



## Residential Indoor Air Quality Guidelines

### Moulds

#### Physical and chemical properties

The word “mould” is a common term referring to fungi that can grow on building materials in homes or other buildings. Mould growth can influence air quality because both spores and mycelial fragments are dispersed into the air and can be inhaled. Their penetration into the bronchial tree depends on their size. The smaller particles penetrate deeper into the lungs.

Three features of mould biochemistry are of special interest in terms of human health:

- mould cell walls contain (1->3)- $\beta$ -D-glucan, a compound with inflammatory properties;
- mould spores and mycelial fragments contain allergens; and
- the spores of some species contain low molecular weight chemicals that are cytotoxic or have other toxic properties (e.g. satratoxins and atranones produced by *Stachybotrys chartarum*).

#### Causes of mould growth

Mould growth in a house requires the presence of nutrients, an adequate temperature, and a sufficient amount of water. The first two requirements being usually met in indoor environments, fungal growth usually results from a moisture problem (CMHC 2003). Major causes of mould growth are:

- condensation of moisture on surfaces due to excessive humidity, lack of ventilation, or low temperature;

- water leakage, e.g. from a broken pipe;
- infiltration of water from the outside, e.g. from a leaking roof or a cracked basement; and
- a flood.

#### Health effects

Health Canada has carried out two reviews of the scientific literature pertaining to the health effects of indoor moulds (Health Canada 1995; 2004). The Institut national de santé publique du Québec also published a review on this subject (d’Halewyn et al. 2003). The following conclusions were drawn:

- exposure to indoor mould is associated with an increased prevalence of asthma-related symptoms such as chronic wheezing, irritation symptoms, and non-specific symptoms; and
- in laboratory animal studies, instillation of fungal antigens (*Penicillium* sp. and *Aspergillus* sp.) and fungal cell components [(1->3)- $\beta$ -D-glucan] resulted in an inflammatory response in the lungs of rodents, while instillation of *Stachybotrys chartarum* spores resulted in severe histological and biochemical changes.

These conclusions have been supported by more recent findings. In two cohort studies (Wickman et al. 2003; Jaakkola et al. 2005), significant associations were found between home dampness and the risk of developing asthma. In experimental studies, asthma-like

responses were observed in mice following exposure to a typical building-associated fungus, *Penicillium chrysogenum* (Chung et al. 2005), and inflammatory responses were seen in rats exposed to low doses of toxins from the same species (Rand et al. 2005).

## Guideline

Health Canada considers that mould growth in residential buildings may pose a health hazard. Health risks depend on exposure and, for asthma symptoms, on allergic sensitization. However, the large number of mould species and strains growing in buildings and the large inter-individual variability in human response to mould exposure preclude the derivation of exposure limits. Therefore, Health Canada recommends:

- to control humidity and diligently repair any water damage in residences to prevent mould growth; and
- to clean thoroughly any visible or concealed mould growing in residential buildings.

These recommendations apply regardless of the mould species found to be growing in the building.

Further, in the absence of exposure limits, results from tests for the presence of fungi in air cannot be used to assess risks to the health of building occupants.

## References

- CMHC 2003. Clean-up Procedures for Mold in Houses. Revised ed. Ottawa: Canada Mortgage and Housing Corporation. ISBN: 0-660-19227-6.
- Chung, Y. J., Coates, N. H., Viana, M. E., Copeland, L., Vesper, S. J., Selgrade, M. K., Ward, M. D. W. 2005. Dose-dependent allergic responses to an extract of *Penicillium chrysogenum* in BALB/c mice. *Toxicology* 209: 77-89.
- d'Halewyn, M. A., Leclerc, J. M., King, N., Bélanger, M., Legris, M. and Frenette, Y., 2002. Les risques à la santé associés à la présence de moisissures en milieu intérieur. Québec : Institut national de santé publique du Québec. 105 p. + appendices.
- Health Canada 1995. Fungal Contamination in Public Buildings: a Guide to Recognition and Management. Ottawa: Health Canada.
- Health Canada 2004. Fungal Contamination in Public Buildings: Health Effects and Investigation Methods. Ottawa: Health Canada. ISBN 0-662-37432-0. 47 p.
- Jaakkola, J. J. K., Hwang, B. F., Jaakkola, N. 2005. Home dampness and molds, parental atopy, and asthma in childhood: a six-year population-based cohort study. *Environmental Health Perspectives*. 113: 357-361.
- Rand, T. G., Giles, S., Flemming, J., Miller, J. D., Puniani, E. 2005. Inflammatory and cytotoxic responses in mouse lungs exposed to purified toxins from building isolated *Penicillium brevicompactum* Dierckx and *P. chrysogenum* Thom. *Toxicological Sciences* 87: 213-222.
- Wickman, M., Melen, E., Berglind, N., Lennart Nordvall, S., Almqvist, C., Kull, I., Svartengren, M., Pershagen, G. 2003. Strategies for preventing wheezing and asthma in small children. *Allergy* 58: 742-747.

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