

# Fleas: Related Health Problems and Control

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Fleas are the most prevalent ectoparasites found on dogs and cats.<sup>1</sup> For most small animal practitioners, flea-related health problems are number one.<sup>2</sup> While a mild infestation of fleas is not significant clinically, the associated dermatitis, tapeworm infection, hemobartenellosis, and anemia are the major health problems.<sup>3</sup>

Flea allergy dermatitis is the most common hypersensitivity disorder of dogs and cats,<sup>1,4,5,6</sup> causing over half of the dermatologic cases in the southern U.S.<sup>1</sup> When a flea pierces the host's skin, it secretes saliva into the wound to prevent coagulation of the blood to be siphoned. Individual dogs and cats vary in their sensitization to the allergens in flea saliva for unknown reasons.<sup>2,7</sup> Atopic dogs and cats introduced to a flea-endemic environment appear to be predisposed to the disease,<sup>2,8</sup> as are those intermittently exposed, which occurs in areas with cold winters. Pets in the southeastern United States are continually exposed to the parasites and are less likely to develop severe allergies,<sup>1,7</sup> possibly due to desensitization.<sup>9</sup> There are no sex or breed predilections associated with flea allergy dermatitis. Variable clinical signs are most common in animals three to six years of age,<sup>4,8,10</sup> and progress with age.<sup>4,8,11</sup>

In dogs, papules, pustules, crusts, scales, alopecia, erythema and hyperpigmentation are commonly distributed over the lumbosacral area, caudomedial thighs, ventral abdomen and flanks<sup>4</sup> of affected animals. Miliary erythematous papules are similarly distributed in cats, and additionally encircle the neck.<sup>11</sup> Pruritis is moderate to severe in both dogs and cats, and acute moist dermatitis ("hot spots") is common in extremely hypersensitive animals.<sup>4,10</sup>

Glucocorticoids are preferred to decrease pruri-

tis, but skin lesions may persist.<sup>9,11,12</sup> Hyposensitization, has been found to be ineffective as treatment.<sup>6,10,11,12</sup> Eliminating fleas from the animal's environment is necessary for successful treatment.

Fleas are the intermediate hosts for *Dipylidium caninum*, the common tapeworm of dogs and cats. Tapeworm eggs are eaten by fleas and then ingested by the animal. Clinical signs such as poor appetite, lethargy, and mild diarrhea are common, resulting from tapeworm interference of intestinal absorption and digestion. This condition can be diagnosed by the presence of eggs or proglottids in the feces, and can be effectively treated with a flea control program in conjunction with a cestocidal drug, such as praziquantel.<sup>4,13</sup>

*Hemobartenella* are rickettsial parasites located on erythrocyte surfaces and free in blood plasma. Blood-sucking arthropods such as fleas are considered to be the primary means of transmission. Subsequent to infection, erythrocytes are phagocytized by the spleen, resulting in anemia, depression, weakness, anorexia and weight loss.<sup>4</sup> Acute hemobartenellosis can occur in cats of all ages, though the risk of infection increases with age. Infection is rare in nonsplenectomized dogs,<sup>4,14</sup> depending upon the severity of the hemolytic crisis, blood transfusions, oxytetracycline and glucocorticoid administration may be warranted. Elimination of fleas and other blood-sucking arthropods is key in the prevention of this disease.<sup>14</sup>

Young and debilitated animals are most susceptible to induced anemia, resulting from severe flea infestation. Intravenous blood and fluid electrolyte administration may be necessary in extremely anemic patients.

During her 3-week life span the adult flea lays an average of 150-200 eggs on the pet or in the environment. These eggs, smooth and non-

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adhesive, drop off the pet. The eggs, resistant to temperature extremes and chemicals, hatch into active, wormlike larvae after a 7-day incubation. Larvae, incapable of skin penetration, but susceptible to environmental treatments, live on debris and digested blood content of adult flea feces. During the next two to three weeks, the larvae undergo two molts, the last of which spins a cocoon from its own saliva or from available debris (such as pet hair, carpet fiber and dust).<sup>4,11</sup>

The pupae mature in one week to one year, depending on optimal temperature (65-80° F) and humidity (70%). The adults emerge from the insecticide resistant cocoons only in response to vibration.<sup>3</sup>

Some products sold for flea control have not been evaluated by controlled trials and are not licensed by the Food and Drug Administration. Many of these products are ineffective and veterinarians are obligated to advise clients against their use.<sup>16</sup> Two of the more commonly used unlicensed products are thiamine and sulfur. Thiamine (vitamin B1) has long been advocated as a flea and mosquito repellent when taken orally, and products containing this vitamin are widely used. However, studies have concluded that thiamine hydrochloride fed to dogs has no efficacy against fleas.<sup>18,19</sup> A study undertaken in 1985, in which an elemental sulfur product was fed to dogs, failed to confirm any flea-repellent action of the product.<sup>16</sup> Devices, such as collars, which claim to repel fleas with ultrasonic radiation also lack data to support their efficacy and are being scrutinized by the FDA.<sup>17</sup> Further investigation into possible hazards to dogs and cats wearing ultrasound emitters is currently being done.<sup>17</sup>

Avon Skin-So-Soft, manufactured by Avon Products Inc., is a human bath oil. There are no indications on the label of any possible insect repellent potential, although there have been reports of its use against mosquitoes and fleas. The product works by forming a mechanical film barrier to the fleas and acts as an olfactory repellent. Skin-So-Soft may be useful as an adjunctive therapy with other insecticides or as a method of partial protection.<sup>20</sup>

Silica aerogel and diatomaceous earth are two products that control fleas by mechanical rather than chemical means. They are finely ground so that particles wedge into the flexible areas of the fleas' body wall. The insects are killed by chafing which results in desiccation due to loss of body wall integrity.<sup>3</sup>

Methoprene, a nontoxic insect growth regula-

tor, stops larval development at the pupal stage and lasts up to 90 days.<sup>10</sup> When it is combined with other insecticides for quick knockdown activity of adult fleas, methoprene's residual effect is 75 days.<sup>3,10</sup> Methoprene has a very high LD50 and is probably the safest indoor product for both animals and owners,<sup>8</sup> because it is rapidly degraded to inactive metabolites. Methoprene needs to be combined with an adulticide for effective flea control.

The major insecticides used in flea control are organophosphates, carbamates and botanicals.<sup>8</sup> Organophosphates, which are acetylcholinesterase-inhibitors, result in overstimulation of the insect's nervous system. Some of the more commonly used organophosphates are: dichlorvos, chlorpyrifos, propetamphos, malathion and diazinon.<sup>10</sup> Residual activity varies from slight to persistent.<sup>8,10</sup>

Carbamates, like organophosphates, overstimulate the insect's nervous system by inhibiting acetylcholinesterase. Three carbamates labeled for flea treatment are: bendiocarb, propoxur, and carbaryl.<sup>10</sup> Carbaryl (contained in many flea powders) should be used outdoors or in kennels only, because in alkaline solutions or at elevated temperatures it hydrolyzes to 1-naphthol, which darkens when exposed to light. Consequently, the application of shampoo or steam to a carbaryl-treated carpet could result in its staining.<sup>8,10,15</sup> Organophosphates and carbamates are extremely toxic if ingested.

Botanical insecticides, derived from plant products, have low toxicity. They degrade rapidly in the environment, so their effect is not as long-lasting as that of organophosphates and carbamates. They have a rapid knockdown (time required for fleas to fall off an animal) effect, however, and are frequently used with residual insecticides. The most commonly used botanicals are the natural pyrethrins, synthetic pyrethroids, rotenone and d-limonene.<sup>8</sup> Paralysis and death of the flea occurs within minutes of exposure to pyrethrins due to altered Na<sup>+</sup>/K<sup>+</sup> exchange. Though extremely rapid in their action, pyrethrins are very sensitive to ultraviolet light and breakdown in sunlight within a few hours of application.<sup>8,10,12</sup> Pyrethrins are often combined with synergistic compounds such as piperonyl butoxide. Though not insecticides, these compounds enhance the toxicity of the pyrethrins by blocking the fleas' detoxification (microsomal oxidation) of the insecticide.<sup>8</sup> Synthetic pyrethroids (resmethrin, allethrin and permethrin) are very similar

to the naturally occurring pyrethrin compounds.<sup>3</sup> They have an advantage, however, in that they are less sensitive to ultraviolet light and so have a longer residual activity.<sup>8,15</sup> Rotenone paralyzes the fleas' respiratory and cardiovascular systems by inhibiting glutamic acid oxidation.<sup>3</sup> Rotenone has quick-kill activity and degrades fairly rapidly in the environment.<sup>10</sup> D-limonene is an organic citrus extract used in various flea dips. It works by stripping the outer cuticle lipid layer from the flea exoskeleton, resulting in desiccation and death of the flea.<sup>3</sup> D-limonene is approved by the Food and Drug Administration as a food additive for dogs and cats. Its toxicity is considered to be low, although CNS toxicity signs have been noted in cats.

Insecticidal sprays, powders, foam, foggers, dips, shampoos, and collars are available, for flea control, as well as microencapsulated and systemic insecticide formulations.

Sprays are convenient, easy-to-use formulations that are available with alcohol or water bases. Though alcohol-based sprays seem to have a faster knockdown effect,<sup>8</sup> some cats and dogs are sensitive to the alcohol and exhibit salivation and agitation after application.<sup>8,15</sup> Because pyrethrins have a very low mammalian toxicity, these sprays can safely be applied daily to pets.<sup>15</sup> For cats that react negatively to the spraying process, the product can be sprayed first on the owner's hands and subsequently rubbed on the cat's haircoat.<sup>11</sup>

Powders and dusts are usually not as concentrated as sprays, because application results in a greater human exposure through inhalation and skin contact. These products are convenient and easy-to-use, however, and are preferred by many owners for use in cats.<sup>8</sup>

Synthetic and natural pyrethrins are also available in a foam base. Foam application is very effective for cats and dogs that are sensitive to conventional sprays.

Foggers or "bombs" are pressurized aerosols designed to treat the indoor environment. Successful use of these products requires that an adequate number of foggers be strategically placed throughout the house, pilot lights and air conditioners be turned off, that the premises be vacated and that the area be thoroughly ventilated after treatment.<sup>8</sup> Because fogger mist does not penetrate unexposed areas, handheld sprayers may be necessary to successfully treat difficult to reach cracks and crevices.<sup>15</sup>

Dips or rinses are prepared by adding a dip

concentrate solution to warm water. Product directions have to be strictly followed to get the best residual effect of the dip.

Shampoos reduce the flea population but generally have no residual activity. Other flea control products need to be used in conjunction with shampoos for effective insecticidal activity.<sup>3,15</sup>

Collar manufacturers claim flea-kill for up to 6 months by a slowly released insecticide. These collars are not repellents, and though they can kill fleas, they cannot eliminate the insects from a continually exposed animal.<sup>3,8,15</sup> All of the collars actually begin to lose their insecticidal activity after 3 weeks.<sup>21</sup>

Microencapsulation is a process that has been applied to pyrethrins and other selected insecticides. This process traps the insecticide within small nylon or polyurea capsules. The insecticide slowly diffuses through the capsule, is deposited on the outside of the shell wall, and is subsequently absorbed by the pet. These microcapsules dramatically increase the stability of the pyrethrins by providing a medium for continual insecticide release from 1 day to 5 weeks.<sup>3,12</sup> The microcapsules adhere to carpet pile, furniture, pet bedding, etc., which contributes to their effectiveness.<sup>10</sup>

Systemic and Oral Insecticides are approved for flea control in dogs. Fenthion (Prospot)<sup>a</sup> is an organophosphate that is used as a systemic flea-control agent. It is applied along the dorsal neck and thorax and is absorbed through the skin. Fenthion disrupts the flea life cycle when the adult feeds on the host's insecticide-containing fluids prior to reproduction.<sup>13,22</sup> Advantages to using fenthion are its use convenience and its 2-3 week systemic effect.<sup>22</sup> Unlike many conventional flea treatments, the duration of its effect are not limited if the dog swims, is bathed with a non-insecticidal shampoo or is exposed to the light. Disadvantages of using fenthion are its potential toxicity to the user and to the dog.<sup>22</sup> Fenthion has been responsible for more unintentional intoxications than any other parasiticide currently available.<sup>8</sup> Human intoxication due to fenthion exposure during or after its application, or pet intoxication due to excessive dosage application, is a potential problem with the drug. To minimize the possibilities for human exposure, gloves need to be worn when applying the product to prevent skin absorption. Because fenthion is absorbed over an 8-hour period post-treatment, contact with the

<sup>a</sup>Prospot Haver-Lockhart Corp., Shawnee, KS 66201.

dog should be restricted for at least that period of time. To minimize pet intoxication, the drug should not be used at less than 2 week intervals for a period longer than 6 months, should not be used on sick, stressed, convalescing dogs, on pups less than 10 weeks of age, or on cats. In addition, fenthion should not be used with muscle relaxants or CNS depressants, and as other cholinesterase-inhibiting compounds, should not be used with drugs having the same method of action.<sup>8</sup>

Cythionate (Proban)<sup>b</sup>, an organophosphate, is taken orally and rapidly absorbed from the animal's stomach and intestine and is distributed throughout the body. As with fenthion, fleas are killed when they ingest the drug from the animal's body fluids.<sup>13</sup> Cythionate's effectiveness is questionable. Although it is labeled as effective for a period of 3-4 days, drug levels may not be effective for this entire time period.<sup>27</sup> Cythionate has less potential for human toxicity than does fenthion because those who contact the dog after its oral administration are not exposed to the drug.<sup>13</sup> Though relatively safe for both pets and owners, cythionate should not be used with the same precautions as Fenthione.

Veterinarians should stress to their clients the necessary precautions for safe insecticide use. As most accidental poisonings could be prevented with proper storage and application, it is important that pet owners read entire product labels.<sup>8,10,21</sup>

Cats are especially susceptible to insecticide toxicity. They ingest more insecticide because of their meticulous grooming habits, and they metabolize insecticides at a slower rate than do dogs. Consequently, many flea control products are not labeled for cats.<sup>15</sup>

Care must be taken to note differences in individual tolerance to insecticides. Young and/or debilitated animals should be examined before treatment with a full-strength application of an insecticide.<sup>15</sup>

Flea dips should be applied with gloves. Unless otherwise specified on the label, dogs can be safely dipped weekly, while cats should be dipped at 10-14 day intervals.<sup>15</sup> Some authors recommend that puppies and kittens less than 3 months of age should not be treated with insecticidal dips.<sup>3</sup>

Flea collars generally contain organophosphate insecticides. Although the commonly used insecticide chlorpyrifos is very toxic to cats, the drug is released slowly enough from the collar that

toxicity has not been a significant problem.<sup>26</sup> Care must be taken to prevent cumulative toxicities when flea collars are used in conjunction with other methods of flea control. In some studies, flea collars have produced systemic signs of intoxication and contact dermatitis in the absence of additional insecticide use.<sup>15,21</sup>

For effective flea control, treatment of the animal needs to be coordinated with a thorough treatment of the environment.<sup>13</sup> Environmental cleanup includes a thorough vacuuming of carpet and upholstery, with a primary focus on areas where the pet spends most of his time. Though expensive and time-consuming, steam cleaning can be used as a method of killing eggs with certainty. Pet bedding and human bedding frequented by pets should be washed thoroughly and machine dried on maximum heat setting.

The house can be effectively treated with foggers containing organophosphate and carbamate adulticides and the growth regulator methoprene. Areas inaccessible to the fogger mist such as floors beneath furniture and beds, cracks, and crevices should be sprayed with a premise product containing a fast-acting pyrethrin, long-acting organophosphate, and methoprene. A small outside exercise area should be fenced in and treated with products available for yard application. All pets in the household should be bathed and dipped weekly with flea control products and treated every other day with a topical spray containing synergized and microencapsulated pyrethrins. As pet treatment is continued, the inside and outside environment should be treated at 2-week intervals until the fleas are eliminated.

The safest and yet effective flea control program that could be used in a household with infants or small children, would include pet treatment with the adulticide d-limonene, and environmental treatment with the adulticidal/larvacidal combination of microencapsulated pyrethrins and methoprene.<sup>26</sup>

If a pesticide toxicity is encountered, toxic principles and therapy can be obtained from the National Pesticide Telecommunications Network (1-800-845-7633), which is for use by health professionals only. Another reference for both veterinarians and pet owners is the National Animal Poison Control Center at the University of Illinois at Urbana-Champaign (1-217-333-3611).<sup>10</sup>

<sup>b</sup> Proban. Haver-Lockhart Corp., Shawnee, KS 66201

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