

ANTIFEEDING EFFECT OF SEVERAL INSECTICIDAL FORMULATIONS AGAINST *Ctenocephalides felis* ON CATS

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Summary :

Evaluation of insecticidal activity of flea products is generally based on counting live fleas in the animal's coat 24 and 48 hours following artificial infestation. This approach, however, does not allow to specify whether the fleas have had the opportunity to bite and take a bloodmeal prior to their death. To address this question, 30 cats were allotted to six groups of five animals. Each cat was housed in a separate cage. At Day 0, each group of cats received a single treatment as follows: Group 1: spot-on application of imidacloprid: cats < 4 kg: 40 mg/cat, cats ≥ 4 kg: 80 mg/cat (Advantage®). Group 2: spot-on application of fipronil: 50 mg/cat (Frontline spot-on®). Group 3: spray application of fipronil: 7.5 mg/kg b.w (Frontline spray®). Group 4: foam application of permethrin 40/60: 50 mg/kg b.w. (Defencat®). Group 5: aerosol spray application of dichlorvos+fénitrothion: one second/kg b.w. (NuvanTop®). Group 6: control group: cats were left untreated. One hour after treatment, each cat was infested with 50 unengorged young adult fleas, *Ctenocephalides felis*, deposited along the dorsal midline. One hour later, each cat was carefully combed using a fine-toothed comb (13 teeth/cm). Collected fleas were swatted to detect blood in their abdomen. To the manufacturers respective product use instructions and efficacy claims, reinfestations were made at Days 3, 7, 14 in all groups; at Days 21 and 30 in Groups 1, 2, 4, 6; at Days 35 and 42 in Groups 3 and 6. The cats were combed one hour after each reinfestation. The results indicate that the topical application of imidacloprid or fipronil does not prevent fleas from biting and feeding within the first hour after infestation prior to being killed while the topical application of dichlorvos/fénitrothion and permethrin led to a better than 80 % decrease of the number of engorged fleas for three and seven days post treatment, respectively.

KEY WORDS : *Ctenocephalides felis*, antifeeding effect, dichlorvos, fénitrothion, fipronil, imidacloprid, permethrin.

Résumé : * EFFET ANTIFEEDING * DE PLUSIEURS FORMULATIONS INSECTICIDES CONTRE *Ctenocephalides felis* CHEZ LE CHAT

L'appréciation de l'activité insecticide d'un produit destiné à la lutte contre les puces est généralement réalisée en comptant les puces vivantes dans le pelage des animaux 24 et 48 heures après chaque infestation expérimentale. Cette méthode, cependant, ne permet pas de préciser si les puces ont eu le temps de piquer et de prendre leur repas avant de mourir. Trente chats ont été répartis en six groupes de cinq. Chaque chat était logé en cage individuelle. A J0, chaque groupe de chat reçoit un traitement unique : Groupe 1 : application en spot-on d'imidacloprid : chats < 4 kg : 40 mg/chat, chats ≥ 4 kg : 80 mg/chat (Advantage®). Groupe 2 : application en spot-on de fipronil : 50 mg/chat (Frontline spot-on®). Groupe 3 : application en spray de fipronil : 7.5 mg/kg (Frontline spray®). Groupe 4 : application d'une mousse de perméthrine 40/60 : 50 mg/kg (Defencat®). Groupe 5 : application d'un aérosol de dichlorvos+fénitrothion : une seconde/kg (NuvanTop®). Groupe 6 : groupe témoin : les chats ne sont pas traités. Une heure après le traitement, chaque chat est infesté par 50 *Ctenocephalides felis* jeunes adultes non gorgées déposées le long de la ligne dorso-lombaire. Une heure plus tard, chaque chat est soigneusement peigné. Les puces récoltées sont écrasées afin de détecter la présence de sang dans leur abdomen. Selon la rémanence d'activité retenue par les fabricants, des réinfestations ont été réalisées à J3, J7, J14 pour tous les groupes; à J21 et J30 pour les groupes 1, 2, 4 et 6; à J35 et J42 pour les groupes 3 et 6. Les chats ont été peignés une heure après chaque infestation. Il ressort que l'application cutanée d'imidacloprid ou de fipronil n'empêche pas les puces de piquer pendant la première heure d'infestation. Seules les applications cutanées de dichlorvos+fénitrothion ou de perméthrine entraînent une diminution supérieure à 80 % du nombre de puces gorgées pendant respectivement les trois et sept jours qui suivent l'application.

MOTS CLÉS : *Ctenocephalides felis*, effet antifeeding, dichlorvos, fénitrothion, fipronil, imidacloprid, perméthrine.

INTRODUCTION

The efficacy of insecticides against fleas infesting domestic carnivores is generally evaluated 24 hours after infestation. However, a possible

antifeeding activity cannot be assessed accurately after an interval of 24 hours. An antifeeding action is defined as the ability of the agent to prevent the fleas from actually biting the host. The act of biting injects allergenic saliva into the host's blood, and preliminary studies have shown that *Ctenocephalides felis* feeds on the host very soon after infestation. Within one hour, 100 % of the males and 96.2 % of females were found to be macroscopically engorged (Franc *et al.*, in press). Topical insecticides may prevent fleas from taking their bloodmeal after jumping on treated animals, either because of a repellent effect (Dethier *et al.*, 1960)

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or because the fleas are killed before they feed. An immediate feeding inhibition effect would be very interesting for prevention of Flea Allergy Dermatitis (FAD). Since an antifeeding activity has yet to be documented, we were prompted to evaluate the antifeeding action of several commercial formulations with proven activity against fleas when assessed 24 hours after infestation (Carloti *et al.*, 1996; Cunningham *et al.*, 1996; Franc & Cadiergues, 1995; Jacobs *et al.*, 1997; Postal, 1995).

MATERIAL AND METHODS

CATS

Thirty adult European cats were selected for the study. The cats were housed in individual cages and received commercial dry food with *ad libitum* access to water.

EXPERIMENTAL PROCEDURE

The various formulations were employed at the dosages recommended by the manufacturers, and the pour-on formulations were applied to one or two sites on the cats as recommended. At the first infestation, the fleas were deposited along the dorso-lumbar line, but by avoiding the areas where insecticide had been applied. Cats in Group 1 received a spot-on application of imidacloprid (Advantage®) at a dosage of 40 mg of a.i. per cat for cats < 4 kg b.w. or 80 mg/cat for cats ≥ 4 kg b.w. Cats in Group 2 received a spot-on application of fipronil (Frontline spot-on®) at a dosage of 50 mg of a.i. per cat. Cats in Group 3 received a spray application of fipronil (Frontline spray®) at a dosage of 7.5 mg of fipronil per kg b.w. Cats in Group 4 received a foam application of permethrin (40/60 : Defencat®) at a dosage of 50 mg/kg b.w. Cats in Group 5 received an aerosol application of dichlorvos-fénitrothion (Nuvan Top®) at a dosage of one second/kg b.w. outside the experimental room. Cats in Group 6 were not treated.

One hour after the treatment, each cat was infested with 50 unengorged young (< 48 hours old) adult fleas *Ctenocephalides felis* deposited along the dorsal midline. One hour later, each cat was carefully combed using a fine-toothed comb. Collected fleas were swatted to detect blood in their abdomen. To match the manufacturers' product use instructions and efficacy claims, reinfestations were made on the same schedule at Days 3, 7 and 14 for all groups; at Days 21 and 30 for Groups 1, 2, 4 and 6; at Days 35 and 42 for Groups 3 and 6. Cats were combed one hour after each reinfestation.

EXPERIMENTAL INFESTATIONS

The strain of *Ctenocephalides felis* used in this study was originally obtained from a wild strain harvested from a cat and maintained in our laboratory since 1990. Each experimental infestation consisted of 50 unengorged young adult fleas (the sex-ratio was about 60 % females and 40 % males) placed along the cat's dorso-lumbar line.

FLEA COUNTING PROCEDURE

The fleas were counted by carefully combing the entire coat of the animal for five minutes using a fine comb (13 teeth/cm). The fleas were collected and counted before being swatted to detect blood in their abdomen.

DATA ANALYSIS

Efficacy was calculated by comparing the mean engorged flea count for treated cats with that for control cats using Abbott' formula (Abbott, 1925) :

$$100 \times \frac{\text{No of engorged fleas in control} - \text{No of engorged fleas in treated group}}{\text{No of engorged fleas in control group}}$$

The counts of engorged fleas (y) were transformed to stabilize variance as follows :

$$X = \arcsin \left[\frac{y + 3/8}{\text{TOTAL} + 3/4} \right]$$

where TOTAL is the total number of fleas placed on an animal at each time (in the present case: 50). The variable X was subjected to a repeated measure analysis of variance (Freemann & Tukey, 1950).

RESULTS

The results of the flea counts and standard deviations are shown on Figure 1. Out of the 4,173 live fleas collected from the treated and untreated cats one hour after infestation, 97.1 % were macroscopically engorged. In the controls, the number of engorged fleas remained constant over the trial period (22.2 on Day 14 to 30.6 on Day 21 or 44-61 % of the initial population). The missing fleas had either left the cats or been licked off during this period. The results of the antifeeding activity of the formulations are listed in Table 1.

The fleas deposited one hour after treatment were found to have bitten the cats treated with fipronil or imidacloprid; there was no significant difference between the untreated control animals and those treated

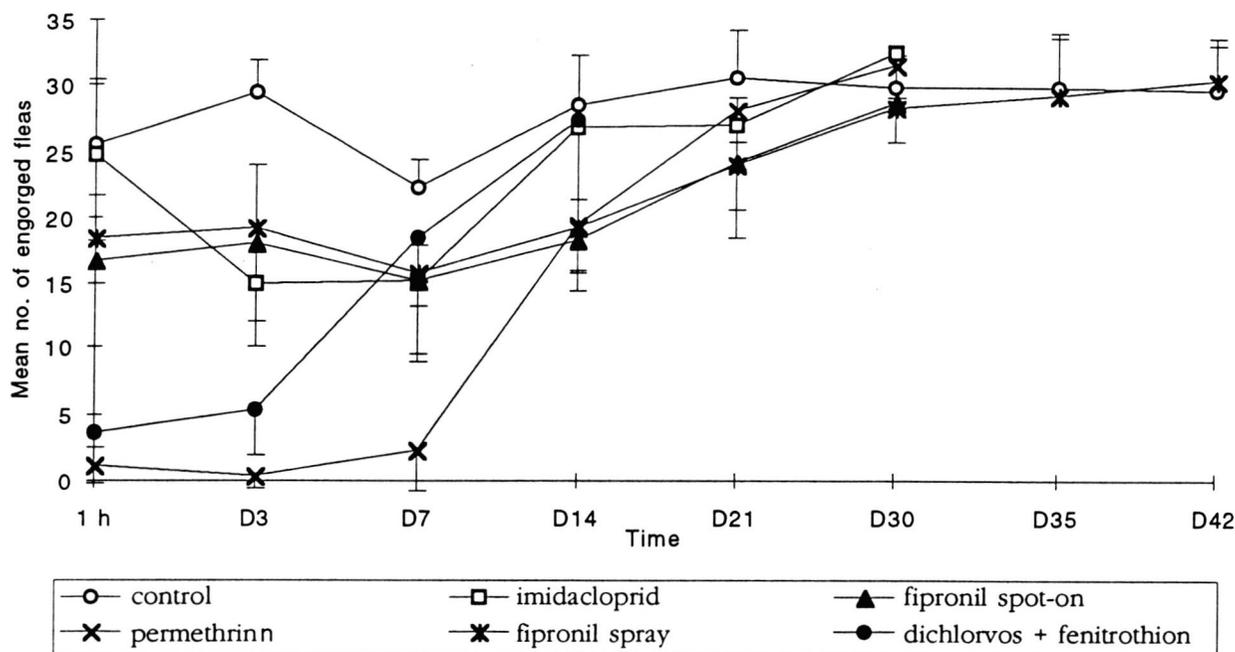


Fig. 1. — Mean number of engorged live fleas collected one hour after infestation with 50 fleas.

Days	Advantage® imidacloprid	Defencat® permethrin	Frontline® spot on fipronil	Frontline® spray fipronil	Nuvan Top® dichlorvos/ fenitrothion
0	2.4	96.2*	33.9*	27.7*	86.1*
3	49.6*	99.1*	39.5*	35.0*	82.8*
7	33.4*	93.5*	32.8*	28.9*	17.6
14	5.9	32.4*	36.7*	33.0*	4.0
21	11.6	7.9	21.0*	21.7*	
28	0	0	3.4	4.6	
35				2.0	
42				0	

* significant at $p \leq 0.05$ versus control.

Table I. — Estimated antifeeding efficacies (%) compared to the untreated group at different time intervals.

with imidacloprid. Although statistically significant, the efficacy in the groups treated with fipronil (spot-on or spray) one hour after fleas infestation was unsatisfactory (33.9 % and 27.7 % respectively).

In the animals treated with the formulations based on permethrin or dichlorvos-fenitrothion, there were significantly fewer engorged fleas than on the untreated control cats: mean 1.2 fleas for the groups treated with Defencat®, and 3.6 in the group treated with Nuvan-Top®, corresponding to antifeeding efficacy of 96.2 % and 86.1 % respectively.

Three days after treatment, the antifeeding effect of the permethrin formulation rose to 98.6 %, while that of the organophosphorus formulation declined to 81.6 %, compared to a less than 50 % efficacy for the other three formulations. At Days 0 and 3, antifeeding per-

centage of Defencat® and Nuvan Top® don't differ significantly.

Seven days after treatment, the antifeeding efficacy of Defencat® was found to be 90 %, while that of the other formulations had fallen to below 35 %.

After Day 14, none of the formulations exhibited satisfactory antifeeding activity, although significant treatment effects were still observed between the controls and the groups treated with permethrin or fipronil.

DISCUSSION - CONCLUSION

In an attempt to evaluate the antifeeding action of insecticidal agents, we counted the number of blood-engorged fleas collected from the fur of the

cats. Any fleas which might have bitten the cats but had left the animals for one reason or another were thus not included in the counts.

No formulation was 100 % efficient with this experiment. It is concluded that the topical application of imidacloprid or fipronil does not prevent fleas from biting and feeding during the first hour after infestation prior to being killed although these products have a long term effect when observed 24 hours after infestation. The topical application of dichlorvos/fenitrothion and permethrin led to a decrease of the number of engorged fleas > 80 % for three and seven days post treatment, respectively.

These informations are useful for dermatologists to choose a product to fight against fleas in particular when animals have flea allergy dermatitis (FAD).

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Reçu le 15 septembre 1997
 Accepté le 15 novembre 1997