Health Consequences of Mold and Mycotoxin Exposure
Part 1: Immune Reactivity

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In a previous series titled *Clinical Consequences and Considerations of Chronic Candidiasis*, I outlined various pathogenicity mechanisms of chronic candidiasis, as well as laboratory test options for detection and various treatment interventions, including medications and botanical supplements. Because candida is a type of fungus linked to any form of candida species (1), it could be assumed that mold organisms – also classified as fungus – would follow a similar pattern of pathogenicity and progression. However, mold organisms, like candida, come in different types and often thrive in various environments.

A mold, by definition, is "A fungus that grows in the form of multicellular filaments called hyphae. In contrast, fungi that can adopt a single-celled growth habit are called yeasts" (2). Candida is a type of yeast. One of the most common mold species, *Aspergillus*, is not yeast but is a fungus.

Molds can produce chemical compounds known as mycotoxins (a general term linked to fungal toxins) that have their own adverse effects. These secondary metabolites (3) of fungus can cause disease and even death in animals and humans (4). For example, aflatoxins produced by *Aspergillus* are carcinogenic. Some researchers have listed aflatoxins as some of the most carcinogenic substances known (5). A complicating factor in the description of mycotoxins is that one mold species may produce many different mycotoxins, and several species may produce the same mycotoxin (6). Therefore, even though candida and molds are both examples of fungi, simply hitting "copy and paste" for information related to candida and applying it to molds will not suffice. Although, some of the same medications and botanical remedies known to help against chronic candidiasis are also useful against various molds.

This series discusses aspects of mold exposure related to different health conditions and explores various mechanisms of pathogenicity, laboratory testing, and treatment interventions. In Part 1 of this series, we begin with an overview of the immune reactions that mold exposure can trigger and their associated symptoms. In Part 2, we will explore some of the different mycotoxins produced by mold and their adverse health effects. Part 3 of this series will end with information on various intervention options for mold and mycotoxin exposure.

Examples of Immune Reactions to Mold

Molds are environmentally ubiquitous. Mold spores are a common component of soil, certain food products (including grains), as well as dust particles in our homes and workplaces. When it comes to common indoor molds, the grouping of *Alternaria*, *Aspergillus*, *Cladosporium*, and *Penicillium* are most common (7). Several species of *Aspergillus*, including A. *fumigatus* and A. *niger*, can grow in damp, humid, and warm environments such as bathrooms, basements, kitchens, ventilation systems, and even window frames (8). *Aspergillus* can even be found in bedding and pillows (9).

When mold spores are present in large quantities, they can trigger allergic reactions, e.g., nasal congestion, itching, sneezing, and respiratory problems such as coughing and wheezing (10). Mold exposure is not limited to upper airway reactivity but can manifest as headaches, migraines, fatigue, and/or rashes. Many of these symptoms are from allergic sensitivity to mold spores or what is termed "mold allergy."

Mold Allergy

A mold allergy is an abnormal immune reaction mediated through immunoglobulin E (IgE) production in response to exposure to mold spores or cellular components of the mold. This IgE antibody, which binds with mast cells, can initiate a cascade of chemicals such as histamine, eicosanoids, and cytokines (e.g., interleukin 6) which drive inflammatory reactions. For some individuals, nuisance symptoms of nasal congestion, throat irritation, sneezing, and watery eyes may be the only manifestation of allergy. Still, more severe problems can occur in others, such as reactive airway disease or mold-induced asthma (11).

Other Mold-Associated Conditions

As mentioned previously, health problems associated with high levels of airborne mold spores can lead to immune-mediated reactions from nasal irritation to severe respiratory disorders such as asthma, respiratory infections, and bronchitis (12). However, when molds spores are inhaled intact, they can embed in lung tissue and begin to grow as an infection. This is particularly serious for anyone already immunocompromised. This type of infection is called aspergillosis and can ultimately lead to invasive aspergillosis (13).

Mycosis is another term for fungal infection and, when linked to invasive or systemic mold, is called "Invasive and Systemic Mycosis," respectively. Immunocompromised individuals who are exposed to high levels of mold can become infected (14). This is particularly true of *Aspergillus fumigatus* as an opportunistic infection (15).

Lung, sinus, and skin infections are relatively common. However, the digestive system may become infected too with the colonization of mold spores. The organic acids test (OAT) from Great Plains Laboratory identifies certain compounds linked to gut colonization of *Aspergillus* and *Fusarium* mold (see, Organic Acids Test - https://www.greatplainslaboratory.com/organic-acids-test).

Mold-Induced Hypersensitivity

It is predicted that approximately 5% of people have some airway symptoms due to allergic reactions to molds in their lifetimes (16). The most common form of hypersensitivity is linked to direct exposure to inhaled mold spores. For hypersensitivity reactions, it does not matter if the mold spore is alive or dead because reactivity can also occur to hyphal fragments that trigger inflammation in the upper airways, lungs, and systemically. These reactions typically occur via the innate immune system, which becomes sensitized to mold exposure. This type of sensitivity has been linked to "sick building syndrome" (17), where people have heightened symptoms and health problems when they encounter environments known to have mold exposure.

There have been multiple papers written on this subject, including a 2018 review of 16 associated studies evaluating sick building syndrome. This study concluded that individuals exposed to molds and associated mycotoxins had "symptoms affecting multiple organs, including the lungs, musculoskeletal system, as well as the central and peripheral nervous systems." (18). This has also been noted concerning the pathogenesis of autism spectrum disorders (19).

It is likely that those who are chronically exposed to mold spores, their cellular components, or hyphal fragments are experiencing associated allergy and hypersensitivity mediated through humoral and/or innate immunity resulting in chronic inflammation.

Once initiated by mold, chronic inflammation may persist even though an individual is no longer in a moldy environment. However, upon re-exposure to a moldy environment or consuming food contaminated with mold, their body is primed to react. The onslaught of inflammation and subsequent metabolic reactions generates a cascade of mold-related symptoms, as mentioned above.

In the second part of this series, I will discuss the role of mycotoxins in mold sickness, common symptoms of exposure, where they are encountered, pathogenicity mechanisms, and laboratory testing for mycotoxin detection. These secondary metabolites produced by fungus, e.g., aflatoxin, gliotoxin, citrinin, can have devastating health consequences and, in some cases, are even lethal (20).

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