



Comparative effectiveness of the complex drugs based on imidacloprid and moxidectin against ecto- and endoparasitic infestations of cats

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Treatments of ecto- and endoparasitic infestations of cats adopt drugs based on imidacloprid and moxidectin. Therefore, the objective of our study was comparing spot-on applied complex drugs, which have different action mechanisms of their active agents, during ecto- and endoparasitic infestations of cats. We provide the data on effectiveness of the complex antiparasitic drug Megastop Ultra for Cats, in comparison to the Advocate for Cats drug, used for treatment and prophylaxis of ecto- and endoparasitic infestations of cats of different breeds, ages, sexes and body weights. Entomological examination of cats of the experimental and control groups revealed fleas such as *Ctenocephalides felis* and *Pulex irritans*, with the infestation intensity of 50 to 90 specimens per individual, the average infestation intensity measuring 65.3 ± 3.37 ectoparasitic insects per animal. Clinically, it manifests in unrest of animals and itching. The efficacy of the tested drug Megastop Ultra for Cats against siphonapterosis of cats was 95.4% on the 8th h after application, whereas such of the comparison drug Advocate for Cats was 97.9%. Starting from the first and third days of usage of the drugs, no fleas were found on the cats. According to the results of acarological examination, cats of the experimental and control groups suffered from *Otodectes cynotis* mites, the infestation intensity equaling 4 to 10 specimens per animal, the average infestation intensity being 7.4 ± 0.5 mites per animal. Otoacariasis was accompanied by itching, reddening of the auricle, and sites of *Otodectes* infestation as moderately thick scabs and crusts. On the 7th day after treating otoacariasis of cats, Megastop Ultra for Cats produced 82.6% efficacy and Advocate for Cats produced 84.5% efficacy. Starting from the 14th day after the treatment, we found no specimens of *O. cynotis* on the internal surface of the auricle and the external acoustic meatus. According to the results of conducted parasitological examinations of animals of the experimental and control groups, we diagnosed spontaneous infestations with endoparasites, nematode pathogens of the digestive tract – *Toxocara cati* and *Ancylostoma tubaeforme*. The intensity (II) of *T. cati* invasion accounted for 60 to 120 eggs in one gram of feces (EGF), the average invasion intensity being 90.4 ± 4.2 EGF, while such of *A. tubaeforme* were 20 to 56 and 39.1 ± 2.3 EGF, respectively. Clinically, nematodosis of the cats' digestive tract manifested in loss of appetite, frustration, paleness of the mucous membranes, and some animals vomitted and had mild diarrhea. After worm removal, we carried out coprological examinations for helminths so as to identify indexes of parasitic infestation and efficiency of the drugs. We determined that the efficacy of the tested drug Megastop Ultra for Cats against spontaneous toxocarosis of cats on the 7th day after worm removal was 95.1%, and such of Advocate for Cats was 98.0%. On the 14th day after worm removal, the efficacy of the both drugs was 100%. The helminthological examinations revealed that on days 7 and 14 after treating spontaneous ancylostomiasis of cats, both the tested drugs, utilized in the doses recommended by the manufacturers, exerted 100% effectiveness. Moreover, the field trials revealed that single spot-on applications of Megastop Ultra for Cats and Advocate for Cats in the doses recommended by the manufacturers had good response among the animals and had no negative impact on them, regardless of breed, age, sex and body weight.

Keywords: parasitology; spot-on; flea infestation; otodectic mange; toxocaroses; ancylostomoses; the effectiveness of the drug.

Introduction

Over the recent years, the number of pets has significantly increased, and therefore the morbidity of ecto- and endoparasitic infestation of cats has increased as well. Depending on the species of parasites and their number, the infestations can cause various clinical signs in cats, ranging from mild dysfunctions of the digestive tract, or symptomless lesions in the respiratory tract, to developmental retardation, anemia or anorexia in more complicated cases, especially in kittens exposed to higher pathogenicity of parasites. Pathogens of ecto- and endoparasitic diseases are carriers of viral, bacterial, mycotic, rickettsial, protozoan and helminth infections of animals and humans. Ecto- and endoparasitic infestations are common among cats in various landscape-geographic zones of Ukraine and Euro-

pean countries, posing a great ecological risk for the population. In general, 50.7% of cats were positive for one internal or external parasite. Ectoparasites were found in 29.6% of cats (CI₉₅ 27.3–32.0%). *Otodectes cynotis* was the species identified most commonly (17.4%), then fleas (15.5%). Endoparasites were found in 35.1% of the cats (CI₉₅ 32.7–35.7%), including the gastrointestinal helminths in 25.7% (CI₉₅ 23.5–28.0%), respiratory nematodes in 5.5% (CI₉₅ 4.2–7.0%) and protozoans in 13.5% (CI₉₅ 11.8–15.3%). *Toxocara cati* was an often-diagnosed endoparasite (19.7%, CI₉₅ 17.8–21.8%). Co-invasion with endoparasites and ectoparasites was found in 14.0% of cats, and 11.9% had both ectoparasites and gastrointestinal helminths (Beugnet et al., 2014).

Ecto- and endoparasites are especially dangerous for stray cats living in urban environments and shelters or other places with large concentra-

tions of animals. Multiparasitism is much more common than one might expect, and there is a tendency that some cats are more vulnerable to be infested with both endo- and ectoparasites because of the general risk factors (Beugnet et al., 2014). Therefore, timely diagnostics, prophylaxis of parasitic diseases, first of all in large cities, are crucial, taking into account such important factors as environmental infestation with invasive elements and spread of anthrozooses.

The commonest entomoses (insect borne disease) and acaroses of cats are caused by ectoparasitic fleas *Ctenocephalides felis* and *Pulex irritans* and the Sarcoptiformes mite *Otodectes cynotis*. Ectoparasite-infested animals suffer itching, scratching, loss of hair, dermatitis, development impairments, etc. (Beugnet et al., 2018).

Some feline parasites can potentially cause a zoonosis through a close contact, or through impact of an infested environment. This is relevant for some nematodes, such as *Toxocara cati* and *Ancylostoma tubaeformae*, which respectively are responsible for visceral/eye and skin migration of larvae in people, (Robertson & Thompson, 2002; Despommier, 2003; Fisher, 2003; Otranto & Little, 2017; Mendoza-Roldan & Otranto, 2023). Helminths in cats can cause digestive disorders, metabolism impairments, hemolytic anemia, intestinal clogging, development retardation, while secondary bacterial and viral flora of the canal exacerbate existing diseases (Ilić et al., 2017; Saari et al., 2019).

Therefore, providing pet owners with all necessary assortments of effective antiparasitic drugs in convenient ready-to-use forms is a way of ensuring health and wellbeing of cats. However, it has to be noted that most of the veterinary anti-parasite medicines are aimed only against ectoparasites or only against endoparasites. Combined veterinary drugs the active agents of which have various action mechanisms are not only more effective than treatment and prophylaxis of ecto- and endoparasites, but also reduce the development of drug resistance (Rinaldi et al., 2015; Wiebe, 2015; Saari et al., 2019; Yevstafieva et al., 2021; Karpenko et al., 2022; Martyshuk et al., 2022; Sameliuk et al., 2022). On the other hand, antiparasitic agents can accumulate in the environment, causing the death of non-target organisms (Kozak et al., 2020).

The locally spot-on applied medical form is one of the most popular against feline parasitoses in the veterinary practice. Spot-on is better tolerated by cats, and therefore animal owners can apply them more easily than peroral drugs. Spot-on is often used against parasites in individual or combined drugs, namely: fipronil (against insects and mites); imidacloprid (against insects); spinosad (insecticide); afoxolaner, fluralaner, sarolaner, lotilaner (against fleas and mites); (S)-Methoprene, pyriproxyfen (against eggs, larvae and pupas of fleas); praziquantel (against cestodes and trematodes); selamectin (insecticide, against mites and nematodes); moxidectin (against insects, mites and nematodes); eprinomectin and emodepside (against nematodes) (Otranto & Little, 2017; Beugnet et al., 2018; Saari et al., 2019). Combination of active agents of imidacloprid and moxidectin, included in Megastop Ultra for Cats, provides a broad spectrum of antiparasitic action in cats against fleas, Sarcoptiformes and Trombidiformes mites, nematodes of the digestive tract and respiratory pathways.

The objective of the study was clinical trials on target animals to identify the effectiveness of the tested drug Megastop Ultra for Cats and of the comparison drug Advocate for Cats, both based on imidacloprid / moxidectin combination for external spot-on application, used in the doses recommended by the manufacturers against feline ecto- and endoparasites.

Materials and methods

All the treatment described in this paper were conducted according to the European Directive (Directive 2010/63/ES), regarding the procedures for protecting animals used for scientific purposes.

In the studies, we used 56 cats of different breeds, age, sexes and body weight, spontaneously infested by the parasites: fleas (*Ctenocephalides* spp.), Sarcoptiformes mites (*Otodectes cynotis* – ear mite) and endoparasites – nematodes of the digestive tract: *Toxocara cati*, *Ancylostoma tubaeformae*. The studies were carried out in the veterinary clinics Pride, Merlion, Doktor Markevych, Vetservis, with the assistance of volunteers.

According to the general rules, based on clinical-parasitological studies, we formed experimental and control groups in relation to each pa-

thogen of ecto- and endoparasites (7 animals in each group), according to the analogue pairs method. Against the background of parasitic infestations, animals of the experimental groups were given the tested drug Megastop Ultra for Cats and the control received the comparison drug Advocate for Cats externally spot-on, directly onto the skin in places where the cat cannot lick, in the doses recommended by the manufacturers. The cats suffering otodectosis had their auricle and the ear canal cleaned from earwax, exudations and scabs. The drug was used once, 2–3 drops into each ear (the drops were introduced to both ears). For an even distribution of the drug, the auricles were folded in halves and slightly massaged at the base. The residual of the drug (estimated per the animal's body weight) was applied on the skin between the shoulderblades using a pipette. To prevent sprinkling of the drug, the animals' heads were fixated for a couple of minutes. With regards to our goals, the cats infected with ectoparasites were visually examined and the material was taken for laboratory surveys, finding wingless insects in accordance with GCP standards and the Guiding Principles of the EU (VICH GL9, 2000; EMEA/CVMP/EWP, 2008, 2017) regarding tests and evaluation of efficacy of antiparasitic compounds for treatment and prophylaxis of feline flea and mite infestations (Marchiondo et al., 2007, 2013).

The intensities of infestations with *Ctenocephalides felis* and *Pulex irritans* were determined by counting the number of ectoparasites on the coat of the animals, by grooming them for a certain amount of time (usually 7 minutes) with a fine-toothed comb in five anatomical regions: the dorsal median line (Linea mediana dorsalis), sit bone (tuber ischiadicum), the left side (pars lateralis sinister left) and the right side of the body (pars lateralis dexter right), and the inguinal region (regio inguinalis) (Dryden et al., 1994; Marchiondo et al., 2007). Using otoscopic examination, we found live Sarcoptiformes mites *Otodectes cynotis* on the internal surface of the auricle and the ear canal. The infestation intensity of skin-eating mites was determined by counting ectoparasites in the scrapings from infested ears of the animals, in a microscopic survey (the vital method). Ectoparasites were identified microscopically according to the practical guidelines (Yuskiv, 1998; Kramer & Mencke, 2001; Zajac & Conboy, 2012; Saari et al., 2019).

The efficacy of the drugs against siphonapterosis was identified on the 8th, 24th and 72nd h after the treatment by grooming them with fine-tooth combs (around 11–13 teeth/cm) and carefully examining the coat of animals of the experimental and control groups for presence of wingless ectoparasite insects. How effective the drugs were against otodectosis was determined using the vital method for presence of *Otodectes cynotis* mites on days 7, 14 and 21 after the treatment.

The efficacy of the drugs against ectoparasites was evaluated using the Abbot's formula:

$$\text{The percentage of efficacy (\%)} = [(C - E) : C] \times 100,$$

where: C – mean arithmetic of the number of vital insects/ectoparasitic mites in the control group; E – mean arithmetic of the number of vital insects/ectoparasitic mites in the treated group of animals (Marchiondo et al., 2007, 2013). Identification of efficacy of the veterinary drugs against endoparasites was performed in accordance with the Guiding Principles of the EU – VICH GL7, Efficacy of anthelmintics: general requirements, VICH GL20 Efficacy of anthelmintics: specific recommendations for felines and the scientific recommendations of the WAAVP regarding assessing of the efficacy of anthelmintics for canines and felines (Jacobs et al., 1994; Beugnet et al., 2022).

Feces samples for the studies were taken from the animals individually, in the amount of 10.0–15.0 g into clean plastic vessels with a closely-covering lid. The coprological examinations were carried out using the sedimentation and flotation techniques in order to determine worm infection of cats (Zajac & Conboy, 2012). The intensity of invasion of the animals with parasites was identified by counting eggs of helminths in feces samples using the McMaster's technique and M. A. Taylor's method (Taylor et al., 2016). To determine the eggs of nematodes of the digestive canal, we used a saturated solution of sodium chloride of the specific weight of 1.20 (500 g of NaCl per 1.0 L of water). The number of helminth eggs in 1 g of feces was determined using the formula:

$$\text{EGF} = y \times 15/x \times 1.2,$$

where: y – number of counted eggs; x – capacity of test tube; 1.2 – correction coefficient (Taylor et al., 2016).

The helminths and their embryos in the cats were identified microscopically using the guide of differential diagnostics (Zajac & Conboy, 2012; Taylor et al., 2016; Beugnet et al., 2018; Saari et al., 2019).

Prior and after removal of worms in the animals, after the 7 and 14 days, we carried out a clinical examination of the cats and coprological exams for helminthiasis. At the same time, we determined indexes of parasitic infection (extensiveness and intensiveness of the invasion) of the cats with the digestive-tract nematodes prior and after worm removals, and thus the effectiveness of the drugs (Jacobs et al., 1994; Bush et al., 1997). All the groups were monitored around the clock.

The efficacy of the drugs against endoparasites was estimated using the formula:

$$\text{The percentage of efficacy (\%)} = [(C - E) : C] \times 100,$$

where: C – mean number of helminth eggs in the control; E – mean number of helminths eggs in the treated animals (Jacobs et al., 1994).

The data were analyzed using the Statistica 6.0 software (StatSoft Inc., USA). The data are presented in the tables as $\bar{x} \pm SD$ (mean \pm standard deviation). Differences between the values in the control and experimental groups were determined using ANOVA, where the differences were considered significant at $P < 0.05$ (taking into account Bonferroni's correction).

Results

The clinical examination and entomological study of the cats in the Vetservis veterinary clinics revealed *Ctenocephalides felis* and *Pulex irritans* fleas. The symptoms of flea infestation in the animals were as follows: biting the skin, scratching, red spots, alopecia (partial loss of hair), and blisters on the skin.

As revealed by the examination of cats of the experimental and control groups for presence of populations of fleas on the five anatomical regions by grooming using a fine-toothed comb for the indicated amount of time, the total intensity of the *C. felis* and *P. irritans* infestations was 50 to 90 ectoparasites per animal, the average intensity being 65.3 ± 3.4 ectoparasites per animal. At the same time, in the experimental group, prior to the treatment with the drug, the average intensity of *C. felis* and *P. irritans* infestations was 62.3 ± 4.1 ectoparasites per animal. In the control group, prior to the treatment with the comparison drug, the average intensity of infestations with *C. felis* and *P. irritans* fleas was 68.3 ± 5.4 ectoparasites per animal, with the infestation intensity measuring 50 to 80 and 50 to 90 ectoparasites per animal, respectively (Table 1).

Table 1

Efficacy of the tested drug Megastop Ultra for Cats and comparison drug Advocate for Cats against flea infestation of cats ($\bar{x} \pm SD$, $n = 7$)

Infestation intensity, species of fleas on the bodies of animals	Experimental group, Megastop Ultra for Cats	Control, Advocate for Cats
Prior to the treatment	62.3 ± 4.1	68.3 ± 5.4
After the treatment		
8 h	2.9 ± 0.3	1.4 ± 0.2
24 h	0.0	0.0
72 h	0.0	0.0
Efficacy, %		
8 h	95.4	97.9
24 h	100	100
72 h	100	100

On the 8th h after treating the cats with the drugs according to the manufacturer's instructions, the experimental group was determined to have decrease in the intensity of infestations with *C. felis* and *P. irritans* fleas, measuring 2 to 4 ectoparasite insects per animal, the average intensity being 2.9 ± 0.3 ectoparasite insects per animal. At the same time, decrease in the intensity of *C. felis* and *P. irritans* infestations in the control group was 1 to 2 ectoparasite insects per animal, the average infestation intensity being 1.4 ± 0.2 ectoparasites per animal (Table 1).

The results indicate that on the 8th h after the treatment with Megastop Ultra for Cats, its efficacy against feline siphonapterosis was 95.4%, whereas such of Advocate for Cats accounted for 97.9%. Starting from the 1st and 3rd days after usage of the drugs, the entomological studies revealed no *C. felis* and *P. irritans* fleas on the coats of the experimental and control cats.

The presented clinical trials on the target animals indicate that on the 1st and 3rd days of the experiment, the tested drugs Megastop Ultra for Cats and the comparison drug Advocate for Cats exerted 100% effectiveness against siphonapterosis infestations.

In the Doktor Markevych veterinary clinic, the clinical examination of the cats and otoscopic studies of the internal surface of the auricle and the ear canal found vital Sarcoptiformes mites *Otodectes cynotis*. The main symptoms of otocariosis were as follows: exudations from the ears and presence of exudations in the ear canal of the animals, reddening of the auricle, itching of the ear.

Acarological examination of the cats revealed ear mite *O. cynotis*, the general infestation intensity ranging 4 to 10 mites per animal and the average infestation intensity being 7.4 ± 0.5 mites per animal. In the experimental group of animals, prior to the treatment with the tested drug, the average intensity of *O. cynotis* infestation on the internal surface of the auricle was 6.6 ± 0.6 mites per animal. In the control group, prior to the treatment with comparison drug, the average intensity of *O. cynotis* infestation equaled 8.3 ± 0.6 mites per animal, the general infestation intensity being 4 to 8 and 6 to 10 mites per animal, respectively (Table 2).

Table 2

Efficacy of the tested drug Megastop Ultra for cats and comparison drug Advocate for Cats against otodectosis of cats ($\bar{x} \pm SD$, $n = 7$)

Intensity of infestation with <i>Otodectes cynotis</i> mites in the ears of animals	Experimental group, Megastop Ultra for Cats	Control, Advocate for Cats
Prior to the treatment	6.6 ± 0.6	8.3 ± 0.6
After the treatment		
Day 7	1.1 ± 0.1	1.3 ± 0.2
Day 14	0.0	0.0
Day 21	0.0	0.0
Efficacy, %		
Day 7	82.6	84.5
Day 14	100	100
Day 21	100	100

On the 7th day after treatment of the cats with the drugs, the internal surface of the auricle (2 drops of the drug were introduced into both ears) and the coating, according to the manufacturer's recommendations, we determined decrease in the number of *O. cynotis* mites on the internal surface of the auricle and the ear canal of the experimental and control animals. In the experimental group, the average intensity of *O. cynotis* infestation was 1.1 ± 0.1 mites per animals, compared with 1.3 ± 0.2 mites per animal in the control. Those results indicate that on the 7th day of the experiment, Megastop Ultra for Cats produced 82.6% efficacy against otodectosis of the cats, whereas Advocate for Cats exerted 84.5% efficacy (Table 2).

As a result of the conducted clinical examinations and acarological studies of the experimental and control groups on the 14th day after the treatment of the auricles of the cats with the drugs, we found no *O. cynotis* mites. The studies revealed that on the 14th day of the experiment, the tested drug Megastop Ultra for Cats and the comparison drug Advocate for Cats were 100% efficient against feline otodectosis.

Therefore, the tested drug Megastop Ultra for Cats had a notable insecticidal activity against ectoparasite fleas *C. felis*, *P. irritans* and acaricidal activity against Sarcoptiformes mites *O. cynotis*, and caused no local effects (skin irritations, dermatitis, seborrheic dermatitis) or systemic side effects, and was well tolerated by cats that were receiving the treatment.

The clinical examination and parasitological study of the cats of various breeds, ages, sexes and body weight, that were submitted to the Pride, Merlion, Doktor Markevych, Vetservis veterinary clinics revealed infections by the digestive-tract nematodes: *Toxocara cati* and *Ancylostoma tubaeforme*. The general intensity of *T. cati* invasion was 60 to 120 EGF, against the average invasion intensity of 90.4 ± 4.2 EGF. The cats were observed to have the following clinical symptoms: frustration, paleness of the mucous membranes, and some animals vomited and had light diarrhea.

Prior to worm removal using the tested drug, the experimental-group animals had the general intensity of *T. cati* invasion accounting for 60 to 100 EGF, the average invasion intensity being 84.6 ± 4.9 EGF, and general intensity of the invasion in animals of the control group was 70 to 120 EGF, the average intensity being 96.3 ± 6.4 EGF (Table 3).

After deworming of cats from researched and control groups using the drugs according to the manufacturer's recommendations, we deter-

mined decrease in the intensity of *T. cati* invasion. Therefore, on the 7th day after worm removal, the general intensity of *T. cati* invasion in the experimental group was 3 to 5 EGF, the average invasion intensity being 4.1 ± 0.3 EGF, and the general intensity of *T. cati* invasion in the control group was 1 to 2 EGF, the average invasion intensity being 1.9 ± 0.1 EGF. On the 14th day of the experiment, after worm removal, coprological examination found no eggs of *T. cati* in the animals of the experimental and control groups (Table 3).

Table 3

Efficacy of the tested drug Megastop Ultra for Cats and the comparison drug Advocate for Cats against *Toxocara* infection of cats ($x \pm SD$, $n = 7$)

Invasion intensity, eggs per 1 g of feces	Experimental group, Megastop Ultra for Cats	Control, Advocate for Cats
Prior to treatment	84.6 ± 4.9	96.3 ± 6.4
After treatment		
Day 7	4.1 ± 0.3	1.9 ± 0.1
Day 14	0.0	0.0
Efficacy, %		
Day 7	95.1	98.0
Day 14	100	100

Our studies suggest that on the 7th day after treatment of *Toxocara* invasion of the cats, the efficacy of the tested drug Megastop Ultra for Cats was 95.1%, while the efficacy of the comparison drug Advocate for Cats accounted for 98.0%. On the 14th day after worm removal, the efficacy of the tested and comparison drugs was 100% against toxocarosis of cats.

Clinical examination and parasitological study of the cats found infection of the cats with *Ancylostoma tubaeforme* with the general invasion intensity equaling 20 to 56 EGF, the average invasion intensity being 39.1 ± 2.3 EGF. In the experimental group, prior to worm removal, the general intensity of *A. tubaeforme* invasion of the cats was 20 to 46 EGF, the average invasion intensity being 37.7 ± 3.3 EGF. In the control group, before the worm removal, the intensity of *A. tubaeforme* invasion was 28 to 56 EGF, the average invasion intensity being 40.6 ± 3.2 EGF (Table 4).

On the 7th day after deworming using the tested drug Megastop Ultra for Cats in the experimental cats and the comparison drug Advocate for Cats in the control-group cats in the doses recommended by the manufacturers, the coprological studies revealed no eggs of *A. tubaeforme* (Table 4).

Therefore, both the tested drug Megastop Ultra for Cats and comparison drug Advocate for Cats proved to be 100% effective against ancylostomiasis of cats on the 7th day (Table 4).

Table 4

Efficacy of the tested drug Megastop Ultra for Cats and the comparison drug Advocate for Cats against ancylostomiasis of cats ($x \pm SD$, $n = 7$)

Invasion intensity, eggs per 1 g of feces	Experimental group, Megastop Ultra for Cats	Control, Advocate for Cats
Prior to treatment	37.7 ± 3.3	40.6 ± 3.2
After treatment		
Day 7	0.0	0.0
Day 14	0.0	0.0
Efficacy, %		
Day 7	100	100
Day 14	100	100

According to the data of the general clinical studies, the tested drug Megastop Ultra for Cats and the comparison drug Advocate for Cats caused no side effects after usage and caused no toxic effect on any cat after single spot-on application in the doses recommended by the manufacturers during the experiment with nematode invasion of cats.

In general, the results indicate high therapeutic efficacy of the antiparasitic drugs Megastop Ultra for Cats and Advocate for Cats on the 7th and 14th days after their usage in field tests against the nematodes of the digestive tract (*T. cati* and *A. tubaeforme*).

Discussion

The new drug on the pharmaceutical market of Ukraine – Megastop Ultra for Cats with active compounds imidacloprid/moxidectin, used

locally spot-on with a month-long interval – was safe and highly efficient against natural flea infestations of cats. The Megastop Ultra for Cats drug against fleas was no less effective than the Advocate for Cats drug, by Bayer, which also has imidacloprid/moxidectin active compounds. Furthermore, the efficacy of the drug based on imidacloprid/moxidectin for spot-on application against fleas was also confirmed in the tests on cats and ferrets (Wenzel et al., 2008; Rust, 2017).

Antiparasitic drug Megastop Ultra for Cats with active compounds imidacloprid/moxidectin, used locally spot-on with month-long intervals, was safe and highly effective against *O. cynotis* mites in cats. Combination of imidacloprid/moxidectin for a spot-on application to the auricles and body of the cats was very efficient against skin-eating ear mites *O. cynotis*, producing 82.6% general effectiveness against them on the 7th day after usage and 100% efficacy on the 14th and 21st days after usage. The therapeutic efficacy of the comparison drug Advocate for Cats against *O. cynotis* mites was 84.5–100%. In general, the tested drug Megastop Ultra for Cats was no less effective than the comparison drug Advocate for Cats against otodectosis of cats. The imidacloprid/moxidectin combination was highly effective in removing *O. cynotis* mites and visual mitigation of clinical symptoms in the animals (Farkas et al., 2007; Le Sueur et al., 2011).

A timely etiological diagnostics of digestive-tract nematodes would allow for an immediate and efficient treatment of cats. The current results indicate that spot-on application of active compounds imidacloprid/moxidectin, included in the Megastop Ultra for Cats drug, is effective and safe for treatment of *Toxocara cati* and *Ancylostoma tubaeforme* infestations. In order for anthelmintic drugs to be considered effective against digestive-tract nematodes, their efficacy should be at least 90%.

Our clinical trials revealed potential efficacy of the drug Megastop Ultra for Cats for local spot-on application, intended for transdermal absorption of imidacloprid/moxidectin into the systemic blood flow. Therefore, imidacloprid/moxidectin combination in the tested drug Megastop Ultra for Cats against nematodes of the digestive tract of domestic cats had 95.1–100% efficacy. At the same time, we observed decrease in *Toxocara* and *Ancylostoma* eggs in feces of the spontaneously infected cats after worm removals by both the tested drug and the comparison drug. The clinical trials on cats (Hellmann et al., 2003) demonstrated efficacy of the same ingredients (imidacloprid and moxidectin) in Advocate for Cats by Bayer, where the efficacy was 99.9% against *T. cati* and 99.6% against *Ancylostoma* spp. As of now, there is a report that imidacloprid 10% (weight/volume) / moxidectin 1.0% (weight/volume) for cats was effective not only against young or mature nematodes, but against their larvae as well (*T. cati* L₄, *A. tubaeforme* L₃, L₄) (Samson-Himmelstjerna et al., 2003).

According to the clinical monitoring, the tested drug Megastop Ultra for Cats caused no side effects and was not toxic to the cats after a single spot-on application in the doses recommended by the manufacturer when treating entomoses (siphonapterosis), acaroses (otodectosis) and digestive-tract nematodes, toxocarosis and ancylostomiasis. It has to be noted that most cats with clinical symptoms of infestations recovered after the first dose of Megastop Ultra for Cats.

Cats are constantly re-infested with fleas, mites, helminth embryos from the environment. Antiparasitic drugs should produce continuous efficacy until the end of treatment so as to protect the animals against infestation relapse. This is necessary not only to decrease the negative clinical impacts those ecto- and endoparasites have on infested cats, but is also important in order to reduce the spread of infestation pathogens in the environment and inhibit the development of pathogens. The Megastop Ultra for Cats drug, which uses the new formula for spot-on application to cats, containing imidacloprid/moxidectin combination, displayed high and stable effectiveness against fleas, mites, and helminths.

Conclusions

The parasitological studies revealed that the tested drug Megastop Ultra for Cats is a highly effective insecticide-acaricide drug against ectoparasite fleas *C. canis*, *P. irritans* and Sarcoptiformes mite *O. cynotis* in cats.

Applied externally, individually in the recommended doses for treatment and prophylaxis of feline endoparasites such as digestive tract-

nematodes *T. cati* and *A. tubaeforme*, Megastop Ultra for Cats can be classified to highly effective anthelmintics (efficacy >98%) according to the WAAVP World Association for the Advancement of Veterinary Parasitology.

Throughout the studies, when identifying therapeutic efficacy of the Megastop Ultra for Cats drug against ecto- and endoparasitic infestations, we saw no negative effect or toxic impact on the cats, having good response among the animals.

The authors declare that there is no conflict of interest.

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