PART 1

Indoor Airborne Mycotoxins

ARE THEY IN HIGH CONCENTRATIONS IN THE AIR YOU ARE BREATHING?

By Robert Goldsworthy

Background

For decades we have heard the term “Toxic Black Mould” which has largely been used by the media to describe a particular mould, Stachybotrys chartarum. The “toxic” part of this term refers to mycotoxins, literally fungal poisons, that can be produced by many species and sub species of moulds, not strictly just S. chartarum. Much of the mycotoxin knowledge that we have today is due to testing within our foods and feeds, commonly referred to as commodities, that are routinely tested and highly regulated for their mycotoxin content simply because the dangers of ingesting these toxic poisons are known.

In recent years, there has been a suspected link between water damaged homes, mould, and mycotoxins. The link was confirmed by collecting dust and spore samples which resulted in evidence of relatively small amounts of mycotoxins being detected which placed doubt over whether this would have any detrimental effect on the health of humans. This was not the opinion of those suffering from suspected mycotoxin related illness/s who have created many online forums and Facebook groups, neither was it my opinion but I had to prove it.

There were several take home messages here, including that the samples being analyzed were settled samples, for example collection from surfaces, or what may settle on a plate, some of these samples were also being compared with outside samples collected. Inherently, the biological fungal make up outside is very different to that of the inside, meaning that they are not comparing like with like. The biggest take home message for me was that they were being detected. What I wanted to know was how much, if any, existed in the air and what we are actually breathing in from possible airborne mycotoxins within our homes and buildings.

Background Continued

It is important at this time to point out some general differences that must be considered when discussing moulds and mycotoxins. From a human health perspective, moulds including mould spores, are generally classed as allergens which are trapped in mucus membranes and most commonly cause irritation to the nose and throat resulting in coughing, sneezing, runny noses, and general allergenic type symptoms. Mycotoxins, on the other hand, can readily make their way to the lungs, respiratory system, and subsequently into the blood stream. Some mycotoxins are known to be carcinogenic, others known to cause neurological symptoms, and even more varieties that can cause many unspecified health consequences. For those suffering with illness, it was important for me to pursue mycotoxins.
In addition, moulds are biological whereas mycotoxins are a chemical. The microbiological field is very different to the field of chemistry.

Importance of mycotoxins over molds

As I embarked on this journey, previous research established that individual moulds could produce more than one type of mycotoxin and specific mycotoxins could be produced by various genera of moulds. It was evident that no assumptions could be made as to the expectation of a specific mycotoxin being present just because a specific species of mould was present. This highlighted the importance to me that we must look for the mycotoxins. If mycotoxins were present, it became unimportant as to the variety of mould that may currently or historically have been active.

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My Research

There are differing theories as to how and when mycotoxins are produced and released.

I hypothesized that because mould produces mycotoxins and requires moisture to grow, that they were aerosolised via evaporation, and movement. From a toxin point of view, we know that those mycotoxins that are released by moulds have a hydrophobic quality, meaning that they do not like moisture, with possibly only the fumonisins being hydrophilic. Being hydrophobic, they will not dissolve in the moisture/water that is aiding the mould growth and therefore will actually sit on top of the moisture. Water molecules are in constant motion. Those that have enough energy and are nearer the surface can escape into the air, thus we have evaporation. In the case of indoor mould growth, the water is usually near the surface creating the perfect conditions for water molecules to start the evaporation process in most temperatures. My theory was that this would in turn release the mycotoxins into the air where their relative weightlessness would enable them to remain suspended for very long periods of time and to be resuspended via air movement through normal activities within a home. My challenges were how to collect them, how to analyse them, and how to quantify them.

I researched many methods for their suitability to collect mycotoxins in the air. I settled on two that I believed may be suitable. I then engaged three people to set about collection of the air samples. Next, the samples were sent to an independent laboratory who routinely analyse commodities, that being food and feed, for their mycotoxin content. The results we received back were astounding as some of them were many times higher than that permissible in our foods.

Over the next few months, we collected many more samples and continued to have them processed by the external laboratory. I sat down to review all of the collection and result detail and realized that we needed to further narrow our study if we were to compare like with like. We decided on one collection technique and set the criteria so that collection rates and times would always be like for like. A review of the external laboratory analysis showed some inconsistencies as well. We then decided on one analysis technique. Through my review of the laboratory analysis, I also identified that the sample extraction technique needed to be refined. My desire to get back into a laboratory and experiment with a few more ideas of my own was pulling me towards building one specifically for the purpose of airborne mycotoxin analysis. My colleague and I discussed it, and in the following months we achieved this world first. The very first laboratory for the specific purpose of airborne mycotoxin analysis.

Drawing on my experience in chemistry, it became clear that the extraction techniques commonly used for preparation of commodity samples were not ideal for airborne mycotoxin samples. After much trial and error, we worked on a new extraction technique until we were achieving consistent results. This was the final piece of the puzzle. We now had consistent criteria for collection, extraction, and analysis. Our research project could now begin in earnest with true like for like comparisons between all of the samples from here on in.

Whilst we continued to collect and analyse samples from mould and water damaged homes, we also collected samples from homes with no known history of mould or water damage to establish a baseline of what could be expected to be found as a background level. We could now confidently report from an established median background level.

It was now that we began to test my hypothesis that mycotoxins would be aerosolized via evaporation. To do this, we sampled several properties before, during, and after different mould removal processes.

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We discovered that mycotoxins were increasing as drying processes were taking place. As the humidity was dropping by either dehumidification, air scrubbing, air purification, and/or air movement, the mycotoxins were increasing. This confirmed my theory that they would become aerosolized as moisture was removed. In addition, we also confirmed that mycotoxins, should some of them be attached to dust and debris, were being scrubbed off other particulates when passing through filtration devices, such as HEPA filters, and being allowed through to the 'clean' air outlet of the equipment being used, thus allowing mycotoxins back into the 'clean' air of the room.

Conclusion

We can conclude that indoor airborne mycotoxins can exist in very high concentrations within our homes and workplaces potentially exposing the occupants to dangerous chemicals. Our initial results will be published in Part 2 of this series.

We can conclude that mycotoxins can be aerosolized via evaporation.
We need to work on confirmation of the best methods of mycotoxin removal from our indoor environments. We have begun this process already with initial results showing great promise. We will report on our progress in Part 3 of this series of papers.

It is apparent that a holistic approach to mycotoxins needs to be pursued. This will entail contributions from medical professionals, mould professionals, scientific professionals, health and safety professionals, and sufferers of mycotoxin related illness/s. We are proposing The Mycotoxin Research Institute to bring together panels of professionals and sufferers to create protocols to tackle this very important issue. The pooling of knowledge will allow an expedited solution.

More information can be found at www.respirarelabs.com

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