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The Monitoring of Filamentous Fungi in the Indoor Air Quality, and Health

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Summary

The air we breathe is essential for life, yet at the same time it is a potential source of contaminants associated with disease. Fungal spores are among the most common airborne bioparticles in air and play an important role in biodeterioration, allergy and many diseases, their concentration and types depend on the environmental parameters, types of vegetation and source of contamination. In this one year survey it was observed that the maximum no. of fungal species was recorded in winter season because of Temperature, Relative humidity and Rainfall favourable for fungal growth ($28 \pm 1^\circ \text{C}$ and R.H. 88%) and minimum no. of fungal species were recorded in summer season because high Temperature and low R.H. and very dry air not favourable for growth of fungal species. The results provide to be helpful to allergologist and clinician in treatment of fungal related disease. This article aims to update current scientific knowledge concerning the health effects of exposure to fungi in indoor air, since most complaints with microbial contamination of indoor air involve this type of microorganism.

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Introduction

In recent years, increased attention has been paid to mould infections, particularly because of the growing incidence of aspergillosis. This mycosis represents a serious medical problem. Today's medical practitioners are often confronted with patients who are exposed to myriad contaminants (often present at low levels) in their indoor environments at home, at school, or in the workplace.

Fungi in indoor air

Where do they come from? The fungi that affect indoor air quality are multicellular organisms formed of microscopic branched filaments called hyphae. A visible colony of interwoven hyphae forms a mycelium, and the mycelioid fungi most commonly found indoors are called molds (Macher 1999); the terms fungus and mold will be used interchangeably in this article.

When windows can be kept open, the kind of fungi in indoor air normally reflect those in outdoor air. To grow and proliferate indoors, however, fungi require a suitable substrate (wood, paper, gypsum board, or other materials that have a high cellulose content) and water. Buildings where there is chronic water damage or where humidity levels are high are particularly at risk of fungal contamination (Macher 1999). Allergenic molds that grow indoors include species from the *Penicillium* and *Aspergillus* genera. When humidity is excessive or water damage exists, *Stachybotrys chartarum* (formerly known as *Stachybotrys atra*), *Fusarium*, *Trichoderma*, and others can grow (N Y 2000). Several authors have tried to estimate the prevalence of homes with high humidity levels and mold growth.

Other health problems. Systemic effects, such as headache, fever, excessive fatigue, cognitive and neuropsychological effects, gastrointestinal symptoms, and joint pain, have also been observed in certain groups exposed to molds. These effects have been less well documented, and their importance is not always clearly established. The potential cause remains unknown, which means that further studies on systemic effects of mold exposure are required (Rylander & Etzel 1999).

What can be done? It is clear that exposure to dampness and mold indoors is unacceptable from a public health perspective²⁴ and that mold, water damage, and musty odours should be investigated immediately (N Y 2000). Certain measures can prevent exposure to molds because moisture must be available for fungal growth. Indoor air pollution has been associated with a wide range of health outcomes.

Fungi are ubiquitous organisms that make up approximately 25% of earth's biomass. Molds are very adaptable and can colonize dead and decaying organic matter (e.g. textiles, leather, wood, paper) and even damp, inorganic material (e.g. glass, painted surfaces, bare concrete) if organic nutrients such as dust or soil particles are available. Because various genera grow and reproduce at different substrate water concentrations and temperatures, molds occur in a wide range of habitats. Constituents of indoor air are determined by both outdoor and indoor sources.

Fungal spores are not equally distributed in the environment their distribution varies according to geographical location and meteorological conditions. During investigation

period 17 fungal species observed indoor of home area Raipur. During investigation period, it is also observed that the maximum fungal species are recorded in winter season, moderate fungal species in rainy season and minimum fungal species are recorded in summer season. Most people spend a majority of their time indoors and that the levels of some air pollutants are higher indoors than outdoors. Fungi are well known as sources for allergens that cause allergic rhinitis, allergic asthma, and extrinsic allergic alveolitis (hypersensitivity pneumonitis). Probably all fungi that may be abundant in indoor environments produces allergens. Arora and Jain (2003) reported minimum number of fungal spores in summer season. Singh and Rakhi (2003) were also reported similar observations at Hardwar, Majumdar and Barui, (2007) at Chennai. Maximum number of fungal species in winter season, minimum in summer season and moderate in rainy season was also observed by Sharma (2001).

Health effects associated with molds

Molds produce acute health effects through toxin-induced inflammation, allergy, or infection. There is no information at this time on the effects of chronic, low dose inhalation exposure to mycotoxins. It is generally an occupational hazard in agriculture, but has been reported in individuals exposed in the home (Flannigan, et al., 1991).

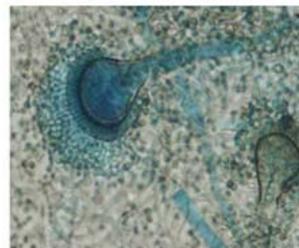
Allergy: Indoor fungal allergens probably affect fewer people than do allergens from cats, mites or cockroaches. Yet a significant proportion (10-32%) of all asthmatics are sensitive to fungi, (Horner, et al. 1995).

Infection: Opportunistic fungal pathogens such as *Aspergillus* are common in indoor air.

Most fungi detected indoors have an outdoor source (Levetin,1995) *Cladosporium* and *Alternaria* species are the most commonly detected fungal genera in outdoor air, originating on the surfaces of plant leaves; but they have been detected indoors also. Other commonly detected indoor fungi include multiple species of *Penicillium* and *Aspergillus*, species which grow readily in topsoil and decay litter. A diverse range of species are commonly detected in both outdoor and indoor ambient air. (Flannigan 1994, Black 2000).



Penicillium crysogenum



Aspergillus fumigatus

Conclusions

Fungi do contribute to allergic disease, and the extent of their involvement is probably greater than is indicated by the available clinical and epidemiologic studies. Further studies are required to establish a causal relationship between exposure to fungi and systemic effects, such as headache, fever, excessive fatigue, and neuropsychological changes.

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