What's Eating You? Cat Flea (*Ctenocephalides felis*), Part 2: Prevention and Control

Dirk M. Elston, MD; Huy Do, BS

The cat flea, *Ctenocephalides felis*, is a common pest on both cats and dogs. It bites viciously, and because of its potential to spread disease, it has been the focus of extensive research on the utility of oral and topical insecticides. In addition to chemical formulations, various mechanical and biological modalities have been developed to control flea populations. Pets should be treated by a knowledgeable veterinarian. Environmental treatment often requires the help of an experienced exterminator. This review will discuss the most practical approaches to control.

Prevention and Control of Cat Flea Infestation

Oral and Topical Formulations of Insecticides—Various formulations of insecticides have been developed to control the flea population in pets (Table). In one study, selamectin, imidacloprid, and fipronil demonstrated similar efficacy against C *felis felis* and C *felis strongylus*.[6] Different agents target specific stages of flea development; therefore, it is important to understand the life cycle of the flea. The eggs are sensitive to humidity and temperature and most will hatch in an environment with relative humidity above 50% and a temperature ranging from 16°C to 27°C.[11] After hatching, the larvae feed on feces from adult fleas. Fleas typically feed prior to mating and roughly 24 hours elapse between the time of feeding and the time of ovipositioning. Oral or topical formulations that kill fleas within 24 hours of attachment to the host have the greatest ability to prevent reproduction. For example, nitenpyram, an oral agent, has demonstrated killing activity at 60 minutes posttreatment.[2] A topical insecticide, metaflumizone, has been shown to reduce egg production by 55.3% within 24 hours posttreatment at doses ranging from 39.0 to 76.2 mg/kg.[1]

In addition to insecticides that kill adult fleas, various systemic and topical ovicides and larvicides such as lufenuron, fipronil with methoprene, and pyriproxyfen are available to prevent cat fleas from reaching sexual maturity. Lufenuron must be ingested by larvae to be effective, while fipronil with methoprene and pyriproxyfen require only skin contact.

Another important point when treating companion animals using topical insecticides is the distribution of cat fleas. The greatest number of fleas can be found in the neck and head regions. Applying insecticide to these areas helps eliminate fleas more effectively.[12]

Insecticide-resistant cat fleas pose a problem in flea control, and models of resistance, such as the KS1 strain, have been used to study insecticide resistance. The reduced susceptibility of KS1 to various insecticides, including imidacloprid and fipronil, is associated with the mutation of the *Rd1* gene.[13] In a comparative study, metaflumizone was more effective in controlling the KS1 population than fipronil–(S)-methoprene; cats treated with metaflumizone (40 mg/kg) had more than 90% flea reduction for 37 days compared to fipronil–(S)-methoprene (7.5 mg/kg), which only had 71.3% reduction for 30 days.[13] A single dose of 11.4 mg of nitenpyram also has been shown to be effective against KS1 fleas.[2] Selamectin also provided good results with more than 90% flea reduction for 28 days when it was used to eradicate the

Dr. Elston is from the Departments of Dermatology and Laboratory Medicine, Geisinger Medical Center, Danville, Pennsylvania.
Mr. Do is from Philadelphia College of Osteopathic Medicine, Pennsylvania.
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Correspondence: Dirk M. Elston, MD, Departments of Dermatology and Laboratory Medicine, Geisinger Medical Center, 100 N Academy Ave, Danville, PA 17822-5203 (dmelston@geisinger.edu).

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Different Formulations of Insecticides

Insecticide Formulation	Drug Class	Mode of Treatment	Time of Onset of Effects on Fleas	Duration of Effectiveness[a]	Susceptible Stage of Cat Flea
Nitenpyram[1,2]	Neonicotinoid	Oral	60 min	Reduction of blood consumption by 98.37%–99.89% up to 28 d posttreatment	Adult flea
Metaflumizone[3]	Semicarbazone	Topical	24–48 h	>90% for up to 7 wk	Adult flea
Spinosyn A and spinosyn D[4]	Spinosad	Oral	Not reported	100% for 51 d	Adult flea
Fipronil–(S)-methoprene combination[5]	Phenylpyrazole/ juvenile insect hormone analogue	Topical	Not reported	>95% for 5 wk in adult fleas; >90% for 8 wk in ovicide; >90% for 12 wk for adult flea emergence	Larvae and adult flea
Imidacloprid[6,7]	Neonicotinoid	Topical	3 h	75.79% at 37 d posttreatment	Adult flea
Permethrin and phenothrin[8]	Synthetic pyrethroids	Topical propylene glycol monomethyl ether formulation	Not reported	99.6% at 14 d; 97.7% at 28 d	Adult flea
Selamectin[9]	Avermectin	Topical	12 h	100% within 48 h posttreatment; effective up to 27 d	Eggs, larvae, and adult flea
Lufenuron[10]	Insect growth regulators/insect development inhibitors	Oral	Not reported	Nonviable eggs for 11 d; 98.2% for 32 d	Eggs, larvae, and adult flea

[a]Reduction in *Ctenocephalides felis* number or feeding.

KS1 colony.[14] Cottontail, KSU, and Auburn are other colonies that have been shown to be resistant to pyrethroids through a mechanism known as *knockdown resistance*. This mechanism involves mutation of the para-type sodium channel protein, which makes the insect's nervous system less sensitive to the insecticide.[15] Combining 2 or more classes of insecticides can reduce the emergence of resistance.[4]

Entomopathogens—Another method being evaluated for control of *C felis* is the use of entomopathogens.[16] *Beauveria bassiana* and *Metarhizium anisopliae* are entomopathogenic fungi that appear promising. When measuring the effect against flea eggs, the *M anisopliae* group at a concentration of 5.31×10^3 conidia/mL decreased the egg's hatchability better than the *B bassiana* group at a concentration of 6.34×10^8 conidia/mL. In adult fleas, *B bassiana* at a concentration of 7.39×10^6 conidia/mL killed adult fleas more effectively than the *M anisopliae* group at a concentration of 1.94×10^6 conidia/mL.[16]

Other Control Methods—Regular grooming reduces the number of fleas on pets. For hard surfaces, dichlorvos and propetamphos demonstrate superior activity. For fabric and carpet, organophosphates are superior. Insect growth regulators such as methoprene and fenoxycarb also play a role.

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Conclusion

Cat fleas not only have the potential to transmit plague and other infectious diseases but also cost billions of dollars to control. The abundance of this flea on feral animals makes elimination of flea populations unlikely. Many oral and topical formulations are used to control the population of *C felis*, and combinations of agents have been suggested to avoid resistance. Entomopathogens and environmental treatments also produce good results. Continued research is needed to find novel methods to prevent vector-borne diseases. A knowledgeable veterinarian is the best source of current information.

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