Indoor Mold: A serious threat to occupant health

By John Fallon PhD

The ubiquitous presence of aerosolised fungi is a substantial threat to maintaining a quality of indoor air for all occupants. Moreover, the growing prevalence of sick building syndrome (SBS) in damp or water damaged homes and workplaces and the potential ill health caused by exposure of individuals to pathogenic fungi means that the there is a need to detect the presence of fungal contamination at the earliest possible opportunity. There are a number of genetically distinct fungal entities which have been demonstrated as potentially disease causing in terms of causing allergic sensitivity to fungal conidia including *Aspergillus*, *Penicillium*, *Fusarium*, *Basiodiomycete*, *Stachybotrys*, *Cladosporidium, Mucor, Ulocladium, Scopulariopsis, Petriella* and *Rhizopus* species.

The buoyant nature of conidia and spores is due in part to their size (between 2 - 8µm) which aid dispersion in the presence of wind disturbance and allow for the colonisation of pulmonary tissue. The ability of these fungi to colonise and grow on the numerous materials and textiles used in modern building construction while as being able to withstand significant variation in temperature, moisture and pH represents a significant issue in the context of the immune state of individuals. Patients who suffer from asthmatic fungal sensitisation are particularly at risk of developing allergic and asthmatic reactions to the presence of fungal conidia and spores therefore greatly reducing their quality of life. In cases where individuals are immunosuppressed or have existing pulmonary issues such as emphysema, tuberculosis or cystic fibrosis, conidia from pathogenic fungal species such as *Aspergillus fumigatus* may pose a serious risk as the polar growth of the fungus in the lung can lead to the development of mycetoma (fungal ball) or latterly invasive infection. It follows that the economic impact owing to the cost of healthcare to individuals and the loss of employee productivity as a result of indoor mold growth means that there is an acute need to prevent and eliminate fungal contamination and persistence.

It has been demonstrated that a primary cause of the development of an indoor fungal burden is the accumulation of moisture either through inadequate ventilation, leaks, showers or water damage due to flooding. In the aftermath of incidences of flooding or issues with building integrity the occurrence of mold signified by the presence of musty odours, black mold propagation on walls, the peeling of paint and wallpaper and mold growth on the grout in wall and floor tiling are often indicative of the presence and scope of indoor fungal burden. Worryingly, such observations are often indicative of far greater issues relating to the presence of mold on surfaces and materials which are normally out of immediate view. The saprophytic nature of fungal species means that cellulose containing materials are often an ideal growth medium for mold development.

A common factor in the development of indoor mold contamination is the aerosolization of the asexually produced conidia and other fungal particulates. The cell wall subunit 1,3 β-D-glucan is estimated to comprise 60% of the dry weight of fungi. As fungi grow 1,3 β-D-glucan is shed from the surface of hyphae and become aerosolised and elicit clinical manifestations such as allergic sensitisation and airway inflammation. The presence of 1,3 β-D-glucan as measured by a biochemical assay on the surface of building materials and its aerosolization in heavily contaminated areas therefore represents a significant risk to individuals depending on the level of allergic sensitivity. In addition, the secretion of fungal secondary metabolites from the surface of filamentous fungi is a particular area of concern in the development of silk building syndrome. Such toxins include patulin, gliotoxin, aflotoxins, trichothecene, helvolic acid, verruculogen, ochratoxin and sterigmatocystin which have can act in an immunosuppressive, cytotoxic or tremorogenic manner in affected individuals thus

resulting in diminished occupant health and wellbeing. The presence of secreted fungal secondary metabolites in the indoor environment whereby house dust can act as a reservoir for fungal growth and therefore facilitate the aerosolization of mycotoxins is an issue which poses a significant risk for occupant health therefore early detection is of critical importance.

Mold growth can be inhibited at levels of humidity below 50%. The monitoring and control of moisture through the use of dehumidifiers in homes and workplaces coupled to regular washing of fabrics, surfaces and removal of dust and mold by effective vacuum cleaning are the primary measures that need to be taken in the process of limiting the accumulation of mold in home or in workplaces. In addition effective cleaning and removal of heavily contaminated materials can also reduce fungal burden thus positively impacting on occupant health. Where contaminated surfaces have been previously removed any underlying materials must also be treated due to the penetrating nature of fungal hyphae. The monitoring and control of excessive available moisture in homes and the workplaces have been shown to assist in the limiting of indoor mold contamination.

Profile

John Fallon is a Senior Scientific Officer in the Microbiology Laboratory at **airmid healthgroup ltd**. John graduated from the National University of Ireland Maynooth with a BSc in Biological Sciences. Following completion of his undergraduate studies John remained at NUIM to complete a PhD in the medical mycology unit examining the disease causing potential of environmental isolates of *Aspergillus fumigatus* in vertebrate and invertebrate immune systems.

John has significant experience in the field of mold culture and phenotypic analysis as well as having published data concerning the detrimental effects of mycotoxins produced by *A. fumigatus* on the function of immune cells.

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