

## BRIEF EXPLANATION ON MYCOTOXIN PANEL

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	Mycotoxin	Cellular activity of Mycotoxin	Symptoms/Others	Association with a "Disease State"
<b>AFLATOXIN FAMILY—Organisms: <i>Aspergillus flavus</i>, <i>Aspergillus oryzae</i>, <i>Aspergillus fumigatus</i>, <i>Aspergillus parasiticus</i></b>				
<b>Aflatoxins have been linked to liver cancer, hepatitis, cirrhosis, and other health issues</b>				
1	<b>B1</b>	Binds DNA and proteins	Shortness of breath, weight loss, most potent and highly carcinogenic.	Primarily attacks the liver, other organs include kidneys and lungs.
2	<b>B2</b>	Inhibits DNA, RNA, and protein metabolism	Enters the body through the lungs, mucous membranes (nose and mouth), or the skin.	Affects the liver and kidneys. Less potent than B1. The order of toxicity is B1 greater than G1, greater than G2, greater than B2.
3	<b>G1</b>	Adversely affects the immune system	<i>A. flavus</i> second leading cause of invasive aspergillosis in immunocompromised patients.	Cancer, chronic hepatitis, and jaundice. Reye's Syndrome.
4	<b>G2</b>	Immunosuppression	Mitochondrial damage. Aflatoxicosis in Humans and Animals.	Hepatitis, malnutrition, lung cancer.
<b>OCHRATOXIN A —Organisms: <i>Aspergillus ochraceus</i>, <i>Aspergillus niger</i>, and <i>Penicillium</i> species</b>				
5	<b>Ochratoxin A</b>	Interferes with cellular physiology, inhibits mitochondrial ATP production, and stimulates lipid peroxidation	A potent teratogen and immune--- suppressant. 30---day ½ life in blood; indefinite existence intra---cellular.	Kidney disease, cancer, infection of bladder. Nephrotoxic. Hepatotoxic.
<b>TRICHOECENE FAMILY (MACROCYCLIC) —Group D Organism: <i>Stachybotrys chartarum</i></b>				
6	<b>Satratoxin G</b>	DNA, RNA and protein synthesis, intracellular	Bleeding disorders, central nervous and peripheral nerve disorders. Most potent inhibitors of protein synthesis.	Wide range of GI problems, skin inflammation, vomiting and damage to blood producing cells. Highly toxic.
7	<b>Satratoxin H</b>	Inhibits protein synthesis	Found in damp or water---damaged environment.	Vision problems, GI problems, breathing issues.
8	<b>Isosatratoxin F</b>	Immunosuppression	Causes of health problems due to poor air quality.	Contributor to "sick building syndrome"
9	<b>Roridin A</b>	Nasal inflammation, excess mucus secretion, and damage to the olfactory system	Acute and chronic respiratory tract health problems.	Acute and chronic lung and nasal problems.
10	<b>Roridin E</b>	Disrupt the synthesis of DNA, RNA, and protein	Roridin E grows in moist indoor environments.	Can impact every cell in the body.
11	<b>Roridin H</b>	Inhibits protein synthesis	Grows well on many building materials subject to damp conditions.	Lymphoid necrosis and dysregulation of IgA production.
12	<b>Roridin L-2</b>	Immunosuppression	Grows on wood---fiber, boards, ceiling tiles, water---damaged gypsum board, and HVAC ducts.	Easily airborne and inhaled by occupants of an infected building.
13	<b>Verrucaric A</b>	Immunosuppression, nausea, vomiting, weight loss	Found mostly in damp environments.	One of the most toxic trichothecenes.
14	<b>Verrucaric J</b>	Can easily cross cell membranes	Absorbed through the mouth and the skin.	Small enough to be airborne and easily inhaled.
<b>GLIOTOXIN DERIVATIVE—Organisms: <i>Aspergillus fumigatus</i>, <i>Aspergillus terreus</i>, <i>Aspergillus niger</i>, <i>Aspergillus flavus</i></b>				
15	<b>Gliotoxin</b>	Attacks intracellular function in immune system	Lung disorders, brain dysfunction, bone marrow dysfunction.	Immune dysfunction disorders. Aspergillosis, association with tumors of brain, lung.
<b>Zearalenone —Organisms: <i>Fusarium graminearum</i>, <i>Fusarium culmorum</i>, <i>Fusarium cerealis</i>, <i>Fusarium equiseti</i>, <i>Fusarium verticillioides</i>, <i>Fusarium incarnatum</i></b>				
16	<b>Zearalenone</b>	Estrogen mimic	Enters the body through the lungs, mucous membranes, or the skin	Can lead to reproductive issues such as low sperm count, inability to ovulate, spontaneous abortions. May lead to early puberty in girls.

References : <https://realtimelab.com/gliotoxin/>; <https://realtimelab.com/aflatoxins/>; <https://realtimelab.com/trichothecenes/>; <https://realtimelab.com/ochratoxins/>; <https://realtimelab.com/molds/>

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## **MARKERS IN MYCOTOXIN PROFILES from Great Plains Laboratories**

[www.greatplainslaboratory.com/gplmycotox](http://www.greatplainslaboratory.com/gplmycotox)

### **AFLATOXIN M1 (AFM1)**

Aflatoxin M1 (AFM1) is the main metabolite of aflatoxin B1, which is a mycotoxin produced by different species of the genus *Aspergillus*. Aflatoxins are some of the most carcinogenic substances in the environment. Aflatoxin susceptibility is dependent on multiple different factors such as age, sex, and diet. Aflatoxin can be found in beans, corn, rice, tree nuts, wheat, milk, eggs, and meat. In cases of lung aspergilloma, aflatoxin has been found in human tissue specimens. Aflatoxin can cause liver damage, cancer, mental impairment, abdominal pain, hemorrhaging, coma, and death. Aflatoxin has been shown to inhibit leucocyte proliferation. Clinical signs of aflatoxicosis are non-pruritic macular rash, headache, gastrointestinal dysfunction (often extreme), lower extremity edema, anemia, and jaundice. The toxicity of aflatoxin is increased in the presence of ochratoxin and zearalenone.

### **OCHRATOXIN A (OTA)**

Ochratoxin A (OTA) is a nephrotoxic, immunotoxic, and carcinogenic mycotoxin. This chemical is produced by molds in the *Aspergillus* and *Penicillium* families. Exposure is primarily through contaminated foods such as cereals, grape juices, dairy, spices, wine, dried vine fruit, and coffee. Exposure to OTA can also come from inhalation exposure in water-damaged buildings. OTA can lead to kidney disease and adverse neurological effects. Studies have shown that OTA can cause significant oxidative damage to multiple brain regions and the kidneys. Dopamine levels in the brain of mice have been shown to be decreased after exposure to OTA.

### **STERIGMATOCYSTIN (STG)**

Sterigmatocystin (STG) is a mycotoxin that is closely related to aflatoxin. STG is produced from several types of mold such as *Aspergillus*, *Penicillium*, and *Bipolaris*. It is carcinogenic, particularly in the cells of the GI tract and liver. STG has been found in the dust from damp carpets. It is also a contaminant of many foods including grains, corn, bread, cheese, spices, coffee beans, soybeans, pistachio nuts, and animal feed. In cases of lung aspergilloma, STG has been found in human tissue specimens. The toxicity of STG affects the liver, kidneys, and immune system. Tumors have been found in the lungs of rodents that were exposed to STG. Oxidative stress becomes measurably elevated during STG exposure, which causes a depletion of antioxidants such as glutathione, particularly in the liver.

### **ZEARALENONE (ZEA)**

Zearalenone (ZEA) is a mycotoxin that is produced by species of the mold genera *Fusarium* and *Gibberella*. It has been shown to be hepatotoxic, hematotoxic, immunotoxic, and genotoxic. ZEA is commonly found in several foods in the US, Europe, Asia, and Africa including wheat, barley, rice, and maize. ZEA has estrogenic activity and exposure to ZEA can lead to reproductive changes. ZEA's estrogenic activity is higher than that of other non-steroidal isoflavones (compounds that have estrogen-like effects) such as soy and clover. ZEA exposure can result in thymus atrophy and alter spleen lymphocyte production as well as impaired lymphocyte immune response, which leads to patients being susceptible to disease.

### **RORIDIN E**

Roridin E is a macrocyclic trichothecene produced by the mold genera *Fusarium*, *Myrothecium*, *Trichoderma*, *Trichothecium*, *Cephalosporium*, *Verticimonosporium*, and *Stachybotrys* (i.e. black mold). Trichothecenes are frequently found in buildings with water damage but can also be found in contaminated grain. This is a very toxic compound, which inhibits protein biosynthesis by preventing peptidyl transferase activity. Trichothecenes are considered extremely toxic and have been used as

biological warfare agents. Even low levels of exposure to macrocyclic trichothecenes can cause severe neurological damage, immunosuppression, endocrine disruption, cardiovascular problems, and gastrointestinal distress.

#### **VERRUCARIN A**

Verrucarin A is a macrocyclic trichothecene mycotoxin produced from *Stachybotrys*, *Fusarium*, and *Myrothecium* molds. Trichothecenes are frequently found in buildings with water damage but can also be found in contaminated grain. This is a very toxic compound, which inhibits protein biosynthesis by preventing peptidyl transferase activity. Trichothecenes are considered extremely toxic and have been used as biological warfare agents. Even low levels of exposure to macrocyclic trichothecenes can cause severe neurological damage, immunosuppression, endocrine disruption, cardiovascular problems, and gastrointestinal distress.

#### **ENNIATIN B**

Enniatin B1 is a fungal metabolite categorized as a cyclohexa-depsipeptides toxin produced by the molds of the *Fusarium* species. These species are common cereal contaminants. Grains in many different countries have recently been contaminated with high levels of enniatin. The toxic effects of enniatin are caused by the inhibition of the acyl-CoA cholesterol acyltransferase, depolarization of mitochondria, and inhibition of osteoclastic bone resorption. Enniatin has antibiotic properties and chronic exposure may lead to weight loss, fatigue, and liver disease.

#### **GLIOTOXIN\***

Gliotoxin (GTX) is produced by the mold genus *Aspergillus* and perhaps *Candida* species. *Aspergillus* spreads in the environment by releasing conidia which are capable of infiltrating the small alveolar airways of individuals. To evade the body's defenses *Aspergillus* releases gliotoxin to inhibit the immune system. One of the targets of gliotoxin is PtdIns (3,4,5) P3. This results in the downregulation of phagocytic immune defense, which can lead to the exacerbation of polymicrobial infections. Gliotoxin impairs the activation of T-cells and induces apoptosis in monocytes and in monocyte-derived dendritic cells. These impairments can lead to multiple neurological syndromes.

#### **MYCOPHENOLIC ACID\***

Mycophenolic Acid (MPA) is produced by the *Penicillium* fungus. MPA is an immunosuppressant which inhibits the proliferation of B and T lymphocytes. MPA exposure can increase the risk of opportunistic infections such as *Clostridia* and *Candida*. MPA is associated with miscarriage and congenital malformations when the woman is exposed in pregnancy.

#### **DIHYDROCITRINONE\***

Dihydrocitrinone is a metabolite of Citrinin (CTN), which is a mycotoxin that is produced by mold species of the genera *Aspergillus*, *Penicillium*, and *Monascus*. CTN exposure can lead to nephropathy, because of its ability to increase permeability of mitochondrial membranes in the kidneys. The three most common exposure routes are through ingestion, inhalation, and skin contact. CTN has been shown to be carcinogenic in rat studies. Multiple studies have linked CTN exposure to a suppression of the immune response.

#### **CHAETOGLOBOSIN A\***

Chaetoglobosin A (CHA) is produced by the mold *Chaetomium globosum* (CG). CG is commonly found in homes that have experienced water damage. Up to 49% of water-damaged buildings have been found to have CG. CHA is highly toxic, even at minimal doses. CHA disrupts cellular division and movement.

Most exposure to CG is through the mycotoxins because the spores tend not to aerosolize. Exposure to CHA has been linked to neuronal damage, peritonitis, and cutaneous lesions.