C31 Forensic Investigations on Mold Growth in Damp Buildings

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After attending this presentation, attendees will have an increased understanding of the role of mycology in forensic investigations in problem (damp-wet) buildings. The general principles for carrying out mold inspec- tions and mold remediation recognized by cognizant authorities and profes- sional societies will be explained. Limitations of laboratory analytical techniques and data interpretation will also be explained.

This presentation will impact the forensic science community by showing techniques essential for carrying out forensic mycology both in the field (in the building) and in the laboratory will be explained. Some sampling techniques such as collection of cellotape slides are simple and straight forward. Other techniques are complex (e.g., collection of air samples) and not routine. Direct microscope observation of fungal structures as seen in cellotape samples and culture analysis of samples using appropriate growth media (e.g., malt extract agar without dextrose; DG-18 agar, etc.) are used in most forensic studies. Sampling and analytical methodologies involved PCR, identification of mycotoxins, quantification of glucans, and microbial volatile organic compounds are currently the subject of much research interest.

It has been recognized since the time of Leviticus over 3000 years ago that the growth of mold on interior surfaces such as plaster, mortar, and timber in buildings is unacceptable. During the past 50 years mold growth problems in buildings have increased because (A) of greater use of highly biodegradable materials (e.g., products containing paper, fiber-board, porous finishes, etc.) and (B) dampness and water leaks often associated with construction and architectural defects. Mycological studies can be useful in identifying dampness-moisture problems in modern construction and some- times in aiding epidemiologists and physicians determine health risk due to bioaerosols in indoor air.

In a "normal" dry building the rank ordor kinds of airborne mold spores found indoors is usually similar to the rank order kinds of spores present outdoors. Damp-wet buildings are often characterized by unique mold ecolo- gies where *Aspergillus* or *Penicillium* species (e.g., *Penicillium chryso- genum, Aspergillus versicolor)* dominate the indoor air. Cellulose degrading molds such as *Stachybotrys and Chaetomium* often grow on water damaged paper products used in building construction.

Taxonomic studies are useful in determining if a building material was merely damp (xerophilic molds such as *Aspergillus versicolor* or *Wallemia sebi* grow) or soaking wet (hydrophilic molds such as *Stachybotrys*, *Chaetomium, Acremonium* grow).

Long term moisture problems on some building materials are indicated by complex microbial ecologies including the presence of mites and other organisms that feed on molds. The occurrence of fecal pellets containing undigested mold spores is an indication of a long term moisture problem and a long term mold ecology. Some mold species such as *Cladosporium cladosporioides*, *Alternaria alternata,* and S*tachybotrys, chartarum* are characterized by spores with a short half life (< 1 year) with regard to culturability. Thus, the presence of substantial amounts of these *Cladosporium, Alternaria*, and *Stachybotrys* species on moldy building materials suggests the occurrence of recent (< 1 year) moisture damage. Other mold species such as *Aspergillus flavus* and *Aspergillus versicolor* have a long (> 10 years) half life in terms of culturability. A key requirement for successful forensic investigations in moldy buildings always involves use of appropriate sampling and collection techniques in the field plus the collaborative involvement of an expert fungal taxonomist in the laboratory.

Several case studies as follows are presented showing the use of forensic mycology in diagnostic studies in "problem" buildings.

Case #1: *Stachybotrys* was the dominant mold found in spray-on cellulosic fire-proofing found in a new building. This evidence showed that the fire-proofing remained wet after its application and that this condition was likely caused by chronic roof leaks (a construction defect).

Case #2: During rainy periods water was observed on the floor in many rooms along external (envelope) walls in a new building. Air sampling for culturable molds showed that *Penicillium chrysogenum* dominated the mold spores present in indoor air in leaky rooms. Only trace amounts of this mold species were found in the outdoor air and in the indoor air of non-leaky (dry) rooms. This data suggested that a substantial amount of concealed mold growth was present in envelope wall cavities, a hypothesis later confirmed by destructive inspection of the wall cavities.

Case #3: Water leaks from windows were present in many rooms in a new building. Mold growth was visible on the wallboard in some rooms, which were subsequently vacated for mold remediation. Occupants in other rooms in the same building were concerned over long-term mold exposure. Settled dusts were collected from above floor surfaces in occupied rooms and these dust samples were analyzed for the presence of culturable molds. *Stachybotrys*, *Aspergillus*, and *Penicillium* species accounted for > 90% of culturable molds in the settled dust suggesting that occupant exposure in the building was atypical or different from that expected in a well maintained dry building.

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