



Show Number: 717

J. David Miller, PhD

Relative Humidity; It's more than just Mold

Good Day and welcome to IAQ Radio+ episode 717 blog. This week we welcomed Dr. David Miller for a discussion on how relative humidity affects indoor environments. Dr. Miller advised IAQradio that he has something important to say and when Dr. Miller has something to say, people listen.

Prof. J. David Miller Dr. Miller received his secondary education at the University of New Brunswick, before studying at the University of Portsmouth in England, where he was also a NATO Science Postdoctoral Fellow. His post-university career started at Agriculture Canada, where he became head of the Fusarium mycotoxin program. He became a Professor & NSERC Research Chair in fungal toxins and allergens at Carleton University in 2000. In 2020, he was appointed as a Distinguished Research Professor. From 1999-2008, he was a visiting scientist and science advisor at Health Canada in the air health effects division. Among other tasks, Dr. Miller helped to draft the guidelines for mold and dampness published by Health Canada. Over the past several decades, he has co-managed many large studies of housing and health including in First Nations Communities.

Dr. Miller has published >350 papers on fungi and fungal toxins and has co-written 10 books on the public health aspects of exposures to fungi holds multiple patents. Miller has served on many national and international committees on mold and dampness in the built environment including on the American Academy of Allergy Asthma & Immunology committee that produced practice parameters for environmental allergens. He was chief editor of the American Industrial Hygiene Association "Green Book" (2008, 2020) and "Field Guide" (1996, 2005) that lay out guidelines for addressing mold and dampness in public buildings.

Miller is an elected member of the International Academy of Indoor Air Sciences. Among other awards, he received the AgExcellence Award from Agriculture Canada, the Toxicology Forum Scott Award for contributions to toxicology, the Applied Research Award from the Ottawa Life Sciences Council, an AIHA award for contributions to the field of industrial hygiene and the 2017 Award of Merit from the Ontario Maple Syrup Producers Association. In 2013, Miller was elected as a Fellow of the American Industrial Hygiene Association. In 2016, he received the prestigious NSERC Synergy Award for his research partnership with JD Irving, Limited. In 2021, he received the inaugural Philip R. Morey award from the ACGIH for contributions to bioaerosol guidance.

Nuggets mined from today's episode:

Relative Humidity affects many other things besides mold. RH affects comfort; when the RH is too high or too low occupants are uncomfortable. When the gray haired IAQradio hosts and Dr Miller were young our homes were leaky.

The ASHRAE climate map stops at the 49th parallel. People live above the 49th parallel. The Köppen climate classification covers the world. Both Canada and the US have areas of absolute desert, cold polar and hot steamy humid.

A wide variety of hygrometers purchased at a hardware store which showed very inconsistent readings when deployed. Most homeowners who rely on these uncalibrated devices are receiving inaccurate information. 40%-50% RH is a comfort zone. The RH is different in the middle of the room and at windows, profound gradients exist in his photos 28% middle of room and 50% at the window.

Building materials are inconsistent, every building material adsorbs and desorbs moisture differently. The percentage of moisture by weight in a material varies dramatically, to support fungal growth wood needs to have a moisture content of 15%, mold will grow on paper faced gypsum board at only .5% moisture content.

Indoors, *Stachybotrys* likes high AW and most often grows on paper gypsum board facing and cellulosic ceiling tiles. Outdoors, *Stachybotrys* lives on the stems of plants near water sources.

As wet building materials dry mold growth slows down. When temperature and Aw aren't ideal the growth of fungi such as *Aspergillus amstelodomi* slows down. The fungus is nether happy or unhappy.

Some substrates are more nutrient rich than others. Some "surface coatings" such as wallpaper adhesive are highly nutrient rich which lowers the Aw needed for growth..

As some fungi grows, they produce hygroscopic chemicals that capture water vapor from the air. Once there is some growth, even lower RH values will support growth than at the beginning.

Carpet indoors is a common reservoir for fine dust. Dust is a powerful reservoir. Studies show that routine HEPA vacuuming (making 4-6 passes per square meter) is effective in removing the maximum quantity of fine dust from carpeting. HEPA vacuuming reduces exposure to what is there. Reducing fine particles reduces occupant exposure.

Dust mites were first detected in 1970 in the USA and Canada and are now pervasive in our homes and sometimes offices. Dust mite allergen is potent and a known cause of asthma.

Is HVAC ductwork within pipe chases prone to fungal growth? Wet metal ductwork is generally resistant to fungal growth while fibrous HVAC insulation is susceptible to fungal growth. It's

uncommon for steam or hot water heating pipes to cause fungal growth in chases or wall/ceiling cavities.

Why doesn't *Wallemia* show up on mold lab reports? Can grow in house dust. Specialized expertise is needed to identify *Wallemia* and most culture media will not support this fungus, often found on high sugar substrates like maple syrup. Yet a fair percentage of people are allergic to it.

Is there a norm as to when and where fungal amplification will occur within a building envelope? It depends on the design of the exterior building envelope, moisture barriers and the risks for water intrusion from either direction. Investigation will require thought, take time, and require cutting or drilling access openings into wall and ceiling cavities.

Do HEPA air cleaners really reduce airborne particulate? HEPA air cleaners are designed to remove airborne particles NOT remove fine particles trapped in reservoirs such as carpet. Intervention which removes fine airborne particles is known to benefit child respiratory health.

RH affects the viability of airborne viruses. It turns out that RH in the range of 40-60% reduce the survival of the common infectious viruses in air, compared to higher or lower values.

RH affects us too. An elegant study, "Wellbuilt for Wellbeing: Controlling RH in the workplace matters for our health." Used personal samplers to see where exposures occurred. "We examined the association between RH and objectively measured stress responses, physical activity (PA), and sleep quality. A diverse group of office workers (n = 134) from four well-functioning federal buildings wore chest-mounted heart rate variability monitors for three consecutive days, while at the same time, RH and temperature (T) were measured in their workplaces. Those who spent the majority of their time at the office in conditions of 30%-60% RH experienced 25% less stress at the office than those who spent the majority of their time in drier conditions. Further, a correlational study of our stress response suggests optimal values for RH may exist within an even narrower range around 45%. Finally, we found an indirect effect of objectively measured poorer sleep quality, mediated by stress responses, for those outside this range."

Endotoxin exposure? Outdoor air, tracking outdoor soil, and pets are three common ways that endotoxins from outdoors get indoors. In the past, humidifiers would be reservoirs for endotoxins. Old style humidifiers are heaven for mold and bacteria. Higher versus lower endotoxins in air and dust in homes affects child health and affects response to allergens like that of house dust mites.

Dr. Miller's Final Comments:

- IN north America, outdoor air pollution has continuously dropped since 1978 so our exposures indoors including of outdoor air pollutants from settled dust..
- It's more than mold

- The new ACGIH BioAerosols Assessment and Control book will be released in 2024.

Z-Man Signing Off

TRIVIA- Name the most toxic and carcinogenic mycotoxin that has been directly correlated with causing liver cancer in multiple animal species and in humans?

Answer: Aflatoxin B1

Answered by: Don Weekes, Ottawa, Ontario, Canada

References on slides

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