Health Consequences of Mold and Mycotoxin Exposure
Part 3: Intervention Options

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In Parts 1 and 2 of *Health Consequences of Mold and Mycotoxin Exposure*, I discussed aspects of immune reactivity to mold and related fungus and laboratory testing options, respectively. In this final article, I will outline some of the common medicinal remedies useful for certain molds and mycotoxins, including prescription antifungal medications and the use of certain botanicals and other natural therapies.

There is an abundance of herbal remedies that have a long tradition of use as antimicrobials for various pathogens, particularly bacteria, but also fungal organisms. In general terms, there is less known about the specific effects of botanicals on various mold organisms, e.g., *Aspergillus*, compared to *Candida* or other bacteria. However, the information does exist, and clinical experience has shown that various botanicals provide a positive response from an interventional standpoint. This is particularly true when botanicals are used in conjunction with intestinal binding compounds such as activated charcoal and/or clays like bentonite or zeolite. I will discuss this in the sections that follow.

It is imperative to understand that when it comes to molds and mycotoxins, the use of most antimicrobial compounds – botanical and/or prescription – will not directly treat mycotoxins. The mycotoxins are different than the mold(s) that produced them. They are separate chemicals that have their own toxic effects. (See Part 1 of *Health Consequences of Mold and Mycotoxin Exposure* for more information).

It is possible to have retained mycotoxins in the body but no longer be exposed to active mold. It is also possible, although less likely, to have a mold allergy illness or infection and not have accumulated mycotoxins. Therefore, the direct fungicidal (killing) and fungistatic (inhibitory) effects of many antimicrobial remedies do not directly remove mycotoxins. Mycotoxin removal is accomplished through detoxification interventions such as intestinal binders, liver detoxification support, including glutathione and N-acetylcysteine (NAC), antioxidants, and others.

This article will profile certain compounds used for direct mold intervention, as well as mycotoxin elimination. The following information is not meant to be an exhaustive list of all variables regarding intervention but instead focuses on some of the more commonly used remedies. Also, please be aware that the science behind mold and mycotoxin intervention is evolving, and various skilled practitioners may have differing opinions and methods.

For this article, I am outlining one category for addressing mycotoxins (via glutathione or NAC, binders, e.g., activated charcoal, zeolite clay) and two distinct categories for mold organism intervention, including non-systemic and systemic medications, specifically Nystatin (aka Mycostatin), Amphotericin B, Fluconazole (aka Diflucan) and Itraconazole (aka Sporanox), and certain botanicals. We begin our discussion with prescription medications of the non-systemic category.

Nystatin

Nystatin, aka Mycostatin, is an antifungal medication used for fungal infections of the mouth, intestines, skin, and vagina (1). It is not appreciably absorbed from the skin or mucous membranes, including the digestive tract. Available in various forms such as capsules, oral suspension, powder, and tablets, it has been a long-time favorite of many conventional and integrative doctors to treat gastrointestinal candidiasis and oral thrush. A good safety profile for long-term use offers flexibility for different age groups and provides good tolerance. Nystatin's side effects include diarrhea, hives, nausea, hypersensitivity reactions, and stomach pains (2).

Nystatin is most helpful in treating fungal infections of the yeast type, including candidiasis. However, an article from Offner and associates (3) shows Nystatin's clinical effectiveness for certain mold infections, particularly aspergillosis, if given in the liposomal form. The authors state that "liposomal nystatin can be effective for salvage therapy of invasive aspergillosis," where Amphotericin B is not effective or tolerated. In my clinical experience, the use of Nystatin can be an option for digestive colonization of *Aspergillus* mold as evaluated from the Organic Acids Test (OAT) that measures for specific mold markers. However, its effectiveness is not greater than using combination botanical remedies. Overall, oral Amphotericin B is more effective than oral Nystatin for gut colonization of *Aspergillus* mold.

Amphotericin B

Amphotericin B is a potent medication often delivered through intravenous (IV) infusion for invasive aspergillosis. However, because of its nephrogenic damage risk, the use of IV Amphotericin B is often unnecessary for more common localized mold infections within the digestive system and/or sinuses. In these situations, compounded Amphotericin B (125mg or 250mg) can be prepared for intranasal delivery, oral capsules, or suspension. In my experience, oral Amphotericin B is highly effective against gut colonization of *Aspergillus*. A common way of prescribing Amphotericin B is 125mg to 250mg taken orally three times daily for 4 to 8 weeks, but a longer duration may be necessary. I will often use Amphotericin B with resistant gut colonization of *Aspergillus* seen on the OAT. In these circumstances, I employ a minimum two-month course of intervention with a repeat OAT done near the end of the intervention period.

Systemic Antifungals

There are many systemic antifungals, e.g., Fluconazole (Diflucan), Itraconazole (Sporanox), Terbinafine (Lamisil), that are useful in the treatment of various fungal infections. A medication becomes "systemic" when absorbed in high amounts from the digestive system into the bloodstream with wide distribution throughout the body. These highly absorbable medications are quite different from non-absorbable oral-capsulated Amphotericin B (or oral suspension) and oral-capsulated Nystatin (or oral suspension), which have their primary effects within the digestive system.

As an antifungal medication, Fluconazole (aka Diflucan) is useful for a wide range of fungal infections, including candidiasis, blastomycosis, coccidioidomycosis, cryptococcosis, and others (4). The side-effect profile of Fluconazole, and other systemic antifungals, is more extensive than oral Amphotericin B and oral Nystatin due to high systemic absorption and blood and tissue distribution. This tissue distribution includes the liver, so their use requires blood monitoring of liver enzymes, i.e., testing of AST and ALT liver function markers once weekly or biweekly, depending on the patient's clinical status. In addition, QT prolongation reflective of cardiac electrical activity, vomiting, diarrhea, and seizures are known side-effects, too.

Itraconazole (Sporanox) is a well-established systemic antifungal for various fungal infections, including the commonly encountered *Aspergillus* (5). It can be used orally as well as intravenously. Some compounding pharmacies can even prepare Itraconazole as a nasal spray.

Itraconazole works by inhibiting a fungal cell cytochrome P450 enzyme called 14α-demethylase. This enzyme is involved in the formation of ergosterol, an essential component of the fungal cell membrane (6). Itraconazole can be so effective for aspergillosis it is often used for unusual forms of *Aspergillus* infections such as Orbital Aspergillosis (7).

As a 100mg capsule, Itraconazole is often dosed every twelve hours. Varying amounts are used alone or in combination with other medications, e.g., liposomal Amphotericin B, or with steroids to lessen the steroid dosing need (8). Because of its high absorption from the digestive tract and systemic distribution, just like Fluconazole, the prolonged use of Sporanox requires monitoring liver enzymes.

Botanical Antimicrobials

Botanicals for the eradication of fungal infections have a long history of use in herbal medicine. The whole plant, or components of a plant, may contain various compounds, e.g., active substances, that provide fungistatic or fungicidal properties.

Molds and *Candida* are a type of fungus. However, *Candida* is a yeast found in the fungal family, and *Aspergillus* is a type of mold which is also a fungus. Although many botanical remedies are known for their anti-yeast and *Candida* effects, these botanicals also have effects against various molds. The following is a list of four specific botanicals with crossover effects for multiple pathogens, including mold.

Berberine

Berberine is an ammonium salt compound found in various plants such as *Berberis*, *Coptis chinensis*, and *Hydrastis canadensis*, aka Goldenseal. Having had extensive use amongst Native American tribes as a medicine for digestive problems, disinfectant properties, and insect repellant (9), it has a wide range of effects in fungal infections.

As an antimicrobial, an interesting characteristic is the proposed efflux pump inhibition effect (10). The efflux pump is an intracellular mechanism of various organisms, including many fungi, that allows them to excrete antimicrobial chemicals that have been transported or diffused into the fungal cell. Inhibition of this pump keeps the antimicrobial within the fungal cell longer to more effectively exert its fungicidal effect.

Bilberry Extract

Bilberry is an edible fruit from the plant species *Vaccinium myrtillus*. The berry has similarities to the American blueberry and goes by various names such as "wimberry," "whortleberry," and European blueberry (11). Much of the beneficial effects of bilberry extract come from its antioxidant and circulatory properties for improved cardiovascular function. Interestingly, bilberry leaf extracts do not appear to affect the growth of certain *Aspergillus* molds, such as *A. flavus*. Still, they do appear to prevent aflatoxin production through aqueous extracts and methanolic acid production (12).

Garlic

Garlic (*Allium sativum*), and its extracts, have long been known to have antimicrobial properties. In fact, garlic contains over a hundred different chemical compounds such as allicin and S-allylcysteine, which have anti-pathogen and antioxidant capabilities, respectively.

Garlic can enhance the function of the innate and adaptive immune system through macrophage, natural killer cell, and T-cell activation and aid in pathogen clearance, including fungal organisms (13).

Oregano

Origanum vulgare, aka Oregano, is in the mint family of plants. It, too, has been used in traditional folk medicine for centuries. As an oil extracted from the oregano plant, it is used extensively in dietary herbal supplements with a good safety profile. There is extensive research on the use of oregano against various fungi, including strains of *Candida albicans* (14). Additionally, its antimicrobial properties are diverse, involving two polyphenolic compounds called carvacrol and thymol (15), which, along with various terpenes, enhance its broad-spectrum antimicrobial capabilities.

Other Botanicals

Many other botanical remedies such as black walnut, gentian, grapeseed extract, lavender, raspberry, and more have their own unique antimicrobial properties and complementary effects when used along with other herbs. One of the most significant advantages of botanical remedies is their multi-use potential and broad-spectrum activity against various pathogens, e.g., bacterial, fungal, parasitic.

In addition, botanical remedies often do not have the same side-effect profiles as common prescription medications and are typically well tolerated by children and adults alike.

For a detailed description of various botanical remedies, their antimicrobial capabilities, and more scientific references, see the White Paper from Bio-Botanical Research: https://prosupplements.nl/Profinfo/Biocidin-White-Paper.pdf

Binders and Detoxification Support

When it comes to mycotoxins, other measures must be taken to rid the body of their presence. For many mycotoxins, the successful conjugation with glutathione is critically important and helpful. Through the various phases of liver detoxification, toxins are processed to be easily eliminated from the body. Phase I of liver detoxification is geared towards initiating lipophilic conversion through hydrolysis and oxidation-reduction reactions. Phase II liver detoxification involves important chemical conversions via conjugation (e.g., glutathione), glucuronidation, methylation, and sulfation. Phase II is the final transformation of lipophilic compounds in hydrophilic chemicals, which are easier for the body to eliminate through bile excretion and kidney filtration.

Glutathione, a compound derived from combining cysteine, glycine, and glutamic acid, is critical with regard to phase II liver detoxification, but also intracellular antioxidant support against various exogenously acquired and endogenously produced toxins.

NAC is a precursor to glutathione. Through the actions of a deacetylation reaction (removal of the acetyl group from cysteine), NAC is converted into the amino acid cysteine. From there, cysteine binds with glutamic acid and glycine through a series of ATP-driven enzymatic reactions to become glutathione.

When it comes to mycotoxins, both NAC and glutathione can help with detoxification. There is no exact established dosage based on age or weight for these supplements when supporting detoxification of mycotoxins and other chemicals. Therefore, a dose of liposomal glutathione at 500mg once to twice daily or NAC at 500mg to 1000mg daily is just a general recommendation. Each patient needs to be treated individually based on their clinical history, symptoms, other confounding factors, etc.

The other critical component for mycotoxin reduction and eventual elimination is the use of intestinal binders. Binders are substances that chemically bind to intestinal toxins produced directly within the digestive system, or find their way into the digestive system, i.e., small bowel through the sphincter of Oddi from toxins being excreted from the liver via the common bile duct. Within the small intestine, the binders will mop up bowel toxins, prevent their reabsorption, and aid in their transport to the large intestine for eventual removal via the stool.

Two specific binders have broad-spectrum applications against various mycotoxins: activated charcoal and zeolite clay.

Activated charcoal

Activated charcoal is a carbon made from coconut, palm, vegetables, wood, and other materials. It appears as a fine black powder, is highly porous, and has a surface area of up to 2,000 square meters per gram. It binds with various compounds through chemical attraction (Van der Waals interaction). Used alone, it is quite effective and reported to bind well to aflatoxin, ochratoxin, and trichothecenes. Like cholestyramine (a prescription binder originally used to lower cholesterol absorption), charcoal can be constipating for some people.

Zeolite clay

Zeolites chemically are aluminosilicates that contain a rigid framework formed by aluminum, silicon, and oxygen atoms. These elements are tightly bound in a honeycomb shape with a sodium ion loosely bound. An ion exchange occurs with other elements that exist as cations, e.g., calcium, magnesium, iron, and various heavy metals (16). In general, clay products, e.g., bentonite, pyrophyllite, and zeolite, act from a chemical binding effect through the complex lattice configurations of these chemicals. Clays have a broader range of mycotoxin binding than activated charcoal, including enniatin B, gliotoxin, zearalenone, aflatoxin, and ochratoxin.

Bio-Botanical Research (BBR)

BBR has a variety of botanical formulations that support digestive health and aid in the reduction and/or elimination of opportunistic pathogens, including fungal organisms and biofilms (which may contain mycotoxins).

Biocidin®, in its various forms (capsule, liquid, liposomal), combines bilberry extract, echinacea (both Angustifolia and purpurea), Goldenseal, oregano, tea tree oil, and other complementary ingredients into a pleasant-tasting, well-tolerated, highly effective combination botanical supplement.

Biocidin® is often combined with additional BBR products such as Olivirex® (a combination of olive leaf extract, garlic, Goldenseal, and more) and Proflora®4R (soil-based organisms of *Bacillus coagulans*, *Bacillus subtilis*, and *Bacillus clausii*) comprising a complementary trio offering excellent support for digestive health and maintenance.

G.I.Detox™+, which contains zeolite clay, activated charcoal, apple pectin, silica, aloe vera, and humic and fulvic acids, is an excellent binder from BBR and is often used in combination with the above-listed products.

You can find contact and additional information about BBR at www.biocidin.com. They provide clinical support, research updates, and free training to practitioners.

Conclusion

The issue with mold and mycotoxin exposure is a confusing one. Their presence can lead to a host of symptoms and diseases, as discussed in the previous articles in this series. Determining the effects of molds and mycotoxins can be complicated as some patients are often significantly ill. The use of various types of laboratory tests and skillful interpretation requires continual study and ongoing clinical experience.

It is critical to understand that every individual dealing with a mold and mycotoxin problem may require individualized dosing based on their unique health circumstances and tolerance. Tailoring a supplement program or medications to each person is necessary. Finally, patients can be helped with mold and/or mycotoxin health issues through many of the interventions described in this article. Still, if they continue to be exposed through their mold-contaminated home, office, school, or other means, they will never fully recover. Ultimately, the source of mold and mycotoxins should be identified and remediated for the affected individual to regain optimal health.

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