

Efficacy of 65% Permethrin Applied as a Topical Spot-on Against Walking Dandruff Caused by the Mite, *Cheyletiella yasguri*, in Dogs

Richard G. Endris^a
Virginia E. Reuter^b
Jerry D. Nelson^c
Jo Ann Nelson^c

^aSchering-Plough Animal Health Corp
1095 Morris Avenue
Union, NJ 07083-1982

^bElanco Animal Health
PO Box 708
Greenfield, IN 46140

^cTrailane Clinic
Soldier, KS 66540

■ ABSTRACT

The efficacy of a 65% permethrin topically applied spot-on formulation (Defend® EXspot® Topical Remedy for Dogs, Schering-Plough Animal Health, Union, NJ) was determined against the dog mite, *Cheyletiella yasguri* (Smiley, 1965). Female dogs and their litters comprised the experimental unit, and all dogs in an experimental unit were treated on the same day 4 to 6 weeks after whelping. Mites and mite eggs were counted weekly on an untreated control group of six litters (15 pups) and on a group of six litters (14 pups) treated with 65% permethrin. Pups in the untreated control group maintained high numbers of *Cheyletiella yasguri* throughout the 14- to 21-day observation period. No mites or mite eggs were detected on dogs within 7 to 21 days after application of 65% permethrin. No adverse reactions were noted during the study. Clinical signs of infestation

with *C. yasguri*—which included skin irritation, thickening of the stratum corneum, scratching with resultant scabs, pruritus, and flaky, scaly skin—were eliminated when mites were killed by the 65% permethrin formulation.

■ INTRODUCTION

Smiley¹ raised the subfamily of mites, Cheyletiellinae volgin, to the familial rank of Cheyletiellidae, which comprises eight genera. The genus *Cheyletiella* (Canestrini, 1885) contains five species of parasitic fur and itch mites (i.e., *C. yasguri* [Smiley, 1965] on dogs², *C. blakei* [Smiley, 1970] on cats, *C. furmani* [Smiley, 1970] on rabbits, *C. parasitivorax* [Megnin, 1878] on rabbits, and *C. strandtmanni* [Smiley, 1970] on hares). *C. yasguri* is distinguished by the heart-shaped or fork-shaped dorsal sensory organ, solenidion, on genu I.^{1,3,4}

The life history of *C. yasguri* has been eluci-

dated in detail by Foxx and Ewing.⁵ The life stages consist of the eggs, larvae, nymph 1, nymph 2, and adults. The mites are obligate parasites of dogs, and their entire life cycle can be completed on a single host. Eggs are attached individually to dog hair 2 to 3 mm above the base in a cocoon-like structure of fine threads. Larvae, nymphs, and adults feed on clear fluids ingested with piercing and sucking mouthparts.⁶ The entire life cycle occurs on the host in about 3 to 4 weeks. Larvae survive up to 1 day off the host; nymphs and adults have been shown to survive up to 2 days off the host. Females have been shown to survive up to 10 days off the host when refrigerated. *C. yasguri* has been found attached to the fly, *Hippobosca longipennis*,^{7,8} suggesting that mites can move between hosts not only by direct contact but also by phoresy.

Signs in dogs, particularly pups, include extensive dermatitis characterized by heavy dandruff over the back, slight alopecia, and pruritus, which may be variable, ranging from intense and complete to absent. Pups initially may show mild or severe seborrheic type (dry or greasy) lesions in the lumbosacral area that may spread along the back and head and eventually become generalized. A papular eruption also may be seen. Asymptomatic carrier states have been reported, especially in older dogs.⁹

The distribution of *C. yasguri* was reviewed^{4,10} soon after description of the species and its differentiation from *C. parasitivorax*. More recently, dogs infested with *C. yasguri* have been reported from Belgium,^{11,12} the Netherlands,^{4,13} Germany,¹⁴ Switzerland,¹⁵ the United Kingdom,¹⁶⁻¹⁹ Ireland,²⁰ Denmark,²¹⁻²⁴ Italy,²⁵ France,²⁶ Nigeria,^{27,28} the United States,^{3,5,8,29-33} Canada,³⁴⁻³⁷ Chile,³⁸ Korea,³⁹ Japan,⁴⁰ and New Zealand.⁴¹ Although *C. yasguri* was not isolated from dogs in Iran, it was collected from a hippoboscid fly,⁴² suggesting that the species likely occurs on dogs in Iran.

The prevalence of canine infestations has roughly coincided with reports of zoonotic infestations from Denmark,^{21,22,24} Sweden,⁴³ Germany,¹⁴ Switzerland,¹⁵ the UK,^{18,44} Ireland,⁴⁵ Scotland,⁴⁶ Belgium,^{11,12} France,²⁶ the Netherlands,^{4,13,47} the US,^{30,31,33} and Japan.^{40,48} In the majority of cases in which *C. yasguri* has infested humans, dog owners were the hosts. After infestations were eliminated on household dogs, human infestations generally resolved with treatment.

No reports of in vitro rearing methods for any members of the Cheyletiellidae have been found. As a result, evaluations of insecticides for their control must be conducted with naturally occurring or induced infestations on dogs. This study reports the results of treatment of naturally occurring *C. yasguri* infestations in dogs with a 65% permethrin spot-on formulation.

■ MATERIALS AND METHODS

Experimental Design

This study was conducted in a commercial rearing establishment from which pups were sold at approximately 8 weeks of age. Each experimental unit treated with a test formulation consisted of a bitch with a litter aged 4 to 6 weeks. As infested litters were detected in the facility, they were alternately assigned to a treatment group. Treatment groups were (1) untreated control and (2) treated with a 65% permethrin spot-on. Infestation evaluation of litters assigned to the untreated control group began when pups were aged 2 to 6 weeks. Infestation evaluation of litters assigned to the permethrin-treated group began when pups were aged 4 to 6 weeks. A total of twelve experimental units were randomly assigned to one of two treatment groups of six experimental units/group when pups reached 2 to 6 weeks of age. The age of puppies at treatment was in accordance with the Defend® EXspor® Topical Remedy for Dogs label for which stud-

TABLE 1. Schedule for Evaluation of Mite Infestations on Dogs

<i>Age of Pups at Treatment (Weeks)</i>	<i>Duration of Efficacy Evaluation (Weeks)</i>	<i>Age of Pups when Experimental Unit Was Removed from the Study (Weeks)</i>	<i>Study Days when Mites Were Counted</i>
4	4*	8	0, 7, 14, 21, 28
5	3*	8	0, 7, 14, 21
6	2	8	0, 7, 14

*Evaluations ceased if no mites or eggs were observed before completion of the observation period.

TABLE 2. Breed, Age of Pups at Treatment, and Litter Size of Dogs Infested with Dog Mites, *Cheyletiella yasguri*, that Were Treated with a 65% Permethrin Formulation or Were Untreated

<i>Dam (Name)</i>	<i>Breed</i>	<i>Treatment Group</i>	<i>Number of Pups per Litter</i>	<i>Pup Age at Treatment (Weeks)</i>
Snoop	Pomeranian	Untreated control	3	4
Sophie	Pomeranian	Untreated control	4	4
Chelsie	Cocker Spaniel	Untreated control	1	6
Sophie	Pomeranian	Untreated control	2	7
Daphnie	Maltese	Untreated control	3	8
Swoozie	Pomeranian	Untreated control	3	6
Trixie	Springer Spaniel	65% permethrin	5	4
Della	Maltese	65% permethrin	3	4
Felice	Maltese	65% permethrin	2	6
Bitsy	Yorkshire Terrier	65% permethrin	3	6
Della	Maltese	65% permethrin	1	6
Cutie	Pomeranian	65% permethrin	2	6

ies have demonstrated the product can be applied safely to 4-week-old pups. Mite infestations were evaluated on up to three pups in an experimental unit. Mite infestations were evaluated on all untreated litters on days 0, 7, and 14 after assignment, and additionally one of the untreated litters was evaluated on day 21 after assignment. Mite infestations were evaluated on all six treated litters on days 0, 7, and 14 after assignment and additionally on two of the treated litters on days 21 and 28 after assignment (Table 1).

Dogs

Five breeds were represented in the study (i.e., Maltese, Pomeranian, Springer Spaniel, Cocker Spaniel, and Yorkshire Terrier). Dogs ranged from 4 weeks to 10 years of age and from 0.4 to 19.1 kg (Table 2). Ten bitches produced 12 litters (a total of 32 pups) that were included in the study over 24 months.

Mite Identification

The mite species determination of *Cheyletiella yasguri* was confirmed by Dr. J. Keithley

(Field Museum of Natural History, Chicago, IL) as described by Bronswijk and de Kreek.⁴

Mite Infestation Evaluation

Mite counting was conducted on a table covered with disposable paper that was changed after mites were counted in each experimental unit. Individuals handling dogs wore disposable gloves and aprons that were changed after handling all dogs in each experimental unit. Combs used in counting mites were rinsed in alcohol and dried between use on each dog. Each experimental unit was brought to the counting table in random order. Mites were counted on up to three pups in each experimental unit weekly for either 2, 3, or 4 weeks after treatment, depending on the pups' age at the time of treatment.

Mite Population Estimation

Using a medium-toothed comb (4.3 teeth/cm), the dogs' hair was gently combed from shoulder blades to the tailhead until the comb moved smoothly through the fur. Dark-colored paper was placed along the puppies' backs (larger dogs in lateral recumbency) or placed under the hind legs (standing) in order to collect mites. A gloved hand was used to slowly stroke along the backline from tailhead to neck for a total of 1 minute. After 1 minute of stroking, the mites and eggs that fell from the hair were collected from the dark-colored paper and transferred to a petri dish for counting. It should be noted that the method used to determine the number of mites per dog only provided an index of infestation and not an absolute determination of the number of mites and mite eggs per dog.

Formulations

The test formulation consisted of 65% permethrin in a novel proprietary formulation that was registered in the US in 1990.

Treatments

As criteria for inclusion in the study, dogs harbored natural infestations of *C. yasguri* of all life stages including eggs. When pups in a litter reached 4 to 6 weeks of age, one treatment application was made to the bitch and all pups in the litter on day 0 (treatment group 2). The formulation was applied as follows in accordance with the label for this 65% permethrin product: for dogs that weighed <15 kg (33 lb), the hair was parted and 1 mL test substance was applied to the skin at the dorsum of the shoulder insertion; for dogs that weighed ≥ 15 kg, 1 mL test substance was applied to the skin at the dorsum of shoulder insertion and 1 mL was applied to the skin at the dorsum of the tailhead. Dogs in group 1 (untreated control) were treated when pups reached 4 to 8 weeks of age to prevent excessive discomfort resulting from heavy mite infestations.

Observations

Dogs were observed hourly for 4 hours immediately after treatment application and daily thereafter for any signs of reaction to the treatments.

RESULTS

The number of mite eggs and live mites recovered from dogs in each treatment group are shown in Table 3. Mite numbers were determined on 15 pups that received no treatment and on 14 pups that were treated with 65% permethrin. Pups in the untreated control group maintained high numbers of *C. yasguri* throughout the 14- to 21-day observation period. The decline in the mean number of mites per untreated dog in the litter evaluated on day 21 was attributed to removal of mites during repeated sampling.

Mites were eliminated from 50% (3/6) of litters within 7 days after treatment and from 83% of litters (5/6) within 14 days after treat-

TABLE 3. Number of Mite Eggs and Mites (All Stages of *Cheyletiella yasguri*) Observed on Dogs that Were Either Untreated or Treated with a 65% Permethrin Product

Treatment Group	Parameter	Number of Days after Treatment				
		Day 0	Day 7	Day 14	Day 21	Day 28
Untreated	Mites*	31.3 ± 13.9	33.0 ± 16.8	34.2 ± 10.4	9.3 ± 0.6	
	Eggs*	68.1 ± 22.7	50.6 ± 19.3	39.0 ± 24.0	6.7 ± 3.1	
	No. of litters infested/	6/6	6/6	6/6	1/1	
	No. of litters evaluated					
65% permethrin	Mites*	42.0 ± 26.4	0.6 ± 1.0	0.0	0.0	0.0
	Eggs*	27.3 ± 30.0	6.4 ± 7.7	0.5 ± 1.4	0.0	0.0
	No. of litters infested/	6/6	3/6	1/6	0/2	0/2
	No. of litters evaluated					

*Indicates the arithmetic mean ± standard deviation number of mites or mite eggs/dog.

ment. No mites or mite eggs were detected on dogs 21 days after the application of 65% permethrin. The mean number of live mites and the mean number of mite eggs recovered from dogs declined from 42.0 to 0.6 and from 27.3 to 6.4, respectively, within 7 days after treatment. No adverse reactions of any description were noted for the bitches or pups aged 4 to 8 weeks during the course of the study.

Clinical signs of infestation with *C. yasguri* included skin irritation, thickening of the stratum corneum, scratching with resultant scabs, pruritus, and flaky, scaly skin. Clinical signs of infestation were eliminated when mites were killed with the 65% permethrin spot-on.

DISCUSSION

Numerous authors have cited treatment regimens considered effective for control of cheyletiellid mites. These treatments have included organochlorines, organophosphates, carbamates, sulfur, benzyl benzoate, and plant-derived insecticides.¹⁰ Bronswijk and de Kreek⁴ reported that insecticides are needed for complete elimination of the mites and stated that complete coverage of the animal by shampoo-

ing, dusting, or bathing with an insecticide formulation would be required to eliminate the mites. Furthermore, these authors recommended repeat treatment every fourth day for 2 weeks or once/week for 6 weeks.

Specific compounds and treatment regimens that have been reported to be effective for control of *C. yasguri* infestations on dogs include the organophosphate dermaton²⁹; colloidal sulfur applied as a dust¹⁴; lime sulfur applied weekly for 3 weeks³⁶; 5% trichlorfon (Neguvon[®]) applied as a bath twice with a 10-day interval³⁷; 0.2% trichlorfon applied three times as a bath at 5-day intervals; gamma benzene hexachloride (Lindane[®]) applied in a 1% bath,¹¹ or applied daily as a shampoo for 7 days,³¹ or applied in a lotion^{13,31}; amitraz³¹ (dogs were clipped, washed, and thoroughly saturated with amitraz solution once weekly for 3 weeks in combination with an intramuscular [300 µg/kg] injection of ivermectin³⁹; and intramuscular injection of ivermectin.³⁷ Many of the compounds previously recommended for control of cheyletiellid mite infestations, particularly organochlorines such as benzene hexachloride, are no longer approved for use on dogs or humans.

■ CONCLUSION

Data presented in this article show for the first time that complete control of *C. yasguri* on dogs can be achieved with (1) a spot-on formulation, (2) a single application of a spot-on formulation, and (3) a synthetic pyrethroid, permethrin. The 65% permethrin spot-on formulation, Defend® EXspot® Topical Remedy for Dogs, can provide effective treatment and control of *C. yasguri* infestations on dogs older than 4 weeks after a single application.

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