

INDOOR ALLERGENS: DUST MITES, CATS, DOGS, AND COCKROACHES

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Introduction

Dust mites, cockroaches, cats, and dogs are known to produce potential allergens. Recent advances in technologies allow testing and monitoring of these allergens in the indoor environments possible. This technical fact-sheet discusses these allergens in detail. For more background information regarding the allergens, you may refer to EMLab P&K's Micromenances (November, 1998).

When and why to sample and test for allergens

All four groups of the allergens are known to cause allergic reactions and respiratory diseases to sensitive people. If allergic reactions are reported, considerations should be given to sample and test for these allergens even though no dust mites and cockroaches are observed and no cats and dogs are allowed in the building. Dust mites are difficult to impossible to see by the naked eye. Cockroaches are often hidden in dark. Allergens from cats and dogs may be carried into buildings by cat and dog owners.

How to take samples for allergen testing

A detailed protocol is described in this fact-sheet (page 2). Other techniques may be used for taking samples for allergen testing. Samples should be collected from fleecy materials (carpets), porous materials (pillows and mattresses), or upholsters (sofa and chairs). A half a teaspoonful of dust is necessary to conduct a meaningful test. One sample can be tested for all four groups of allergens discussed in this document.

What do the results mean?

The following list is to assist you on result interpretation.

1. **Dust mite allergens:** Two species of dust mites (*Dermatophagoides pteronyssinus* and *D. farinae*) are common in the US. Allergens of these two species are the standard allergens tested. They produce several allergen species. Der f I and Der p I are the two major allergens recommended for routine testing. Der f II and Der p II are more stable and may be tested to determine if a cleanup is effective in removal of dust mite allergens.

Clinical guidelines of “safe” and “unsafe” levels were developed based on the correlation of dust allergen levels and patient symptoms. Levels of Group I allergens (Der p I and Der f I) below 2 µg/g of dust are considered “low and safe”. Levels of group I allergens between 2 and 10 µg/g of dust are considered “moderate” and likely to cause sensitization in genetically predisposed individuals. Levels of group 1 allergens greater than 10 µg/g of dust are considered “high” and expected to provoke exacerbations of allergic diseases, such as asthma.

2. **Cockroach allergens:** There are several species of cockroaches inhabiting US buildings. The two most common species found in homes are the American cockroach (*Periplaneta americana*) and the German cockroach (*Blattella germanica*). The German cockroach is particularly common in large cities and in the southern US. These are also the two species that have been extensively studied for respiratory allergic diseases.

Three major cockroach allergens have been identified, two from the German cockroach (Bla g I and Bla g II) and one from the American cockroach (Per a I). **Currently, an ELISA based test specific to Bla g I is the only test available commercially to detect cockroach allergen in settled dust.** Detectable levels of cockroach allergen have been measured from buildings of various uses, including homes, schools, day care centers, office buildings, and cafeterias. However, **no clinical guideline of “safe or hazardous” levels** is available presently. The current “safe” approach is to use both pesticide application and environmental control to reduce or eliminate both cockroach populations and allergen levels when cockroach allergens are detected and cockroaches are sighted.

3. **Cat allergens:** Cats are common pets in US homes. It is estimated that cats are in over 25% of American homes. The most recently available data suggest about 2% of the U.S. population are allergic to cats. This number is generally believed to be low.

Cats (*Felis domesticus*) produce several allergens, but the most abundant allergen is Fel d I. A monoclonal antibody-based ELISA test specific to Fel d I is available commercially to measure the allergen in environmental samples. Homes with cats often had cat allergen levels exceeding 10 µg/g of dust, while cat-free houses had levels below 1 µg/g. In offices where cats are not allowed, significant levels of cat allergens were associated with carpets and upholstered chairs of cat owners.

There are clinical guidelines proposed for “safe and hazardous” levels of cat allergens. “Low and safe” levels of allergens of Fel d I are considered to be below 1 µg/g of dust. Levels of the allergen between 1 and 8 µg/g of dust are considered “moderate” and likely to cause sensitization in genetically predisposed individuals. Levels of the allergen greater than 8 µg/g of dust are considered “high” and expected to provoke exacerbations of allergic diseases, such as asthma. It is also important to note that cat allergen is carried by small particles of less than 2 µm diameter. The particles are easily aerosolized and stay afloat in the air. An allergic individual can immediately become aware of the presence of the cat and its allergen.

4. **Dog allergens:** Dogs are the most common pets in US homes. It is estimated that dogs are in over 40% of American homes. However, there are observations to suggest that fewer people are sensitive to dog than to cat allergens. These may be due to the facts that more cats are kept indoors and dogs are washed more frequently. A regional study suggested that dog allergies occurred in 17% of the population tested.

Dogs (*Canis familiaris*) produce at least 28 allergens. One major allergen was identified as Can f I and it has been demonstrated that dog allergic patients reacted to it. The allergen was found in hairs, danders, and saliva. A monoclonal antibody-based ELISA test specific to Can f I is available commercially to measure the allergen in dust samples. Studies using this assay showed that most homes without a dog had less than 10 µg/g of dust of Can f I while homes with dogs had significantly higher Can f I at 120 µg/g of dust.

Unlike cat allergen, there are currently no clinical guidelines for Can f I or other dog allergens developed. It is not known whether dog allergen becomes airborne in significant levels or the size of particles of which Can f I is carried.

Control and Prevention

For people with allergic history to the allergens, avoiding airborne exposure is the best means of controlling health problems and symptoms. The primary sources of the allergens are in settled dust. It is, therefore, important to minimize aerosolization of the allergens in the dust. HEPA vacuum cleaner should be the cleaning equipment of the choice in the environment where the allergens are detected. Increase ventilation and filtration to dilute and reduce airborne allergen concentrations may be useful in the homes and work environments of allergy patients.

People sensitive to dogs and cats should not allow dogs and cats into their indoor environment. However, it is often very difficult to detach these pets from their owners. Frequent washing of the pets can help reduce allergen load in the environment. Good housekeeping procedures and practices can reduce allergen levels of dogs and cats as well as dust mites and cockroaches.

Moisture control can help keeping dust mite and cockroach populations under control. Removal of food sources in the open is recommended if cockroach infestation occurs. Routine HEPA vacuuming reduces food source for dust mites. Application of pesticides may be necessary if populations of dust mites and cockroaches are out of control. However, allergens may persist for a period of time even though dust mite and cockroach populations are reduced or eliminated from the environment.

Frequent hot water washing of pillows, bed covers, linens, clothing, and rugs can reduce allergen levels. HEPA vacuuming of carpets, sofas and couches can also reduce allergen loads. Steam shampooing is often suggested as a possible solution to allergens in carpets. However, frequent steam shampooing may allow microbial growth to occur unless carpets are dried

quickly. Application of allergen de-naturalization chemicals, such as tannic acid, may temporarily reduce allergy symptoms. However, such application only has temporary effects if allergen sources are not removed.

It is important to note that good housekeeping not only decrease allergen levels but also reduce the possibility of dust mite and cockroach infestation.

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Sampling Protocol: Collecting Dust for Indoor Allergen Analysis

1. Obtain 37 mm, three-piece filter cassettes. Polycarbonate or PVC membrane filter is preferred. Although MCE filter is fine, it is brittle and may break under vacuum pressure. Pore size of 0.8 μm is recommended.
2. Connect the cassette to a high volume vacuum source running at 10 to 20 liters per minute (lpm).
3. Open the cassette cover and turn on the pump.
4. Use the cassette to vacuum dust from pillows, blankets, sheets, mattress, carpet, window covers, upholstery, office furniture and partition dividers.
5. Vacuum a suspect item for at least 5 minutes or until one half of a teaspoonful dust is collected in the cassette. It is important to have approximately 0.25g of dust available for the analysis. One dust sample can be analyzed for all allergens discussed.
6. Remove the cassette, cover it, and seal the entire cassette with a piece of masking tape to prevent the cassette from becoming open during shipping.
7. Label the sample. Complete the chain-of-custody sheet and send with the samples to EMLab P&K for analysis. Samples can be shipped at ambient temperature.

Collecting Air Samples for Indoor Allergen Analysis

Air sampling for indoor allergens are not recommended because the sampling and analytical method are not sensitive enough. It is occasionally necessary to sample and test for airborne allergens. The following air sampling protocol is for your reference.

1. Obtain 37 mm, three-piece filter cassettes. Polycarbonate or PVC membrane filter is preferred. Although MCE filter is fine, it is brittle and may break under vacuum pressure. Pore size of 0.8 μm is recommended.
2. Connect the cassette to a high volume vacuum source running at 10 to 20 liters per minute (lpm).
3. Open the cassette cover, place the filter side up, and turn on the pump. Collect for at least 24 hours.
4. Remove the cassette, cover it, and seal the entire cassette with a piece of masking tape to prevent the cassette from becoming open during shipping.
5. Label the sample. Complete the chain-of-custody sheet and send with the samples to EMLab P&K for analysis.

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