

SUSCEPTIBILITY OF THE CAT FLEA, *CTENOCEPHALIDES FELIS* (SIPHONAPTERA : PULICIDAE) TO FOUR PYRETHROIDS

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Summary :

The amounts of active ingredient required to kill adult *Ctenocephalides felis* fleas on filter insecticide impregnated papers were determined in an attempt to compare the activity of different active ingredients. The following compounds were tested: bioallethrin, deltamethrin, esbiothrin and permethrin. The LD50 and LD90 against *Ctenocephalides felis* were 121 and 770 mg/m² respectively for bioallethrin, and 161 and 671 mg/m² respectively for esbiothrin. For deltamethrin and permethrin, the LD50 were 0.38 and 23 mg/m² respectively, and 15 and 60 mg/m² respectively for LD90.

KEY WORDS : *Ctenocephalides felis*, insecticide susceptibility, bioallethrin, deltamethrin, esbiothrin, permethrin.

Résumé : SUSCEPTIBILITÉ DE LA PUCE DU CHAT *CTENOCEPHALIDES FELIS* (SIPHONAPTERA : PULICIDAE) À QUATRE PYRÉTHRINOÏDES

Les quantités de principes actifs nécessaires pour tuer des puces adultes (*Ctenocephalides felis*) sur papiers filtres imprégnés ont été déterminées pour essayer de comparer l'activité de différents principes actifs. Les molécules suivantes ont été testées : bioalléthrine, deltaméthrine, esbiothrine and perméthrine. Les DL50 et DL90 sur *Ctenocephalides felis* sont respectivement de 121 et de 770 mg/m² pour la bioalléthrine, de 161 et 671 mg/m² pour l'esbiothrine. Pour la deltaméthrine et la perméthrine, les DL50 respectives étaient de 0,38 et 23 mg/m², les DL90 sont de 15 et 60 mg/m².

MOTS CLÉS : *Ctenocephalides felis*, susceptibilité aux insecticides, bioalléthrine, deltaméthrine, esbiothrine, perméthrine.

INTRODUCTION

Ctenocephalides felis is a common ectoparasite of cats and dogs throughout the world. It not only causes damage from bites (pulicosis, FAD), but is the intermediate host of *Dipylidium caninum* (Franc, 1994). Natural pyrethrins and pyrethroids are widely used to kill fleas on domestic carnivores as well as in their environment. The efficacy of pyrethroids on *Ctenocephalides felis* has been demonstrated in numerous clinical trials both on livestock (Kilonzo, 1991; Kilonzo & Gisakanyi, 1988) and on carnivores (Kitagawa *et al.*, 1984; Lemke *et al.*, 1989), although the effective doses were not established. Effective doses are, however, available for organophosphorus compounds (Schwinghammer *et al.*, 1985). The present study was performed to determine the amount of active ingredient required to kill fleas brought into contact with impregnated paper.

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MATERIALS AND METHODS

COMPOUNDS AND DOSES

The LD50 and LD90 of four pyrethroids against *C. felis* were determined in mg/m² at 24 hours. The insecticides tested were bioallethrin, esbiothrin, deltamethrin and permethrin. Unlabeled technical products (bioallethrin: 94.4 %; esbiothrin: 95.1 %; deltamethrin: 100 %; permethrin: 98.9 %) diluted in acetone were used.

Primary trials with the different pyrethroids are not reported in this paper. Only values directly used for the LD50 and LD90 estimation are listed in Table I.

SUPPORTS

Tests were conducted on 25 adult fleas placed in cylindrical transparent plastic vials, 3 cm in diameter and 7 cm high. A disc of Whatman No 1 filter paper 3 cm in diameter, impregnated with active ingredient diluted in acetone, was placed at the bottom of each vial. Discs were impregnated with two hundred microliters of solution. The discs impregnated with acetone alone served as controls in each test.

Test 1				Test 2				Test 3			
Product	Dose (mg/m ²)	No	% eff.	Product	Dose (mg/m ²)	No	% eff.	Product	Dose (mg/m ²)	No	% eff.
Bioallethrin	22.5	50	16.3	Deltamethrin	0.4	100	49	Permethrin	7.81	50	8
	45	50	18.4		0.9	100	59		15.62	50	26
	90	50	38.8		1.7	100	73		31.25	50	71.4
	180	50	67.3		3.5	100	78		125	50	98
	360	50	75.5		7	100	85		417	50	100
	720	50	89.8		14	100	91				
Esbiothrin	22.5	50	0	28	100	97					
	45	50	16.3	56	100	95					
	90	50	38.8	112	100	94					
	180	50	40.8	224	100	99					
	360	50	85.7	448	100	99					
	720	50	87.8								

No = Number of fleas. % eff. = % of efficacy.

Table I. — Products tested and results.

FLEAS

All tests were conducted on the same strain of *Ctenocephalides felis*, obtained from a cat and maintained in our laboratory since 1990. Young imagos, unfed and aged less than 3 days were divided into groups of 25 using a pooter. They were then placed in the vial, which was covered with a fine mesh tissue allowing free movement of air, but preventing the fleas from escaping. The vials were left in the laboratory (21 °C, 60 % RH).

The dead fleas (*i. e.* those that were motionless) were counted 24 hours after coming into contact with the test compound.

DATA ANALYSIS

Regression lines were estimated by probit analysis, following logarithmic transformation of the doses. Linear adjustment were tested using a χ -square test ($p > 0.05$), and the LD50 and LD90 values were calculated with their 95 % confidence intervals.

RESULTS AND DISCUSSION

Mortality on control vials was very low (less than 2 % at 24 hours). The efficacies have been calculated with the ABBOT's formulae. They are listed in Table I. Test 1 provided estimates of the LD50 and LD90 at 24 hours for bioallethrin (212 and 770 mg/m² respectively) and esbiothrin (161 and 671 mg/m²), with 95 % confidence intervals. In tests 2 & 3, values of LD50 of deltamethrin and permethrin were 0.38 and 23 mg/m² respectively, and 15.7 and 60.54 mg/m² respectively for the LD90. The

four compounds could thus be ranked in decreasing order of relative activity (relative LD50 values: Table II). The potency ratio of LD50 of permethrin/deltamethrin is about 60; on *Musca domestica*, the relative toxicity by topical application is about 33 (Anonymous, 1988). Bioallethrin and esbiothrin show less promise in view of their photolability (Bullivant *et al.*, 1973) and lower efficacy. Permethrin and deltamethrin are more interesting in the fight against fleas because of their photostability and their activity at low dosages.

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	LD50 (95 % CI) (mg/m ²)	LD90 (95 % CI) (mg/m ²)	Potency ratio*
Deltamethrin	0.38 (0.23-0.62)	15.7 (11-22.5)	60.5-318.4-423.7
Permethrin	23.0 (19.3-27.5)	60.54 (43.1-85)	5.3-7
Bioallethrin	121 (96.0-152)	770 (491-1209)	1.3
Esbiothrin	161 (132-195)	671 (468-955)	/

* Potency ratio of LD50 relative to following compound (most to least potent).

Table II. — Toxicity of four insecticides against *Ctenocephalides felis*.

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