased risk for generalized dermatophytosis (Lee Gross et al. 2006). Persian cats also have a predisposition to dermatophytosis.
- Familial predisposition has been suggested in cats.
- Any debilitating disease may play a role by making dogs and cats more susceptible to dermatophyte infection. This kind of disease should be systematically identified and, if possible, treated before commencing specific antifungal treatments. In cats, the association between retroviral (FIV or FeLV) infection and dermatophytosis is still a matter of controversy. In one study, dermatophytosis was three times more common in FIV-infected cats; whereas in another, no association between FIV or FeLV and dermatophyte infection was apparent.
- Ectoparasites (such as fleas, ticks or mites of the genus *Cheyletiella*) or pruritus from secondary infections may be sources of cutaneous micro-trauma that can predispose dogs and cats to dermatophytosis.
- Increased warmth and humidity are predisposing factors for dermatophytosis.
- Cats living in catteries or shelters, stray or feral cats and cats living with other cats or dogs may be at greater risk of acquiring dermatophytes and may require special consideration.
- Dogs in kennels, living outdoors, stray or hunting dogs may be at greater risk of acquiring dermatophytes and may require special consideration.
- Cats and dogs which regularly attend shows or field trials may be predisposed to dermatophytosis.
- Too frequent washing and/or the use of harsh soaps can predispose to dermatophytosis.
- Common dermatophyte species (*Microsporum canis, M. gypseum, M. persicolor* and *Trichophyton mentagrophytes*) have a very wide distribution in all European countries. Dermatophytosis is probably more prevalent in less developed countries or in areas in which there are large populations of free-roaming dogs and cats.

When recommending a management programme for *Malassezia* dermatitis and/or otitis externa, veterinarians should consider the following elements:

- Any breed is susceptible to *Malassezia* dermatitis. However, several investigations clearly indicated that some breeds are predisposed to the development of abnormally high populations of *Malassezia* yeasts. In dogs, the list includes Basset

Hounds, Dachshunds, Cocker Spaniels, Shar Pei, Poodles, Bulldogs and West Highland White Terriers. In cats, Devon Rex and Sphinx seem to be more frequently colonized by *Malassezia* yeasts.

- Atopic dermatitis is the most frequently diagnosed concurrent disease in dogs with *Malassezia* dermatitis. However, it seems important to appreciate that not all dogs with atopic dermatitis have *Malassezia* dermatitis, and that *Malassezia* dermatitis occurs in association with disorders other than atopic dermatitis.
- Ectoparasites (such as ear mites or fleas) or pruritus from secondary infections may be sources of *Malassezia* overgrowth.
- Any debilitating disease may play a role by making dogs and cats more susceptible to *Malassezia* dermatitis. In cats, the isolation of *Malassezia* has been associated with retroviral infections, paraneoplastic syndromes, thymoma, and diabetes mellitus. Based on these findings, *Malassezia* overgrowth may be considered as a marker of life-threatening, underlying diseases in some cats.

2. CONTROL OF DERMATOPHYTOSIS IN DOGS AND CATS

2.1. Diagnosis

Dermatophytes invade hair shafts and cornified epithelium. As a consequence, dermatophytosis usually presents as patchy areas of alopecia on the face, ears or forelegs. The condition is typically considered as non-pruritic but some animals (especially adult cats) may be moderately to intensely pruritic. Uncommon clinical manifestations include folliculitis, feline miliary dermatitis, feline acne, pemphigus-like syndromes and pseudomycetoma.

Dermatophytosis should be considered in the differential diagnosis of many skin diseases and diagnostic aids are systematically required. Examination of the haircoat with an ultraviolet lamp (Wood's lamp) is a good screening method for dermatophytosis in dogs and cats. When exposed to the light, hairs invaded by most of the isolates of *M. canis* glow yellow green. The fluorescence is due to tryptophan metabolites produced by some dermatophyte species including *M. canis*. Hairs infected by other dermatophyte species (*T. mentagrophytes*, *M. persicolor* or *M. gypseum*) never fluoresce and some topical medications may destroy fluorescence. Thus a negative Wood's lamp examination does not rule out dermatophytosis. The observation of fluorescence should systematically be confirmed by microscopic examination of hairs, which remains the gold standard diagnostic tool (even though the recognition of infected hairs is not always easy and may require an experienced eye). Hairs should be collected through skin scrapings or during Wood's lamp examination. After digestion with a clearing solution (such as potassium hydroxide or chlorolactophenol), infected hairs present as enlarged and swollen structures with a rough and irregular surface. The hair surface typically demonstrates clusters or chains of fungal spores (2-4 µm for *M. canis*). Mycological culture remains the most reliable technique for confirming dermatophytosis in dogs and cats.

Sample collection may be obtained by scraping the cutaneous lesions, plucking hairs (under Wood's lamp) or brushing the haircoat with a sterile toothbrush or a little piece of sterile carpet. Several media are suitable for mycological cultures. Since the development of a specific culture medium proposed by Taplin et al. in 1969, Dermatophyte Test Media (DTM) have become very popular among small laboratories and are regularly used in veterinary medicine. However, only a very few attempts have been made to evaluate the performance of such media with material obtained from animals. An investigation demonstrated that the rapidity of color change was related to the incubation temperature and to the number of infected hairs deposited on DTM. Moreover, there is a risk of false positive results as saprophytic fungi may turn the medium red. For these reasons, the use of DTM is not recommended for the diagnosis of animal dermatophytoses. The material collected from the animals should be sent to a laboratory with an expertise in veterinary mycology. In the laboratory, specific identification is made by microscopic examination of the fungal colonies. The number of

fungal colonies may help distinguish between mechanical carriers and infected animals. Mechanical carriage is due to the contamination of the environment and is usually associated with a limited number of dermatophyte colonies in culture. Infection leads to a massive production of spores (arthroconidia) and is usually associated with a very high number of dermatophyte colonies in culture.

2.2. Treatment Procedures

Antifungal treatment should be systematically recommended to shorten the course of the infection and to reduce dissemination of infective material into the environment. Infective material is composed of small pieces of hair covered by microscopic fungal spores (called arthroconidia). Infective material is easily spread and can remain viable in the environment for up to 18 months under optimal conditions of temperature and humidity. Infected animals (with or without clinical signs) and contaminated environments represent long term sources of exposure to other animals and owners. Systemic antifungals are supposed to speed up the resolution of the infection, whereas topical antifungals are required to reduce the risk of transmission and environmental contamination. Current treatment recommendations stem from both *in vivo* and *in vitro* studies.

Important therapeutic measures include:

- Combination of systemic and topical treatment. Conventional systemic treatment relies on oral antifungal drugs: griseofulvin, ketoconazole and more recently itraconazole or terbinafine (Table 3). Griseofulvin was the most commonly used systemic treatment for dermatophytosis in small animals, although it is no longer licensed for animal use in several European countries. The micronized formulation of griseofulvin should be administered orally at 25 mg/kg twice daily with a fatty meal, to promote drug absorption. Haematological and gastrointestinal adverse effects may occur and are probably more common in cats. Griseofulvin is teratogenic and should not be given to pregnant animals. The principal alternatives to griseofulvin for systemic therapy of dermatophytosis are azoles such as ketoconazole and itraconazole. Itraconazole is safer than ketoconazole, which may cause anorexia, vomiting, hepatotoxicity as well as interfering with steroid hormone metabolism. Itraconazole is licensed for use in cats with *M. canis* dermatophytosis using an alternate-week dosing schedule, reflecting its incorporation rate into stratum corneum and hair. For concurrent topical treatment, many products have been proposed (Table 4). The decision to use topical therapy should be based upon the owner's ability and willingness to pour or sponge the product over the entire hair coat of the infected animal. Spot treatment of lesions is not recommended. The frequency of topical treatment should be at least twice a week.
- Appropriate length of treatment. The general recommendation is to sample the animal once a month during treatment and to stop antifungal administration after two negative cultures. Three negative results are preferred when multiple cats are involved. When mycological follow up is not possible, combined systemic and topical treatment should be continued for at least 10 weeks. If lesions persist after 8 weeks of treatment, veterinarians should suspect (i) that the treatment is not being administered correctly by the owner (ii) that an underlying disorder is interfering with the normal action of the immune system, or that the animal has a genetic background that makes it more susceptible to dermatophyte infection. The presence of resistant strains is regularly suspected but resistance of dermatophytes to antifungal drugs has been proved in only a very few instances and this hypothesis should not be considered as the most likely in cases of treatment failure. Lack of environmental control is most often the reason for the recurrence.
- Clipping of the hair coat, especially in severely infected animals, long-haired cats or in multi-animal households. Clipping makes topical therapy application easier and

allows for better penetration of the drug. In households with one or two pets, spot clipping of lesions may be enough. Clipping must be performed carefully and in an area that can be easily disinfected (see Section 3). Infected hairs should be burned or placed in plastic biohazard bag and autoclaved. Disposable clothing should be used in order to limit infection from animal to human. In cats, clipping the coat may require sedation. All whiskers should be clipped.

- Complete separation of infected animals from non-infected ones.
- Hygiene measures especially environmental decontamination (see section 3).

All dermatophyte species have a similar susceptibility to currently available antifungal drugs. As a consequence, the specific identification of the dermatophyte is not required for the choice of the drugs. Identification of the dermatophyte may be useful for a better understanding of the epidemiology of the infection and for preventing new contamination.

In catteries and animal shelters, dermatophyte infection is very difficult to eradicate and creates a significant health hazard for people in contact with animals. The cost of antifungal drugs and the reluctance of the breeders to admit that their colony is infected usually account for lack of compliance with treatment. Most recommendations for the control of dermatophytosis in catteries are based on the concept of a total treatment programme, which associates the use of reliable diagnostic tools, both topical and systemic treatment of all the cats and strong environmental decontamination procedures. Interruption of breeding programmes and show campaigns may also be recommended, as well as the isolation of new animals.

2.3. Prevention

Although the risk of dermatophyte infection is greater for puppies, kittens and aged or debilitated animals, the infection is not strictly age or health status-related, and so the risk continues throughout life. Consideration should be given to provide all dogs and cats with appropriate dermatophyte control throughout their lives.

Contact with animals or contaminated environments represent the major risk of infection. The best way to avoid infection is to prevent this contact. This prophylactic strategy is very simple but not always feasible because infected animals do not necessarily show obvious clinical signs. Asymptomatic carriers are frequently observed in feline populations. These animals may correspond to mechanical carriers or truly infected cats that could develop clinical signs in a few days or weeks.

To protect animals, the use of antifungal drugs has been proposed:

- Oral antifungal drugs were not proved to be appropriate. Carefully controlled studies in humans demonstrated that oral griseofulvin has no prophylactic action. Recent investigations showed that oral lufenuron may delay the initial establishment or progression of dermatophytosis in cats reflecting some inhibitory effect, but lufenuron did not prevent infection. Lufenuron is not licensed for dermatophyte prophylaxis in cats.
- Topical treatment is probably more valuable. Rinses or shampoos containing enilconazole or miconazole are licensed for dogs and cats. The general recommendation is to apply an antifungal shampoo or rinse to the entire body of any dog or cat which has been in contact with an infected animal or a contaminated area. Under optimum conditions, infective fungal spores germinate within 6 hours on the skin of pet cats and dogs, so the preventive application of antifungal drug should be performed in the day following the presumptive contamination.

Efforts to develop fungal vaccines to prevent dermatophytosis in dogs and cats continue. There are only a few products which are currently commercialized in just some European countries. These are live vaccines that may contain different dermatophyte species (*Microsporum canis* and *Trichophyton mentagrophytes*, for example). Investigations proving that these vaccines are protective against challenge exposure are still lacking.

As a consequence, the use of these vaccines should not be recommended for a long term prevention of dermatophytosis in dogs and cats.

In dog and cat breeding units as well as in animal shelters, the main risk is represented by the introduction of an infected animal. Newbury et al. (2007) recently described a management plan that should be recommended for the long term prevention of dermatophytosis in any dog or cat colony. This plan includes screening, monitoring and treatment procedures. At the point of entry, animals should be carefully examined, vaccinated against major (life threatening) infectious disease, and treated for ectoparasites and intestinal worms. The animals should also be screened for dermatophytosis via Wood's lamp examination and fungal culture. Animals should then be transferred to a quarantine ward until the results of the tests are known. The provision of a separate area for the treatment of animals with dermatophytosis is preferable. The most interesting information provided by Newbury et al. is that treatment decisions should be made according to fungal culture results. Colony-forming unit count combined with clinical examination can help to differentiate mechanical carriers from infected animals. Mechanical carriers should be treated with a single topical application of an antifungal drug before introduction within the colony. Infected animals are kept in quarantine and treated using a combination of systemic and topical antifungal drugs. These animals are not introduced to the colony before two negative fungal cultures have been obtained.

3. ENVIRONMENTAL CONTROL OF DERMATOPHYTE TRANSMISSION

Dermatophytes are transmitted through microscopic spores, which are formed via fragmentation of fungal hyphae on the infected skin or hair. The presence of these spores in the environment increases the risk of exposure, reinfection and prolonged treatment of animals. Decontaminating the environment involves thorough cleaning and regular disinfectant application.

Spores and fragments of infected hairs may be mechanically eliminated by regular vacuum cleaning of the surfaces where animals lie.

Recent studies demonstrate that both undiluted bleach and 1% formalin were able to kill all dermatophyte spores in the environment. However, because of its caustic properties, undiluted bleach is not recommended for use in households. Sodium hypochloride solution at 1:10 dilution and enilconazole solution were also proven to be active. All other tested products demonstrated poor efficacy.

An enilconazole smoke fumigant formulation for disinfection of farm buildings including poultry houses is available in most European countries. This kind of formulation is not licensed or appropriate for household use.

Brushes, combs, rugs and cages should be carefully washed and if possible, treated with a solution of enilconazole or 1:10 dilution of household bleach.

Vehicles used for transporting animals should be also treated.

In animal shelters or breeding establishments, contact plates or an air sampler can be used to sample environmental surfaces and check that disinfection has been performed correctly. Commercial cloths may also be used to monitor the environment for contamination.

4. CONTROL OF *MALASSEZIA* DERMATITIS IN DOGS AND CATS

4.1. Diagnosis

Malassezia dermatitis should be suspected in animals with inflammatory skin diseases characterized by erythematous and/or greasy lesions, especially when lesions involve intertriginous areas. In dogs, it may mimic or complicate atopic disease and dietary sensitivity. Hyperpigmentation and lichenification are frequently observed in animals with chronic disease and are particularly common in West Highland White terriers. Dogs with concurrent otitis externa show erythematous vertical ear canals and pinnae with varying degrees of lichenification and scaling, accompanied by a yellow or brownish ceruminous discharge. Although skin lesions may be confined to one area, multiple regions are usually affected, especially the limbs, ventrum, ears and the

face. The diagnosis of *Malassezia* dermatitis is based on clinical signs, presence of elevated numbers of yeast organisms in lesional skin, and a clinical and mycologic response to antifungal therapy. The tape strip technique is convenient and reliable: clear adhesive tape is pressed on the surface of the skin, thus collecting the stratum corneum cells and any superficial microbes. Because a small population of the yeast might create disease in sensitized animals, and in view of the variations in population sizes between different canine breeds and anatomic sites, trial therapy should be given whenever the yeast is readily identified in cytologic specimens obtained from compatible lesions.

4.2. Treatment Procedures

Topical treatments licensed for canine *Malassezia* otitis externa in veterinary medicine generally contain either azole antifungal drugs (principally miconazole, clotrimazole or posaconazole) or nystatin. These are normally combined with antibiotics and a glucocorticoid, reflecting the need to control concurrent bacterial infection and reduce inflammation and proliferative pathologic changes (e.g. stenosis) of the ear canal. Combined antibacterial and antifungal drug administration may also prevent the switch from bacterial to yeast infection, or vice versa, that may be encountered when antibacterial or antifungal monotherapy is used in dogs with otitis externa or otitis media. Concurrent use of ear cleaners is indicated when cerumen is excessive. Animals with *Malassezia* otitis should receive a complete dermatologic evaluation, because failure to identify and correct predisposing, primary, and other perpetuating factors may result in persistent or recurrent disease.

Because *Malassezia* yeasts are located within the stratum corneum, topical therapy alone may be sufficient to resolve the clinical signs of infection, provided the owner and pet are compliant. A recent evidence-based review of the treatment of *Malassezia* dermatitis in dogs (Nègre et al. 2009) concluded that there was good evidence for the twice-weekly use of a 2% miconazole/2% chlorhexidine shampoo. The authors concluded that there was fair evidence for the use of oral ketoconazole (10 mg/kg, once daily) and oral itraconazole (5 mg/kg, once daily) for 3 weeks. Itraconazole might be preferred to ketoconazole because it is better tolerated. As in dermatophytosis, the keratinophilic and lipophilic properties of this drug enable intermittent administration, with the advantage of reducing costs and the potential for adverse effects, and potentially improving compliance. Severe claw fold infections may require longer treatment or higher doses, and otitis externa cases may not respond adequately. As with otitis externa, identification and correction of primary causes and predisposing factors is often essential for successful management, although many dogs with *Malassezia* dermatitis require regular maintenance therapy to prevent relapse. Clinical and cytologic assessments should be repeated to determine the efficacy of antifungal therapy and to establish whether there is evidence of concurrent diseases. Relapsing infection is common when primary causes and predisposing factors are not identified or corrected.

5. OWNER CONSIDERATIONS IN PREVENTING ZOONOTIC DISEASES

In cases of dermatophytosis, important preventive measures for pet owners include:

- **practicing good personal hygiene (dermatophytes are zoonotic)**
- **controlling dermatophyte infection through regular diagnostic testing and/or repeated proper treatments (see under 2.2.)**
- **preventing infection by reducing wherever possible opportunities for the pet to acquire infection**
- **minimizing exposure especially of children to potentially contaminated environments or infected animals**

People in contact with infected animals should be advised of the risks and made aware that there are specific risk groups in society.

This information should be made available on request by anybody from physicians and veterinarians without the need for a medical history of the client and his/her family.

Although *Malassezia pachydermatis* is not normally isolated from human skin, there have been several reports of *M. pachydermatis*-associated fungaemia in infants in neonatal intensive care units and in adults with serious internal diseases. Heightened awareness of the potential for the transfer of *Malassezia* yeasts to human patients and the application of molecular typing methods might lead to the recognition of more cases in the future. The renewed emphasis on hand hygiene in hospitals after the emergence of nosocomial infections with multidrug-resistant bacterial pathogens should help prevent the development of zoonotic *Malassezia* infections.

6. STAFF, PET OWNER AND COMMUNITY EDUCATION

Protocols for the control of dermatophyte infection should be communicated to veterinary and para-veterinary staff and consistently applied. Awareness of dermatophyte infection, including clinical manifestations in people and particularly children, should be created in the medical profession through information brochures. Cooperation between the medical and veterinary profession ought to be encouraged and its benefits underlined in the case of zoonosis.

Pet owners should be informed about the potential health risks of dermatophyte infection, not only to themselves but also to family members and all people living in regular contact with their pets. Brochures in veterinary practices, pet shops, posters or specific websites are useful tools to achieve this. Responsible dog and cat ownership can remove public health concerns.

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Table 1: Characteristics of major dermatophyte species infecting dogs and cats in Europe

Dermatophyte species	Major hosts	Source of contamination	Zoonotic agent
***Microsporum* genus**			
Microsporum canis	Cats, dogs and many other mammals (including humans)	Cats most frequently	Yes
Microsporum gypseum	Dogs, horses	Soil (geophilic dermatophyte)	Yes (but very rare)
Microsporum persicolor	Small rodents (moles and voles), dogs and cats	Small rodents	Yes (but very rare)
***Trichophyton* genus**			
Trichophyton mentagrophytes	Small rodents (guinea pigs, rats), rabbits, dogs	Small rodents (guinea pigs, rats), rabbits, dogs	Yes
Trichophyton rubrum	Human, dogs (very rare)	Man (pet owner)	The dog is contaminated by its owner (and not the opposite)

Table 2: Characteristics of *Malassezia* species recovered from the skin of animals

Species	Major animal hosts	Related diseases	Potential zoonotic agent
Non lipid-dependent species*			
*Malassezia pachydermatis***	Dogs, cats and many other mammals, birds	Otitis and dermatitis in dogs and cats	Yes
Lipid-dependent species*			
Malassezia sympodialis	Cats and other mammals	Otitis	Status unknown
Malassezia globosa	Cats and other mammals	Otitis	Status unknown
Malassezia slooffiae	Cats, pigs and other mammals	Otitis, dermatitis	Status unknown
Malassezia nana	Cats and cattle	Otitis	No
Malassezia caprae	Goats	Dermatitis	No
Malassezia equina	Horses	Dermatitis	No
Malassezia cuniculi	Rabbits	Unknown	No

*Non lipid-dependent *Malassezia* yeasts grow on routine mycological media (like Sabouraud dextrose agar) without lipid supplementation whereas lipid-dependent yeasts require lipid-supplemented media (like Dixon's medium). Thirteen lipid dependent species are now recognised: *M. furfur, M. sympodialis, M. globosa, M. obtusa, M. restricta, M. slooffiae, M. dermatis, M. japonica, M. yamatoensis, M. nana, M. caprae, M. equina* and most recently, *M. cuniculi*

** Some strains of *M. pachydermatis* have shown lipid-dependent characteristics

Table 3: Systemic antifungal drugs for the treatment of superficial mycoses in dogs and cats
The availability and recommended dose of the drugs may vary according to the European countries.

Antifungal drugs*	Antifungal groups	Dosage and frequency of administration	Comments on use	Adverse effects
Itraconazole	imidazole	• 5 mg/kg administered every 24h	• the drug is registered for use in cats but not in dogs • because of its high lipophily, the drug has been proved to be effective in an alternate week regimen (one week off and one week on)	• itraconazole has lower toxicity than ketoconazole and at regular dosages, adverse effects are very seldom observed • the drug should not be administered to pregnant dogs and cats (even if teratogenic effects have been reported only in rodents and at very high doses)
Ketoconazole	midazole	• 5mg/kg administered every 12h	• in some European countries, the drug is registered for use in dogs (but not in cats) • the absorption is improved when the drug is given with food	• the drug is teratogenic and must not be administered to pregnant dogs and cats • anorexia, vomiting and diarrhoea are sometimes observed • ketoconazole has hepatotoxic effects, including elevated serum alanine transaminase activity • ketoconazole interferes with the metabolism of other drugs and with steroid hormone metabolism
Griseofulvin	polyene	• 25 mg/kg administered every 12h (micronised form) • 5 mg/kg administered every 12h (ultramicronised form)	• in many countries, the drug is no longer used and is not registered for use in dogs and cats • the drug should be administered with a fatty meal (the fat enhances absorption)	• the drug is highly teratogenic and must not be administered to pregnant dogs and cats • gastrointestinal disorders are sometimes observed • myelosuppression has been documented in FIV-infected cats
Terbinafine	allylamine	• 20-40 mg/kg administered every 24h	• the drug is commonly used for the treatment of dermatophytosis (especially onychomycosis) in humans but it is not registered for use in cats and dogs	• No teratogenicity has been reported in rodents or rabbits. The drug is not contraindicated in pregnant women • vomiting may sometimes be observed in cats

* Lufenuron is a chitin synthesis inhibitor commonly used for the prevention of flea infestations in dogs and cats. Since chitin is a component of fungal cell walls, several recent studies have investigated whether lufenuron has useful antifungal activity. The first retrospective study was conducted in Israel and suggested that lufenuron treatment was strongly associated with recovery in many dogs and cats with a number of fungal infections, including dermatophytosis. However, the results of other investigations were contradictory and increasing scepticism about efficacy of lufenuron rapidly occurred. To date, the use of lufenuron should not be recommended for the treatment of superficial mycoses in dogs and cats. Lufenuron is not registered for use in the prophylaxis or treatment of dermatophytosis.

Table 4: Topical antifungal drugs for the treatment of superficial mycoses in dogs and cats
The availability and the dose of the drugs may vary according to the European countries.

Antifungal drugs*	Antifungal groups	Dosage and frequency of administration	Comments on use	Adverse effects
Shampoos				
Miconazole + chlorhexidine	imidazole + disinfectant	• 2% miconazole and 2% chlorhexidine twice weekly	• lathering or rubbing process may macerate fragile hairs and increase the release and dispersal of spores	• no adverse effect has been documented
Rinses				
Enilconazole	imidazole	• 0.2% solution twice weekly	• the entire body must be treated and the antifungal agent left to dry on the skin • careful application (using sponges and by patting rather than rubbing) is recommended • after application, the coat and skin can be dried with a hairdryer	• topical application of enilconazole is well tolerated (including by cats)
Lime sulphur		• 1:32 or 1:16 twice weekly	• lime sulphur is commonly used in the USA but is not available in all European countries • the entire body must be treated and the antifungal agent left to dry on the skin • careful application (using sponges and by patting rather than rubbing) is recommended	• lime sulphur has an offensive odour and may stain light-coloured hair • oral ulceration has sometimes been observed in cats. As a consequence, cats should be collared to prevent them from licking the solution
Creams, gels, ointments and suspensions				
Several compounds available (e.g. miconazole)	Several groups (e.g. imidazole)		• the efficacy of these products has not been demonstrated specifically in dogs and cats with dermatophytosis or Malassezia dermatitis	• the products may be messy or easily groomed off by the animals

Captan, povidone-iodine, and chlorhexidine (alone and at a concentration lower than 3%) have been found to be ineffective against dermatophytes in both in vitro and in vivo studies.

Sodium hypochlorite solution has been used as topical treatment of dermatophytosis in cats. However, it dries and irritates the skin and bleaches the haircoat. The use of this product is not recommended.

Only a few products approved for the treatment of otitis externa are also approved for topical use in the treatment of local skin lesions. These agents typically contain an antifungal, antibiotic and corticosteroid and while the vehicle used may not be suitable for treatment of large skin lesions or areas where there is a lot of hair, they may be suitable for local application to discrete lesions due to *Malassezia* yeasts.

APPENDIX 1 – BACKGROUND

ESCCAP (European Scientific Counsel Companion Animal Parasites) is an independent, not-for-profit organisation that creates guidelines and promotes good practice for the control and treatment of parasites in and on companion animals. With the proper advice the risk of diseases and parasitic transmission between animals and humans can be minimized. ESCCAP aspires to see a Europe where companion animal parasites no longer threaten the health and wellbeing of animals and humans.

There is a great diversity in the range of parasites and their relative importance across Europe and the ESCCAP guidelines summarize and highlight important differences which exist in different parts of Europe and, where necessary, specific control measures are recommended.

ESCCAP believes that:

- *Veterinarians and pet owners must take measures to protect their pets from parasitic infections*
- *Veterinarians and pet owners must take measures to protect the pet population from risks associated with travel and its consequent potential to change local parasite epidemiological situations through the export or import of non-endemic parasite species*
- *Veterinarians, pet owners and physicians should work together to reduce the risks associated with zoonotic transmission of parasitic diseases*
- *Veterinarians should be able to give guidance to pet owners regarding risks of parasite infection and diseases and measures which can be taken to minimise these risks*
- *Veterinarians should attempt to educate pet owners about parasites to enable them to act responsibly not only for their own pet's health but for the health of other pet animals and people in their communities*
- *Veterinarians should wherever appropriate utilise diagnostic tests to establish parasite infection status in order to provide the best possible advice*

To achieve these objectives, ESCCAP produces guidelines in different formats:

- *A detailed guideline for veterinary surgeons and veterinary parasitologists*
- *Translations, extracts, adaptations and summarised versions of guidelines which address the varied requirements of European countries and regions*

Versions of ESCCAP guidelines can be found at www.esccap.org.

Disclaimer:

Every effort has been taken to ensure that the information in the guideline, which is based on the authors' experience, is accurate. However the authors and publishers take no responsibility for any consequence arising from the misinterpretation of the information herein nor is any condition or warranty implied. ESCCAP emphasises that national, regional and local regulations must be borne in mind at all times before following ESCCAP advice. All dose-rates and indications are provided for guidance. However, vets should consult individual data sheets for details of locally approved treatment regimens.

ESCCAP

EUROPEAN SCIENTIFIC COUNSEL COMPANION ANIMAL PARASITES

Superficial Mycoses in Dogs and Cats

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