



Report Supporting Document

INDOOR ALLERGENS

Allergens from dust mites, cat, dog, cockroach, rodents, and mold pose one of the most common serious health threats in indoor environments. The allergens produced by these organisms, can cause allergic symptoms by becoming aerosolized and entering the human airways or by direct contact. Respiratory symptoms typically include wheezing, coughing, sinusitis, chronic or perennial rhinitis, and allergic asthma. When these allergens come in contact with the skin, it may cause, dermatitis (eczema), hives and itching; or in the eyes, it may cause itching, burning, swelling, and watering. Some allergens such as cockroach and cat also have been shown to exacerbate symptoms or trigger asthma. In addition to their allergenic potential, cockroaches and rodents pose serious threats as disease vectors.

Common Indoor Allergens

1. Dust Mite Allergens

Dust mite allergens are considered one of the most potent allergens found in indoor environments. They feed on debris of animals and plants and thus are found mostly in sleeping quarters and high-use areas with carpets and upholstered furniture where human skin scales and animal dander collect and serve as food. The fecal material and small body parts of the mites are the primary source of allergens. These can easily become airborne when dust is disturbed. Dust mites are a member of the arachnid family, which includes spiders, chiggers, and ticks. They are 8-legged spider-like creatures that measure less than 1 mm in length. The two most commonly species found in the U.S are *Dermatophagoides farinae* and *D. pteronyssinus*. Allergens of these species are known as *Der f1* and *Der p1* respectively.

2. Dog and Cat Allergens

Of the domesticated animals found in urban areas, cats are one of the most allergenic. Studies have shown that sufficient cat allergen can be carried on owners clothing and it can cause severe allergic reactions in co-workers that do not own cats. Dogs are far less allergenic than cats. Allergic reactions to both cats and dogs are caused by proteins found mainly in the animal's saliva, urine, and to a lesser extent in their dander. *Fel d 1* and *Can f 1* are the most common allergens from cat and dog, respectively. They are small-molecular-weight proteins that are able to circulate on the air currents throughout homes. In additions, these allergens are also sticky and become easily attached to clothes, walls, and furniture, making it virtually impossible for any room to be completely allergen-free. As a result, several reports have shown that dog and cat allergens are present in more than 99% of the homes in the US regardless of the presence or absence of these pets at the time of testing.

3. Cockroach Allergens

Allergy reactions caused by cockroaches are produced from exposure to their saliva, fecal material, eggs, secretions, and cast off skin. Cockroach allergens are similar to those of dust mites in that they occur in house dust and bedding. The most common cockroach allergens found in the US are from the German cockroach (*Blattella germanica*) the *Bla g 1* and *Bla g 2* to which analytical tests are available. The symptoms of cockroach allergy do not differ from other types of inhalant allergies.

4. Rodent Allergens

Rodent allergens include rat and mice allergens. These allergens are especially important in laboratories where these animals are handled for research and in establishments and in homes where mice and rats are kept as pets as well as in inner-city houses or buildings. Allergic reactions are most common in people handling the animal's bedding and cage-washing. Mouse allergens have been found in over 80% of the US households in the inner-city areas. These allergies are mainly caused by the rodent's saliva, urine, and dander. In addition to the allergenic potential, rodents can pose a serious threat to humans by carrying diseases such as Hantavirus. Exposure to such diseases is generally rare but when it does occur, can cause severe health problems or even death.

5. Mold Allergens

Molds are certain kind of fungi that grow by producing mycelia which many times looks fuzzy or velvety. Molds produce tiny spores to reproduce that can move through indoor and outdoor air continually. When mold spores land on a damp spot indoors, they may begin growing and digesting whatever they are growing on such as wood, paper, carpet, drywall, or foods. When excessive moisture or water accumulates indoors, mold growth will often occur, particularly if the moisture problem remains undiscovered or un-addressed.

Sampling Methods

An effective method for testing for indoor allergens is by sampling house dust, as this is the most likely reservoir for these allergens. Dust may be sampled by vacuuming dust from different porous material such as carpets, pillows, upholstery, etc. Different devices are available but the most common ones use a sample collection device or sleeve that is placed over the extension hose of a normal vacuum cleaner. The area is then vacuumed (a new device should be used for each sampled area) and the whole device is sent to laboratory where dust will be tested. It is imperative that the samples have at least a visible amount of dust (preferably a spoonful) to be able to perform analyses for all different allergens from same sample. One strategy is to sample in an X pattern across the desired surface (flooring, bedding or furniture). By determining the actual area sampled, you can get data per gram of dust and per square meter (or per square centimeter) of area. Some other suggested strategies for sampling are air and swab samples which can also be tested, although in this case, allergens might have to be in considerable large amounts to be detected by the analysis.

Analysis and Data Interpretation

Allergen analysis is done by an ELISA (Enzyme-Linked Immunosorbent Assay) test which uses antibodies to detect the presence of these allergens or antigens in the sample. The results are reported in µg/g of dust for dust mite, dog, cat, rodents and mold or in units (U)/g in the case of cockroach. Some guidelines for thresholds for each allergen have been proposed by different publications reporting them as "low" or "safe", "moderate" and "high" risk depending on their ability to cause allergic reactions. Most investigators have adopted these criteria to determine the management and control strategies best suited to decrease or eliminate the dangers these allergens may pose. The specific sensitivity to these allergens will be determined not only by the level of the allergen but also by the individual's specific immune system and previous sensitization.

Result Significance:

Low – This allergen level is considered safe or low risk of sensitization or symptoms.

Moderate – This allergen level is considered moderate and has been reported to cause allergy sensitization or symptoms in sensitive people.

High – This allergen level is considered high risk and has been reported to exacerbate other allergy-related symptoms including asthma.

Not Significant/Significant – In the case of dog and cockroach allergens, there is no specific/official guideline as per the threshold limit value, the level of significance is determined based on published studies.

1. **Dust Mites:** Allergen levels below 2 µg/g are low; levels between 2-10 µg/g are moderate and have been reported to cause allergy symptoms in sensitive people. Levels above 10 µg/g are considered of high risk and have been reported to exacerbate other allergy-related symptoms including asthma.
2. **Cat:** Levels below 1 µg/g are considered to be safe while levels between 1-8 µg/g are moderate and able to trigger some allergy symptoms. Levels above 8 µg/g are of high risk and have been associated with intensification of more severe symptoms such as asthma.
3. **Dog:** There are no scientific studies as per to a determined threshold trigger allergies, in general, same rules as for cat allergens are being followed. Allergen level above 10 µg/g is considered significant.
4. **Cockroach:** As in the case of dog allergens there are no official guidelines as per the levels where cockroach allergens may oppose a problem. However, due to the high correlation of these allergens with asthma in kids, most reports suggest zero tolerance in any household. A more recent study suggests that 2U/g of dust may be treated as the threshold for cockroach allergen, although this information has not become official. For this report, cockroach allergen level above 2 µg/g is considered significant.
5. **Rodents (mouse and rat):** No known threshold levels have been reported for these allergens. As with cockroaches, many reports recommend a zero tolerance due to the disease potential as well as the allergenic threats. Any levels of these allergens call for control and management techniques.
6. **Mold allergens:** Since mold allergens can be caused by many different species and commercial testing is available only for few of these species. Although risk levels have not been established, any building materials supporting mold growth should be remediated and the source of moisture eliminated.

Management and Control of Indoor Allergens

In order to eliminate or minimize the allergies caused by most allergens, an integral control of dust from the environment is imperative. As such all bedding, carpets, furniture, and other textile home furnishings such as draperies should be thoroughly vacuumed with a HEPA filtered vacuum on regular basis and washed in hot water as frequently as possible. Also encasing mattresses, springs, and pillows in allergen-impermeable covers, and removing carpet, when possible, is advisable. **Dust mites, and molds** can survive and reproduce at environments with high humidity so maintaining humidity in the environment lower than 40% will also aid in controlling these allergens.

In addition, elimination of factors that favor **cockroach and rodent** survival is imperative. Some of these factors include food sources (food crumbs, wall paper, paints), water supplies (sweating pipes, standing water, moist areas), and hiding places (cracks, cervices, cardboard boxes, etc.). A “precision-targeted”

IPM (Integral Pest Management) program has proven very effective in cockroach cleaning and is especially designed for households with small children who are more sensitive to pesticides. The system must include an initial determination of the "hot-spots" that harbor the pest(s) in order to target the intervention with safe pesticides and traps, followed by HEPA-vacuuming and thorough wet-cleaning of the household.

In cases where allergic reactions to **cats or dogs** are severe, the most effective route might be the complete removal of pets from the indoor environments followed by the intense cleaning of air ducts, replacement of HVAC filters and a thorough cleaning of the residence.

Elimination of **mold** allergens must begin by locating the source of the mold in the indoor environment. Prior to any cleaning, the source of moisture must be eliminated to prevent future mold growth. Affected areas must be removed whenever possible or cleaned and disinfected if material cannot be eliminated; this must be followed by the intense HEPA-vacuuming and a thorough cleaning as stated above.

Glossary

Airborne: Total suspended particulate matter found in the atmosphere as solid particles or liquid droplets.

Allergen: Substance capable of causing an allergic reaction in an individual due to their sensitivity to that substance

Allergy: An exaggerated response to a substance or condition produced by the release of histamine or histamine-like substances in affected cells.

Asthma: A disease of the branches of the windpipe (bronchial tubes) that carry air in and out of the lungs. Asthma causes the airways to narrow, the lining of the airways to swell, and the cells that line the airways to produce more mucus. These changes make breathing difficult and cause a feeling of not getting enough air into the lungs

Atopic dermatitis: The word "dermatitis" means inflammation of the skin. "Atopic" refers to a group of diseases where there is often an inherited tendency to develop other allergic conditions, such as asthma and hay fever. In atopic dermatitis, the skin becomes extremely itchy

Chronic: Disease or condition that persists or progresses over a long period of time

Dander: Small scales of animal skin or hair. Dander floats in the air, settles on surfaces and makes up much household dust.

Eczema: General term for several types of inflammation of the skin.

HEPA: High Efficiency Particulate Air filter which removes small particles by forcing it through screens containing microscopic pores.

Mold: Microscopic fungi that may float in the air. Mold is a common trigger for allergies and can be found in damp areas.

Protein: Molecule made up of amino acids that are needed for the body to function properly

Trigger: Something that can aggravate an allergic reaction but is not necessarily the actual cause of the allergy.

Threshold: The point at which an allergen first produces a reaction.

References

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About Aemtek

Aemtek, Inc. is an environmental microbiology laboratory serving the indoor air quality industry. Its mission is to provide accurate, fast, and reliable expert services for detection, identification, analysis of fungi and bacteria in human environments. Aemtek also provides contracted research and expert testimony services. Aemtek is committed to the highest level of quality, scientific integrity, and customer service.

Aemtek, Inc. implements a series of quality assurance procedures. All analytical protocols are developed based on scientific merits and are validated regularly. Aemtek is accredited by the American Industrial Hygiene Association (AIHA) Environmental Microbiology Laboratory Accreditation Program (Lab No.: 167620)

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