The effectiveness of the use of the drug "Fungivet" in dermatophytosis in cats

Tatyana Alekseeva[1] , *Olga* Krotova[1,2*], *Konstantin* Savenkov[3], *Bairta* Dordzhieva[4], *Sofia* Chimidova[4], and *Timur* Artaev[4]

[1] Don State Agrarian University, Krivoshlykov str., 24, 346493, Rostov region, P. Persianovsky, Russia
[2] Don State Technical University, Gagarin Sq., 1, 344003, Rostov-on-Don, Russia
[3] St. Petersburg State Agrarian University, Peterburgskoe shosse, 2, 196601, Pushkin, St. Petersburg, Russia
[4] Kalmyk State University named after B.B. Gorodovikov, Pushkin str., 11, 358000, Elista, Republic of Kalmykia

Abstract. Dermatophytoses are a widespread group of infectious diseases known since ancient times, but still a problem even for modern clinical veterinary medicine. Despite the fact that vaccination against fungal infections for cats is a fairly common procedure in Russia, these diseases do not cease to be registered in our country. At the moment, veterinarians have increasingly begun to use systemic antifungal drugs in the treatment of animals, which show high effectiveness in combating dermatophytosis. They have a convenient application scheme, the drugs have a cumulative effect in tissues, while they do not have a toxic effect on the liver. This indicates the need to develop this topic, to develop new tools for animal immunization. It is also necessary to choose the most effective treatment regimen for this disease in order to minimize its spread among cats living in shelters, specialized kennels, and to prevent infection of people in contact with them. The development of effective methods for the treatment of dermatophytosis in cats is one of the promising areas of veterinary science and practice. since they are zooanthroponotic diseases. In most cases, human infection occurs due to his close contact with sick animals (more often cats) in case of non-compliance with sanitary and hygienic rules. Children under 7 years of age are at greater risk of infection, and a decrease in immunity significantly increases the duration of treatment for this pathology. The disease is accompanied by an increase in body temperature, headaches, intoxication syndrome, and may be complicated by the addition of a secondary bacterial infection requiring special treatment.

1 Introduction

Dermatophytoses are a group of infectious diseases characterized by lesions of the skin and its derivatives (hair, horny formations) caused by parasitic fungi – dermatophytes. They belong to superficial mycoses, which, unlike deep and visceral mycoses, affect only the upper

* Corresponding author: alb9652@yandex.ru

layers of the skin [1-16]. The causative agents of the disease are pathogenic fungi of two genera - Microsporum and Tnchophyton, causing microsporia and trichophytia, respectively [9,14]. The sources of pathogens of trichophytia and microsporia are diseased and over-sick animals. The spread occurs through contact between healthy and sick animals, especially when crowded in nurseries and shelters, it is transferred through care items, ammunition, bedding, feed, in addition, pathogenic fungi can be brought home by owners on clothes or shoes, rodents and ectoparasites freely moving around the premises and beyond. Injuries, scratches, maceration of the skin contribute to infection. The disease is registered at any time of the year [4,5,6,7]. Being the animals closest to humans, dogs and cats pose a potential danger as sources of infection of humans and other animals with infectious diseases, in particular microsporia and trichophytia. Among the reasons for the widespread spread of microsporia in recent years is the increased interest in rare and decorative breeds of dogs and cats, the so-called "pet boom". As a result, there has been a sharp increase in the number of owners, dog breeders, businessmen pursuing various kinds of goals: breeding new breeds, selling, etc.. Dog and cat visits to exhibitions are sometimes the cause of infection with microsporia. M.canis is most often isolated from cats after exhibitions. Some researchers cite facts that indicate a higher incidence of M.canis in purebred cats compared to mongrel cats, and explain this by a lower susceptibility to microsporia of the latter. The pathological process of dermatomycosis development is almost identical in trichophytia and microsporia. Once on the skin of a susceptible animal, mycelium or spores of the pathogen germinate on the surface and penetrate into the hair follicles, infection is facilitated by tissue damage such as scratches, abrasions, peeling of the epithelium. Germinating, the fungus begins to multiply and spread in the stratum corneum of the epidermis, while releasing proteolytic, including keratolytic enzymes that help it germinate deep into the hair. The waste products of dermatophytes have a local irritating effect, causing inflammation, the appearance of bubbles, and increased permeability of the walls of the capillaries of the skin. In addition, the toxins of the fungus disrupt the nutrition of the hair, they lose their shine, elasticity, split, become brittle at the base. Phenomena such as hyperkeratosis, cellular infiltration are manifested. Crusts of the secreted serous exudate form on the surface of the skin. The animal feels itchy in the affected areas of the skin. In adult cats, a latent form is more often registered, and in kittens, a superficial one. When examining kittens, flaky foci with broken hair are found on various parts of the head, neck, at the base of the tail, on the forelimbs, and trunk. In some cases, deeper lesions are revealed — the presence of crusts from dried exudate and glued scales [1,2,3,12]. The duration of the disease ranges from 3-9 weeks to 7-12 months. Adult cats carry the disease relatively easily, however, among young animals with a disseminated form, a fatal outcome is also possible. Microsporia in dogs and cats is very often complicated by various types of fungi and bacteria. In these cases, broad-spectrum antibiotics are required for the treatment of dermatophytes, which also have antibacterial activity. Such antimycotics should be keratinotropic, provide a high percentage of cure and good tolerability, and a minimum number of adverse reactions and complications [10,11,13].

All these requirements are met by the drug "Fungivet" (manufacturer JSC "AGROBIOPROM", Russia) This drug belongs to a fundamentally new class of antimycotics - allylamine compounds. The active substance of this drug, terbinafine hydrochloride, has a double effect on fungal cells - fungistatic and fungicidal. Clinical trials of terbinafine indicate its high therapeutic efficacy in dermatomycosis[16].

In connection with the above, the purpose of our work is to study the effectiveness of the use of the drug "Fungivet" in complex therapy in the treatment of dermatophytosis in cats.

2 Materials and methods

The research was conducted at the veterinary clinic "White Fang" (Novocherkassk) from September 2022 to June 2023

The research material was cats belonging to private owners with an average body weight of 3.5 kg/head, as well as blood samples taken from them and pathological material in the form of scrapings from the affected skin areas.

Blood sampling was performed in cats from the subcutaneous lateral vein of the thoracic limb, or the medial subcutaneous vein of the pelvic limb in a volume of 2 ml/head. All laboratory tests were carried out in the laboratory of the veterinary clinic. A general blood test was performed on a veterinary hematology analyzer "MEK 6400K": the content of leukocytes, ESR, erythrocytes, platelets, hemoglobin, hematocrit, lymphocytes, monocytes, granulocytes (eosinophils, basophils and neutrophils). Biochemical blood analysis was also performed using an analyzer. The levels of: alanine aminotransferase (AlAT), aspartate aminotransferase (AsAT), bilirubin, creatinine, urea, total protein, gamma-GT, glucose were determined. Blood sample analyses and the results of skin scraping studies from experimental animals were examined in the laboratory of the Kotelnikovo veterinary station. In addition, several diagnostic methods were used to make an accurate diagnosis: luminescent analysis (using a Wood OLDD - 01 lamp), direct microscopy of hair (trichogram). Biomaterial from animals with clinical signs of skin and hair lesions was used to isolate pathogens of dermatophytosis. The samples were taken in a veterinary clinic.

The biomaterial was taken from the periphery of lesions that had not previously been subjected to drug treatment. Crusts with remnants of hair, hair, were pulled out with tweezers and placed in Petri dishes, which indicated the age, type, breed and degree of damage to the animal, as well as the date of taking the material.

Special attention was paid to the rules for the selection of biomaterial from micro-carrier animals that do not have characteristic clinical signs of damage to the coat and skin. The material from such animals was taken from at least 12-15 skin areas in the head, neck, trunk, hips, paws, tail (2-3 samples from each area).

It was decided to divide the studied animals with similar clinical signs of the disease in the amount of 20 heads into 2 groups of experience and control, 10 heads each. The groups were mixed by sex and age.

When making up the groups, all animals were subjected to a standard examination, which included: anamnesis collection, external examination, measurement of pulse and respiratory rate, thermometry, blood sampling for general and biochemical analysis, luminescent analysis and trichogram. Based on the results of a general clinical examination and special diagnostics, individuals with similar symptoms were selected.

In this work, 2 treatment regimens for cats with dermatophytosis were tested and analyzed; for the experimental and control groups of animals, a certain method of using various drugs and their combinations was prescribed:

Scheme No. 1 (experimental group) – an external antifungal agent and a systemic antifungal drug:

- the drug "Fungivet" – 20 mg / kg every 24 hours, orally, for 14 days;
- Miconazole cream 2% - 2 times a day, externally on the affected areas for 14 days.

Scheme No. 2 (control group) – the use of an inactivated vaccine against dermatophytosis, an external antifungal agent and an immunomodulator:

-the inactivated vaccine Vakderm was administered 1 ml per head, intramuscularly, followed by revaccination: after 14 days twice;

-solution for injection of Gamavit – 0.5 ml / kg 2 times a day subcutaneously for 5 days.

- Miconazole cream 2% - 2 times a day, externally on the affected areas for 14 days.

The effectiveness of therapy methods was judged by the amount of time from the beginning of treatment to the onset of the first improvements in the condition of animals and complete recovery, as well as by the presence of side effects after the use of drugs.

3 Results

An analysis of the incidence of dermatophytosis in Novocherkassk for 2020-2023 showed that cats had a tendency to decrease the incidence. If 105 cases of cat microsporia were reported in 2020, then in recent years the absolute number of cases has been noted in lower numbers. For example, in 2021 - 78, in 2022 - 61, in 2023 - 50 cases. The maximum increase in morbidity was registered in 2020 (105 cases). A total of 1,587 cats with signs of skin and hair lesions were examined between 2020 and 2023. Of the examined animals, 294 patients with microsporia were identified during the specified period, which amounted to 18.5%.

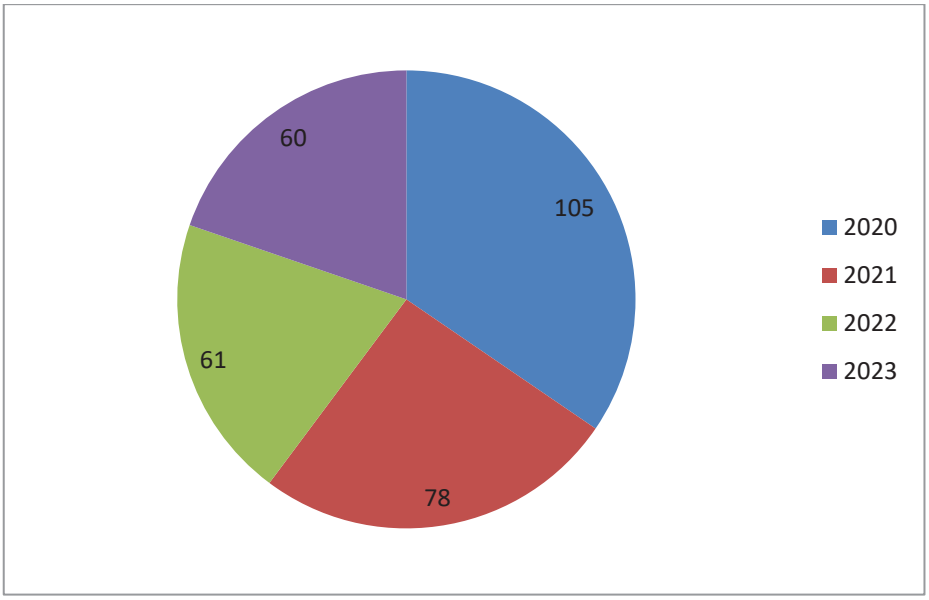

Fig. 1. Dynamics of morbidity in % ratio of cats with dermatophytosis in Novocherkassk for the period 2020-2023

The analysis of age-related features in the case of microsporia of small domestic animals revealed that animals get over dermatophytosis mainly at the age of 6 months. A higher incidence of microsporia in kittens than in adult animals is obviously associated with transmission of infection from sick mothers. The data obtained indicate that the highest incidence of microsporia is observed in mongrel animals.

Table 1. Analysis of morbidity by age

Age group	The number of animals with dermatophytosis/%
Up to 6 months	189/63,4
6-12 months	45/15,3

Older than 1 year	60/20,4
Total:	294

We explain the decrease in the incidence of microsporia among small domestic animals, on the one hand, by the effectiveness of trapping stray dogs and cats, on the other hand, by timely detection and effective treatment of animals with dermatophytosis, especially mycophytosis.

4 Discussion of the results

Susceptibility to dermatophytosis, in particular to microsporia, varies in dogs and cats and depends on individual and breed characteristics, as well as on exploitation and maintenance.

As a result of the examination of cats from the experimental groups, the following symptoms characteristic of dermatophytosis were revealed: skin areas with hair broken off at the base, peeling epithelium, dried crusts from the exudate secreted were found on the surface of the body, the local temperature in these areas was increased in some individuals, itching was noted. The body temperature in a few animals was also increased, but only slightly, which indicates the presence of an inflammatory process. Apathy and decreased appetite were noted in individuals with a long course of the disease. The data on symptoms for each cat from the study groups are presented in Table 2.

Table 2. Symptoms found in cats from the experimental and control groups

№ Group	№ p / p	Peeling of the epitheliu m	Exudation	Increased local temperatu-re	Itchy skin	Increased body temperat ure	Decreased appetite	Apathy
1	1	+			+		+	
	2		+			+		+
	3	+			+	+	+	
	4		+	+	+			+
	5		+	+	+		+	
	6	+	+		+	+	+	+
	7	+					+	
	8	+	+	+				+
	9		+	+	+	+		+
	10	+		+	+		+	
2	1		+				+	
	2		+		+		+	
	3	+	+	+			+	
	4	+		+		+		+
	5		+		+			
	6	+	+	+				
	7	+			+	+	+	+
	8		+	+				
	9	+	+				+	
	10	+		+		+		+

Before starting treatment, blood samples were taken from all animals of the experimental and control groups for general and biochemical analysis. The results are presented in Tables 3 and 4, respectively.

Table 3. The results of a general blood test of cats with dermatophytosis before treatment

Indicators	A group of animals		
	Experienced	Control	Reference values
Hemoglobin, g/l	135,0±16,0	140,0±1,9	90,0-156,0
Erythrocytes, million/µl	6,30 ±0,1	7,70 ±0,2	5,80-11,80
ESR, mm/hour	10±2	9±1	0-13
Leukocytes, thousand/µl	21,8±8,7	23,1±3,4	4,8-20,1
Rod-shaped neutrophils, %	0	1	0-3
Segmented neutrophils, %	39±2	42±1	35-75
Lymphocytes, %	50±5	49±3	25-55
Eosinophils, %	0	1±1	0-6
Basophils, %	1±1	0	0-1
Monocytes, %	2±1	1	1-4

Comparing the results of analyses of blood samples of cats from the groups of experience before the start of treatment and the control group, it can be concluded that there are deviations in the indicators of diseased cats. They had increased values of the number of leukocytes - in the experimental group: 21.8±8.7, in the control group 23.1±3.4, with a physiological norm - 4.8-20.1 and the ESR index - in the experimental group: 10 ± 2, in the control group - 9±1, with reference values 0-13, which indicates the presence of an inflammatory process. The indicators of biochemical blood testing in cats of all groups were within the limits of physiological values.

Table 4. Results of biochemical blood analysis of cats with dermatophytosis before treatment

Indicators	A group of animals		
	Experienced	Control	Reference values
AlAT, units/l	41±2	39±3	9-52
AsAT,units/l	35±4	21±3	11-42
Total protein, g/l	60±4	57±2	40-73
Bilirubin, mmol/l	4±1	7±3	3-12
Gamma-GT,c/l	1±1	2±1	0-3
Glucose, mmol/l	4,5±0,02	4,78±0,26	3,3-6,3
Urea, mmol/l	5,02±0,12	5,66±1,05	3,5-9,2
Creatinine, mmol/l	89±2	91±3	26-120

After the start of treatment, all animals from the groups showed different dynamics of the course of the disease. The animals from the experimental group had the earliest improvement. On the 5th day of the use of funds from this treatment regimen, the healing of the affected areas was recorded in animals. When using the vaccine regimen, cats initially showed a deterioration in the condition of the animals, on the 8th day after revaccination, signs of improvement in their condition appeared. Recovery in the animals of the experimental group occurred on the 10th- 14th (on average - 12th) day, in the control group - after the second revaccination on the 20th day, the data are shown in Table 5.

Table 5. Therapeutic efficacy of treatment regimens

Indicators	Group	
	I Group (n=10)	II Group (n=10)
Recovered in 30 days of treatment	10	10
Recovered in 30 days of treatment, %	100%	100%
Recovery time, day	12	20

After applying all treatment regimens, blood samples were re-taken from the experimental groups for general and biochemical analyses in order to clearly demonstrate the effectiveness of the procedures performed, as well as to analyze the effects of the drugs used. The results are presented in table 6 and table 6.

Table 6. Results of the general blood test of cats with dermatophytosis after treatment

Indicators	A group of animals		
	Experienced	Control	Physiological limits
Hemoglobin, g/l	136,0±11,0	138,0±5	90,0-156,0
Erythrocytes, million/µl	7,30 ±0,4	7,68 ±0,3	5,80-11,80
ESR, mm/hour	3±2	5±1	0-13
Leukocytes, thousand/µl	10,1±2,7	13±3,2	4,8-20,1
Rod-shaped neutrophils, %	0	0	0-3
Segmented neutrophils, %	40±4	41±2	35-75
Lymphocytes, %	44±5	47±2	25-55
Eosinophils, %	0	0	0-6
Basophils, %	0	0	0-1
Monocytes, %	2	1	1-4

Table 7. Results of biochemical blood analysis of cats with dermatophytosis after treatment

Indicators	A group of animals		
	Experienced	Control	Physiological limits
AlAT, units/l	40±2	36±4	9-52
AsAT,units/l	31±5	21±3	11-42
Total protein, g/l	55±4	57±2	40-73
Bilirubin, mmol/l	6±2	7±3	3-12
Gamma-GT,c/l	2±1	1±1	0-3
Glucose, mmol/l	4,20±0,02	4,62±0,14	3,3-6,3
Urea, mmol/l	5,11±0,07	5,61±1,03	3,5-9,2
Creatinine, mmol/l	85±7	95±2	26-120

Analyzing the results of the blood test and the results of external examination and repeated trichogram, it can be concluded that the cats recovered in all experimental groups. Over time, the disadvantages of the scheme with the use of the vaccine "Vakderm" as a therapeutic drug were revealed: there were cases of repeated infection of animals from this group with dermatophytoses, and the treatment period was the largest number of days.

Table 8. Economic and therapeutic results

Indicators	Group	
	Experienced	Control
Pu,rubles	10000	10000
Sv,rubles	4678	4376
Ev, rubles	5322	5624
Er rubles/rubles	1,14	1,29
Et,%	100	100
Recovery rate, days	12	20

In animals from the experimental group, where a complex of external and systemic antifungal agents was used for treatment, improvement and recovery occurred earlier than in the control group, and, in addition, side effects from the use of systemic drugs were not observed, which is confirmed by the results of a biochemical blood test. This gives us reason to recommend this scheme as the most preferable.

5 Conclusions

As a result of the conducted research, it was found that a promising direction in the treatment of dermatophytosis in cats is the use of systemic antifungal drugs containing terbinophine. The use of the drug "Fungivet" in the therapeutic regimen for the treatment of dermatophytosis had a positive effect on the rate of recovery of animals and the prevention of relapses of the disease. We recommend

using the drug "Fungivet" as part of complex therapy for dermatophytosis in cats according to the following scheme: 20 mg / kg every 24 hours, orally, for 14 days.

References

1. A.O. Michel, T.A. Donovan, B. Roediger, Q. Lee, C.J. Jolly, S. Monette, Veterinary Pathology, **59** (1), pp. 120-126 (2022) DOI: 10.1177/03009858211045439
2. S.Chaiyasak, C. Piewbang, J. Yostawonkul, S. Boonrungsiman, T. Kasantikul, A. Rungsipipat, S. Techangamsuwan, Veterinary Pathology, **59** (1), pp. 127-131 (2022) DOI: 10.1177/03009858211045441
3. M. Katayama, Y. Uemura, Veterinary Sciences, **8** (12), article № 328 (2021) DOI: 10.3390/vetsci8120328
4. M. Davenport, A. Muntean, N. Hadzic, Journal of Clinical Medicine, **10** (23), article № 5675 (2021) DOI: 10.3390/jcm10235675
5. S.R. Compton, Comparative medicine, **71** (5), pp. 333-341 (2021) DOI: 10.30802/AALAS-CM-21-000007
6. D.A. Meekins, N.N. Gaudreault, J.A. Richt, Viruses, **13** (10), article № 1993 (2021) DOI: 10.3390/v13101993
7. O. Krotova, T. Alekseeva, K. Savenkov, S.Sklyarov, M. Savenkova XV International Scientific Conference "INTERAGROMASH 2022" , Vol. **575**. – Rostov-on-Don: Springer Cham, P. 897-905 (2023) DOI 10.1007/978-3-031-21219-2_101
8. T. Yeargin, A. Fraser, G. Huang, X. Jiang, Journal of Food Protection, **78** (10), pp. 1842-1850 (2015) DOI: 10.4315/0362-028X.JFP-14-515
9. D.Jas, V. Frances-Duvert, D. Vernes, P.-M. Guigal, H. Poulet, Veterinary Microbiology, **177** (1-2), pp. 123-131 (2015) DOI: 10.1016/j.vetmic.2015.03.009
10. P. McDonagh, P.A. Sheehy, A. Fawcett, J.M. Norris, Veterinary Microbiology, **177** (1-2), pp. 78-86 (2015) DOI: 10.1016/j.vetmic.2015.02.015
11. P. McDonagh, P.A. Sheehy, A. Fawcett, J.M. Norris, Veterinary Microbiology, **176** (3-4), pp. 370-377 (2015) DOI: 10.1016/j.vetmic.2015.02.007
12. A.E. Rivas, J.N. Langan, K.M. Colegrove, K. Terio, M.J. Adkesson, Journal of Zoo and Wildlife Medicine, **46** (1), pp. 141-145 (2015) DOI: 10.1638/2013-0216R1.1
13. P.M. Beczkowski, M. Harris, N. Techakriengkrai, J.A. Beatty, B.J. Willett, M.J. Hosie, Vaccine, **33** (8), pp. 977-984 (2015) DOI: 10.1016/j.vaccine.2015.01.028
14. A.C. German, M. Iturriza-Gómara, W. Dove, M. Sandrasegaram, T. Nakagomi, O. Nakagomi, N. Cunliffe, A.D. Radford, K.L. Morgan, Journal of Clinical Microbiology, **53** (2), pp. 455-464 (2015) DOI: 10.1128/JCM.02266-14
15. P.M. Bęczkowski, N. Logan, E. McMonagle, A. Litster, B.J. Willett, M.J. Hosie, Journal of General Virology, **96** (3), pp. 671-680 (2015) DOI: 10.1099/vir.0.071522-0
16. S.K.Tiwari, L.M.T. Dicks, I.V. Popov, A.M. Ermakov, M.L. Chikindas, A. Karaseva, A. Suvorov, J.R.Tagg, R. Weeks, Frontiers in Microbiology, Vol. **11**. № JAN. P. 1877 (2020) DOI: 10.3389/fmicb.2020.01877