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How to prevent and control flea infestations in cats?

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ABSTRACT

Fleas are generally obligate ectoparasites having complex life cycles and live on the blood of the host. Common outcomes of flea infection include loss of blood, allergy, irritability, and transmission of diseases associated with bacteria, parasites, and viruses. Various studies have been done regarding the control and treatment of cat flea infestations. In this article, different ways to control fleas in cats including biological control, chemical control, vaccination, and herbal control methods have been discussed.

Introduction:

The cat flea *Ctenocephalides felis*, is of great significance affecting both domestic dogs and cats worldwide [1]. A cat flea can also cause FAD (flea allergic dermatitis). FAD is a hypersensitive state brought on within the host by means of injection of salivary antigens during feeding. In addition, cat fleas are also responsible for the transmission of the Feline leukemia virus [2]. From environmental treatments to the use of ectoparasiticides, many measures have been practiced for this purpose. Alternative modified ways to control cat flea are also under discussion for the past two decades [3].

Biological Control:

Studies have been done to control cat flea infestations by using living organisms like bacteria and fungi [4]. Recent studies have shown that the spores of the fungus *Beauveria bassiana* after exposure to red LED light and fluorescent lightning produces rapid death of cat fleas, killing 100% of fleas within a short duration of 36 hours [5]. However, the research regarding biological control still remain limited.

Vaccines:

Scientists are also working on the development of vaccines against fleas for the past 40 years. Vaccines serve the benefits of being less hazardous to the environment, having zero insecticide resistance, and targeting a wide but specific range of parasites [6]. Vaccines also have certain disadvantages including innate immunity loss, problems in collecting flea extracts, and serine proteinase in flea mid-guts [7]. If we become successful in determining the genomic sequences that encode for the proteins of flea hindgut and malpighian tubules, we will be able to devise many modified flea control strategies using the molecular biology approach [8]. Vaccination of cats basically impairs the reproductive capability of fleas thus providing immunity with an efficacy of 32-46% [9]. Similarly, the identification and use of genomic sequences of flea saliva proteins and antigens have helped in alleviating the allergic effects of FAD [10]. But the development and then safe administration of such types of vaccines is quite difficult and time taking process. However, vaccines that suppress the reaction of the body against flea bites are expected to be available in near future.

Botanical-based compounds:

Among the plant-based compounds essential oils (EOs) are widely used to control parasitic insect attacks [4]. EO preparations of mugwort, lemon, juniper, lavender, lemon balm, and cedar are useful but have less experimental support [12]. Plant products with d-limonene as an active ingredient are registered for use against fleas [1,13]. Similarly, carvacrol and nootkatone are useful killers of oriental rat fleas (*Xenopsylla cheopis)* [14]. Incense cedar, Port Orford Cedar, and western juniper against *X.cheopis* species and California Peppertree (Schinusmolle) extracts were effective against adult *C. felis* [15] . The use of filter papers treated with EOs like clove oil gave 100% control against flea larvae and eggs within 24h [16]. These products are supposed to be used with proper veterinary consultation, otherwise, they can inflict many dreadful effects as the external use of Australian tea tree oil causes adverse nervous disorders and muscle twitches in dogs and produces toxicosis in cats leading to death [17]. Similarly, spot-on products containing peppermint oil, cinnamon oil, and clove oil produce nervous instability in cats [18]. Research has shown that certain EOs exhibit a specific repellent property against fleas that does not allow them to come in contact with the animal. These EOs include *Cinnamomum osmophloeum* (leaves), *Taiwaniacryptomerioides* (heartwood), and *Plectranthusamboinicus* (leaves) which provide protection to cats [19]. Extracts of monk's pepper (*Vitex agnus castus*) seeds also provide a 6h flea repulsion in cats [20].

Chemical Treatments:

Chemical treatments are also used with the main aim to treat pets and prevent flea multiplication. Among these chemical compounds are Aminoglycosides which include spinosads. Spinosads are obtained when the bacteria *Saccharopolyspora spinosa* is subjected to fermentation. Spinosad is given in oral dosage form and provides protection against cat fleas for several months [4]. Insect growth regulators (IGRs) like methoprene and pyriproxifam inhibit flea egg hatching and metamorphosis and lufenuron interferes with the viability of eggs [4, 21]. Chlorfluazuron and dicyclanil are also lethal to cat fleas [22]. A new class of insecticides Isoxazolines mainly act by behaving as non-competitive antagonists of GABA receptors [23]. They are also effective against certain species of mites, ticks, lice, triatomine bugs, mosquitoes, biting flies, and sea lice in addition to cat fleas. Afoxolaner was first introduced in 2014 in the market as both an oral and topical product against fleas and mites in dogs [24]. Fluralaner prevents the reinfestation of pets and kills 100% of fleas. It is used as spot-on in combination with moxidectin and provides more effectiveness than the topical application of popular insecticide combination fipronil + Methoprene [25]. Lotilaner is given orally. Its main function is to retard the normal production of eggs [26]. Sarolaner is another chemical product that is 10 times more potent than fluralaner and afoxolaner. It is also given orally. Experiments have shown that it provides maximum protection against flea attacks for up to 35 days [27]. These chemical treatments can also kill certain types of other external and internal parasites. Isoxazolines not only prevent flea and tick infestations but also kill a wide range of nematodes and heartworms. For this purpose, Isoxazolines are given in combination with certain endo-parasiticides (i.e., macrocyclic lactones). Isoxazolines are also effective killers of *Demodex* mites in dogs with lesser side effects [28]. *Triatoma infestans* (a principal vector of Chagas disease) is a bug that lives by feeding on the blood of dogs. Afoxolaner or Fluralaner was given orally to the infected dog providing 100% eradication of triatoma bugs [29]. A combination of selamectin+sarolaner is used topically to treat *Dirofilaria immitis* in cats [30]. Afoxolaner has also been proven to be an effective repellent of the yellow fever mosquito Aedes Aegypti [31].

Future directions:

Scientists have developed an innovative strategy to control flea attacks in the future. It is by the use of RNAi delivery systems that target specific nucleic acid sequences and block the expression of selective genes in both insects and acarine [32]. Although many chemical treatments in present use are effectively controlling *C. felis* infestations, there is still a need to keep the susceptible flea populations under monitoring to detect any changes in their genome that will produce insecticide resistance [33]. *C. felis* proliferation in the environment can be controlled by treating the Feral animals with appropriate drugs (e.g, Isoxazolines) as they act as reservoirs of cat fleas.

Conclusion:

The advancements in the development of modified strategies to check flea infestations have greatly altered the extent to which cat fleas are controlled in urban areas. Today, there is a lesser need for environmental treatments. Animals are treated with appropriate drugs and that is enough for their protection. Some of these might not be affordable for all but other insecticides with IGRs are a good economical alternative.

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