Comparative Evaluation of the Speed of Flea Kill of Imidacloprid and Selamectin on Dogs*

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ABSTRACT

Imidacloprid (Advantage®, Bayer Corporation, Shawnee Mission, KS) and selamectin (Revolution™ [United States], Pfizer Animal Health, Exton, PA 19341; Stronghold® [European Union], Pfizer Animal Health Ltd, Sandwich, Kent CT 13 9NJ, UK) were tested to assess the speed of flea kill achieved against existing flea infestations and subsequent reinfestations. Thirty-six dogs were infested with 100 unfed adult fleas on day –1. On day 0, 12 dogs (group 1) were treated with imidacloprid at the minimum label dose of 10 mg/kg body weight. Twelve dogs (group 2) were treated with selamectin at the minimum label dose of 6 mg/kg body weight. Twelve dogs (group 3) remained as untreated controls. Four subgroups (A through D) of three dogs each were designated within each group. All dogs were subsequently reinfested with fleas on days 6, 13, 20, 27, 34, and 41. Live flea counts were performed for subgroups A through D at 6, 12, 24, and 36 hours after treatment/reinfestation. Imidacloprid provided significantly and consistently greater flea kill than selamectin at 6, 12, and 24 hours after treatment and at 6 and 12 hours after each reinfestation. Although both products are commercially labeled for monthly topical use, imidacloprid provided significantly greater 36-hour flea kill at 34 and 41 days after treatment.

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INTRODUCTION

Studies indicate selamectin is selectively distributed in the sebaceous glands and in the basal layer of epithelium after topical applica-

tion.[1] Adult fleas ingest the compound while feeding on the pet. Imidacloprid (Advantage®, Bayer Corporation, Shawnee Mission, KS) has proven to be highly effective against the cat flea (*Ctenocephalides felis*) in laboratory and clinical studies.[2–4] Selamectin (Revolution™ [United States], Pfizer Animal Health, Exton, PA 19341; Stronghold® [European Union], Pfizer Animal Health Ltd, Sandwich, Kent CT 13 9NJ, UK) is a new compound with limited clinical experience. Both products are active against the adult flea stage with 1-month residual efficacy after topical application. Revolution™ also has label claims against eggs and other endoparasites and ectoparasites. The purpose of this investigation was to determine the comparative speed of flea kill of each of these products when applied to dogs with existing flea infestations and against subsequent reinfestations.

MATERIALS AND METHODS

Thirty-six adult mixed-breed dogs of both sexes with medium to long haircoats and weighing between 11.9 and 36.1 kg were studied. Dogs were housed indoors in chain-link runs with concrete floors. Groups were separated by solid partitions or housed in separate areas.

Dogs were first bathed with a noninsecticidal shampoo and combed to remove any existing fleas. On day –3 each dog was infested with 100 unfed adult fleas. All flea infestations used fleas from a strain maintained on laboratory dogs (Ag Research Consultants, Greenbrier, AR) for more than 10 years. On day –2 dogs were weighed and fleas were removed and counted. Dogs were ranked by their ability to maintain flea infestations and then randomized into groups 1, 2, and 3 (12 dogs/group). Each group was further divided into four subgroups: A, B, C, and D. On day –1 each dog was infested with 100 unfed fleas. On day 0 dogs in group 1 received 10 mg/kg body weight of imidacloprid applied along the dorsal midline. Dogs in group 2 received 6 mg/kg body weight selamectin applied along the dorsum as well. Group 3 remained untreated. The dogs were individually treated at the minimum labeled dose for the two products to minimize variations in animal size relative to the labeled dose schedule. The individual products were transferred from commercial tubes to a bulk container. The appropriate dose for each dog was withdrawn and applied with a calibrated syringe according to label instructions for each product.

Total body live flea counts were conducted using a fine-tooth flea comb at 6, 12, 24, and 36 hours after treatment for subgroups A, B, C, and D, respectively. To control bias, technical staff conducting the flea counts were unaware of the treatment status of individual dogs.

Dogs from all groups were reinfested with 100 unfed adult fleas on days 6, 13, 20, 27, 34, and 41. Flea counts were then conducted in each subgroup as previously described at 6, 12, 24, and 36 hours after reinfestation. A summary of the study's activity schedule is found in Table 1.

Flea control efficacy was calculated at each time interval according to the following formula:

$$\% \text{ Efficacy} = 100 \times \frac{\text{(Geometric mean fleas [control] – Geometric mean fleas [treated])}}{\text{Geometric mean fleas (control)}}$$

Statistical significance was determined via a one-way ANOVA and all analyses and calculations were conducted using SAS® version 6.12.

RESULTS

Percentage of flea control achieved at each

TABLE 1. Summary of Study Activity

Day	*Activity*
–3	Infest 100 fleas/dog
–2	Comb dogs, remove fleas, weigh/randomize groups
–1	Reinfest 100 fleas/dog
0	Treat groups 1 and 2
6 h after treatment	Comb and remove fleas from subgroups 1A, 2A, 3A
12 h after treatment	Comb and remove fleas from subgroups 1B, 2B, 3B
24 h after treatment	Comb and remove fleas from subgroups 1C, 2C, 3C
36 h after treatment	Comb and remove fleas from subgroups 1D, 2D, 3D
Days 6, 13, 20, 27, 34, 41	Reinfest each dog with 100 fleas
Days x+6 h, x+12 h, x+24 h, Day x+36 h	Comb and remove fleas from each subgroup as described in the article

TABLE 2. Percentage of Flea Control 6 Hours After Treatment/Reinfestation

Day		*Imidacloprid Group*	*Selamectin Group*	*Control Group*
0	x Fleas	9.2	79.6	68.9
	Percentage of control	86.6*†	–15.4	—
6	x Fleas	1.4	38.1	94.3
	Percentage of control	98.5*†	59.6	—
13	x Fleas	1.0	40.5	87.8
	Percentage of control	98.9*†	53.9*	—
20	x Fleas	7.3	48.0	88.4
	Percentage of control	91.7*†	45.6	—
27	x Fleas	3.7	48.2	77.8
	Percentage of control	95.3*†	38.0	—
34	x Fleas	43.8	61.2	73.0
	Percentage of control	40.0	16.1	—
41	x Fleas	31.8	61.5	84.9
	Percentage of control	62.5	27.6	—

*Significantly different from control group ($P < .05$).
†Significantly different from selamectin group ($P < .05$).

time interval is displayed in Tables 2 through 5. For the 6-hour posttreatment/reinfestation flea counts, imidacloprid provided significantly superior flea control relative to selamectin on study days 0 through 27. Selamectin provided significant 6-hour flea control (relative to controls) only on day 13. At 12 hours after treatment/reinfestation, imidacloprid provided significant flea control (compared with controls) throughout the study from days 0 through 41. Imidacloprid was significantly superior to selamectin on all 12-hour samples with the exception of day 20. Selamectin provided 12-hour flea control that was significantly more effective than that of the untreated group on days 6, 13, and 20. At 24 hours after

TABLE 3. Percentage of Flea Control 12 Hours After Treatment/Reinfestation

Day		*Imidacloprid Group*	*Selamectin Group*	*Control Group*
0	x Fleas	2.7	72.9	82.0
	Percentage of control	96.7*†	11.0	—
6	x Fleas	1.7	12.3	84.4
	Percentage of control	98.0*†	85.4*	—
13	x Fleas	1.6	14.7	98.6
	Percentage of control	98.4*†	85.1*	—
20	x Fleas	2.1	6.3	80.4
	Percentage of control	97.4*	92.1*	—
27	x Fleas	2.4	24.9	83.2
	Percentage of control	97.1*†	70.1	—
34	x Fleas	3.5	28.6	71.6
	Percentage of control	95.1*†	60.0	—
41	x Fleas	4.4	34.7	89.7
	Percentage of control	95.1*†	61.3	—

*Significantly different from control group ($P < .05$).
†Significantly different from selamectin group ($P < .05$).

TABLE 4. Percentage of Flea Control 24 Hours After Treatment/Reinfestation

Day		*Imidacloprid Group*	*Selamectin Group*	*Control Group*
0	x Fleas	1.8	66.2	76.8
	Percentage of control	97.6*†	13.8	—
6	x Fleas	1.0	2.6	98.4
	Percentage of control	99.0*	97.3*	—
13	x Fleas	1.0	2.1	101.0
	Percentage of control	99.0 *	97.9*	—
20	x Fleas	1.0	1.9	85.2
	Percentage of control	98.8*	97.8*	—
27	x Fleas	1.3	4.2	89.2
	Percentage of control	98.6*	95.3*	—
34	x Fleas	3.4	14.4	86.1
	Percentage of control	96.0*	83.3*	—
41	x Fleas	5.5	20.7	89.6
	Percentage of control	93.8*	76.9*	—

*Significantly different from control group ($P < .05$).
†Significantly different from selamectin group ($P < .05$).

treatment, imidacloprid provided significantly better control than selamectin (97.6% versus 13.8%). However, by test day 6 and continuing through day 41, imidacloprid and selamectin provided statistically equivalent 24-hour flea control. Finally, at 36 hours after treatment/reinfestation, both groups had significantly fewer fleas than controls on days 0

TABLE 5. Percentage of Flea Control 36 Hours After Treatment/Reinfestation

Day		*Imidacloprid Group*	*Selamectin Group*	*Control Group*
0	x Fleas	1.0	1.0	89.7
	Percentage of control	98.9*	98.9*	—
6	x Fleas	1.0	1.0	92.2
	Percentage of control	98.9*	98.9*	—
13	x Fleas	1.0	1.0	65.5
	Percentage of control	98.5*	98.5*	—
20	x Fleas	1.0	1.4	60.1
	Percentage of control	98.3*	97.6*	—
27	x Fleas	1.0	4.8	79.8
	Percentage of control	98.7*	94.0*	—
34	x Fleas	1.6	10.6	82.5
	Percentage of control	98.1*†	87.2*	—
41	x Fleas	2.6	46.4	51.7
	Percentage of control	94.9*†	10.3	—

*Significantly different from control group ($P < .05$).
†Significantly different from selamectin group ($P < .05$).

through 34 and there were no statistical differences between groups through day 27. However, for days 34 and 41, imidacloprid provided significantly better 36-hour flea control than selamectin.

DISCUSSION

Both products provided significant flea control relative to untreated controls for at least 1 month after application. This is consistent with approved product labeling. However, imidacloprid provided significantly greater flea kill at 6, 12, and 24 hours after treatment. This superiority was maintained at the 6- and 12-hour flea counts throughout the study on all reinfestation days, with the exception of the 12-hour flea count on day 20. Although both products are labeled for monthly application, both provided measurable flea control beyond 30 days; however, imidacloprid provided superior control relative to selamectin at the 36-hour flea counts on days 34 and 41.

For flea control to be fully effective, adult fleas must be killed rapidly to provide relief for the afflicted pet and break the flea life cycle. The imidacloprid results obtained in this study are consistent with previously published studies. Cruthers and Bock[5] demonstrated that imidacloprid killed up to 100% of fleas within 12 hours of application and up to 100% within 2 hours of reinfestation. Studies by Mehlhorn and colleagues[6] demonstrated that fleas exposed to imidacloprid show neurologic signs after 10 minutes of exposure and that this response is caused by uptake of imidacloprid through the flea's thin intersegmental membranes and not via feeding activity.

CONCLUSION

The investigation reported here demonstrates that imidacloprid (Advantage®) provides consistent and rapid relief of flea infestations, providing highly significant flea control in as little as 6 hours after application. Furthermore, imidacloprid provided significantly more rapid flea kill than selamectin (Revolution™/Stronghold®) throughout the expected treatment interval.

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