

# Understanding Mycotoxin-induced Illness: Part 2 Testing and Treatment

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Mycotoxins can cause inflammation and oxidative stress throughout the body, leading to a chronic disease often called Chronic Inflammatory Response Syndrome (CIRS). Its symptoms overlap with those of many chronic diseases, such as Mast Cell Activation Syndrome, and chronic infections, such as *Borrelia*. For suspected mycotoxin illness, developing an list of indicators is important. Taking a thorough history of a person's potential mold exposure at his or her current home, past residences, and work location is critical. After clarifying the person's clinical symptoms and exposure history, the practitioner can perform tests to confirm specific mycotoxin exposure and then can implement treatment plans.

## TESTING OPTIONS

The primary tests that many practitioners use are urinary mycotoxin tests. The measured mycotoxins vary a little bit among testing companies, although the procedures for some of the most common, such as aflatoxins, are similar. A newer technology uses liquid chromatography mass spectrometry (LC-MS/MS),<sup>1</sup> and this technology is well established in the measurement of drugs and toxins.<sup>2</sup>

The LC-MS/MS urinary mycotoxin tests can be helpful for practitioners, and they can follow the results over time. One important issue to consider is that some people have poor detoxification and aren't able to eliminate mycotoxins well. Because of this, their tests can appear negative or show that they have very low levels of mycotoxins.

With treatment, these patients can then have increases in their mycotoxin levels that can appear as increased exposure when they really have increased excretion. Even people with elevated mycotoxins can have increases in their levels initially

with treatment. Mycotoxins exist in food, and the debate is ongoing among practitioners about how this may or may not contribute to the test results.

New blood tests measuring antibodies and other blood markers are available, but the research is new. Mycotoxins bound to bile salts are also eliminated through the digestive tract, but a test isn't currently available for them. In my opinion, such a test would be helpful because binders working through the digestive tract are a mainstay of treatment.

Dr. Shoemaker, one of the first practitioners to study and treat mycotoxin illness, has a list of laboratory markers to help identify mycotoxins and treat patients.<sup>3</sup> The laboratory markers evaluate a patient with CIRS to assess the level of inflammation and immune-system imbalance, together with specific hormone-dysregulation markers.<sup>3</sup> Shoemaker's experience had led him also to identify and treat a nasal pathogen, multiple antibiotic resistant coagulase negative *staphylococci* (MARCoNS), that is often present in patients with CIRS.

Identifying mold and mycotoxins in the home and workplace is also critical. This identification is important to make sure that the mold is properly remediated to prevent ongoing exposure. It's very difficult for a patient to recover from mycotoxin illness if they continue to have exposure. Some professional organizations will inspect and treat home-and-workplace mold contamination. Home kits are also available for mycotoxin evaluation.

## TREATMENT

### Binders Overview

Mycotoxins are naturally eliminated through the digestive tract. The body releases bile salts, which bind to the mycotoxins in an attempt to remove them from the body. The naturally occurring enterohepatic circulation in the body, however, is a problem. In an attempt to conserve bile acids, the body reabsorbs bile salts back to the liver. If the bile salts are bound to mycotoxins, these mycotoxins are also reabsorbed where they can still cause harm to the body.

One of the mainstays of treatment is the use of binders, sometimes called adsorbents. To bypass the enterohepatic circulation, binders take the mycotoxins off the bile salts and adhere to them to be removed from the body through the digestive tract.

Rudd has indicated that it's important, with all of the different mycotoxins, to remember that different binders bind to different mycotoxins, and he has worked develop that information.<sup>4</sup> Most patients will have multiple mycotoxins, together with other microbes that are common in water-damaged buildings. One of the advantages of the urinary mycotoxin test is that it identifies the different mycotoxins so that practitioners can use the best binder for a mycotoxin. Because of variety of mycotoxins, it's often helpful to use multiple binders for a patient's treatment.

Patients can be very sensitive to treatments, with an initial worsening of symptoms; so beginning treatment slowly is essential. It's also critical to use purified binders that have been tested for heavy metals and toxins since many of them are derived from soil and natural substances. Patented binders exist that have been developed to increase their binding capabilities and that are third-party tested for purity. Much of the information about binders comes from the agricultural literature. Contaminated feeds are a big health risk to livestock, and the use of binders for mycotoxins in their feeds can help decrease these issues.

## **BINDERS**

### **Charcoal**

Activated charcoal has a long history of safe use as a binder in medicine for acute poisonings, overdoses, and toxin exposures.<sup>5-7</sup> Some research has also shown that activated charcoal has the ability to bind to endotoxins, making it helpful for acute and chronic digestive illness.<sup>8,9</sup> Most of the research on the way in which activated charcoal binds to mycotoxins, has focused on aflatoxins in agricultural feed for animals. Some studies have shown that charcoal is a strong binder for aflatoxins.<sup>10,11</sup> Other agricultural studies have shown that activated charcoal can be a successful binder for other mycotoxins, including ochratoxins, trichothecenes, and zearalenone.<sup>12-15</sup>

### **Zeolite**

Zeolites are minerals that are a combination of aluminosilicates that create cavities and that can bind many diverse types of molecules. The zeolites' structure leads to a high absorbency of different molecules through a high ion exchange.<sup>16</sup> The most well-researched form is zeolite clinoptilolite (ZC), which Mastinu et al found can have detoxifying, anti-inflammatory, and anti-oxidant effects.<sup>16</sup> Animal-research studies have shown that zeolites can provide adsorption of mycotoxins, including aflatoxins, ochratoxins, and zearalenone.<sup>17,18</sup>

The interesting thing about zeolites is that they are also able to absorb biologic amines, such as histamine and ammonia.<sup>19,20</sup> For gastrointestinal health, that ability can be helpful. After eating zeolites, patients with mast-cell activation issues can show a decrease in symptoms from histamine exposure from foods.

Heavy-metal absorption is another area of interest for the use of zeolites.

### **Bentonite Clay**

Bentonite clay is formed when volcanic ash is exposed to seawater. The two primary forms are either sodium montmorillonite—sodium bentonite clay—or calcium montmorillonite—calcium bentonite clay. They are both primarily made out of crystalline clay minerals—aluminosilicate, with the addition of either sodium or calcium.

Agricultural research has shown multiple mycotoxins that bentonite clay can bind, including aflatoxins, ochratoxins, fumonisins, sterigmatocystin, and deoxynivalenol.<sup>21-24</sup> Bentonite clay also has the ability to bind to heavy metals and herbicides, such as atrazine.<sup>25</sup>

Since clay comes from the ground, a potential for contamination exists, which means it's critical for this compound, more than for other binders, to know the source and to use a supplement that a third party has tested for contaminants.

### **Humic and Fulvic Acid**

Humic and fulvic acid are organic acids that are the final breakdown components from the natural decay of plants and animals. They are present in soils, peats, oceans, fresh waters, and humus in the soil. Animal research has shown them to be good binders for both mycotoxins and heavy metals. Some research has shown that these acids provide good binding for aflatoxins, deoxynivalenol, ochratoxin, and zearalenone.<sup>26-30</sup>

While aflatoxin is commonly known as a food contaminant, deoxynivalenol can also be an issue in grains. Its mechanism of action involves inhibiting proteosynthesis and inducing oxidative stress.<sup>30</sup> Humic acid, in addition to binding this mycotoxin, also can help decrease the oxidative-stress induction from this mycotoxin.<sup>30</sup>

### **Microchitosan and Chitosan**

Both types of chitosan are derived from the outer skeleton of shellfish and are a form of polysaccharide. Their mechanism may have some overlap with the prescription drug Cholestyramine Light.<sup>31</sup> They can bind compounds such as mycotoxins, fungus, heavy metals, toxic chemicals, and bacterial endotoxins.<sup>32-36</sup>

### **Prescription Binders**

Many practitioners, such as Shoemaker, have use two prescription drugs, Cholestyramine Light and Welchol, as initial treatments for mycotoxin illness.<sup>3</sup> Cholestyramine Light's mechanism of action is as a bile sequestrant that can remove cholesterol from the body in people with hypercholesterolemia.

Welchol has a similar mechanism of action. Because of this, it's able to bind mycotoxins that are bound to bile acids, including ochratoxins and fumonisins.<sup>37,38</sup> While many practitioners use this binder for adults, as a pediatrician I don't use it routinely in my practice. Cholesterol is an integral part of brain development and the backbone of hormones, so I am concerned with reducing it in children.

## General Support

Mycotoxins can cause pathology in the body, leading to chronic disease through several mechanisms. In treating mycotoxin-induced disease, it's important to support immunological, anti-inflammatory, and microbiomic systems, in addition to using binders to eliminate the mycotoxins.

Immune impairment is one of mycotoxins' mechanisms of action, making it more difficult for the body to recognize and mount an immune response.<sup>39,40</sup> Part of this immune suppression is a downregulation of the T helper type 1 (Th1) immune response.<sup>41</sup> Transfer factors are immune-signaling proteins that can improve Th1 immunity that the body needs to mount a response to mycotoxins.

Guerre indicates that mycotoxins can also cause inflammation and immune dysregulation that negatively impact the microbiome and can lead to dysbiosis.<sup>42</sup> He found that supporting the microbiome with species such as *Lactobacillus planetarium* can be helpful in supporting the immune system. Treating dysbiotic organisms in the GI tract can also be beneficial.

Since mycotoxins cause inflammation and oxidative stress as part of their mechanisms of action, supporting the body to treat that action is a critical component of treatment. Chronic disease accompanies chronic inflammation and oxidative stress in the body.

Many natural anti-inflammatories exist that be supportive, such as curcumin, resveratrol, ginger, and sulforaphane, among others. Combinations of natural herbs can cover more potential pathways of inflammation development and are often also anti-oxidants. Liposomal glutathione is another standard treatment for any detoxification program that I use for mycotoxin detoxification.

## Antifungals

One other under-researched areas in mycotoxin-illness treatment is the concept of mold colonization in the gastrointestinal (GI) tract, nose, and sinuses as an ongoing source of mycotoxins. Currently, practitioners know that gut mycobiome and fungi reside in the human gastrointestinal tract. Hallen-Adams and Suhr found that candida yeast species, a type of fungal organism, can be normal inhabitants and can become an issue with overgrowth.<sup>43</sup> Those researchers have shown that mold species can be at least transient inhabitants of the GI tract but that the human mycobiome has the ability to change more than the bacterial microbiome.

Practitioners do treat mycotoxin illness with antifungals, using either prescription and/or herbal protocols. Many patients with mycotoxin illness have dysbiosis and candida overgrowth, so antifungals can be beneficial to them, maybe through this mechanism or in combination with potential mold colonization.

Again, practitioners need more human research to establish how mold exists in the body and produces damage through mycotoxins. One current concern comes from studies that have shown mycotoxins' resistance to antifungal

agents and incomplete eradication of mold with prescription antifungals.<sup>44,45</sup>

## CONCLUSION

Understanding and treating mycotoxin illness is an ongoing education for practitioners. It's one area where they really need more clinical human research. Research on mycotoxin treatment for animals exists and shows the beneficial effects that many binders can have. The issue is that much of the mycotoxin exposure for animals is through food and for humans it's more complex, with exposure from water-damaged buildings as well as food.

Awareness of the seriousness of chronic mycotoxin illness is becoming more common. The basic tools such as binders and supportive therapy can help patients, but practitioners need to back up the use of these treatments with more research for better awareness and treatment.

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