Ochratoxin Health Effects

Ochratoxin is a toxic chemical produced by several different molds, including Aspergillus ochraceus, Aspergillus niger, Aspergillus carbonarius and Penicillium verrucosum. It is a common contaminant of several different foods and also has been found in the air of water-damaged buildings. A Pub Med search yields nearly 3000 articles on this toxin, including more than 700 on the negative health effects on humans, other mammals and birds.

Ochratoxin is most recognized for its strongly negative effects on the kidney in a variety of species, including humans. It is widely acknowledged as being at least in part responsible for Balkan Endemic Nephropathy and appears to be one of the main causes of Focal Segmental Glomerulosclerosis (FSGS). It also has been shown to have a negative effect on other detoxification organs, including the liver, urinary tract and bladder.

Many studies suggest that ochratoxin also is a risk factor for a variety of cancers. These include cancers of the kidney, liver, testes, urinary tract, bladder, skin and breast.

Effects on offspring are another major cause of concern. Ochratoxin is transferred to the fetus through the placenta and is excreted profusely in breast milk. It is especially associated with problems with brain development, including the cerebral cortex and hippocampus. Neural tube defects, immune system problems and eye malformations also can result.

Neurological problems also can be an effect of ochratoxin exposure in children and adults. Ochratoxin is neurotoxic, causing problems especially with the astrocytes and hippocampus, and also affects glutamate.

Ochratoxin has a variety of effects on the immune system. Components that have been shown to be affected include macrophages, neutrophils, monocytes, T-cells, lymphocytes and Natural Killer Cell activity. Chronic inflammation also is an effect, with raised IL-1b and IL-8.

As a result of the immune system problems, pathogens are more likely to be problematic. Pathogens in animals that have been identified as proliferating as a result
of ochratoxin poisoning include Trypanosoma brucei rhodesiense, Salmonella, Coccidiosis, Escherichia coli, certain bacterial infections and Hepatitis.

Ochratoxin has a negative effect on the epithelium, interfering with the barrier function of the skin and causing intestinal permeability. It has been associated with skeletal abnormalities, loss of bone strength, damage to the testes and ovaries, and decreases in testosterone. The literature also suggests that it may have negative effects on the pancreas and mesenchyme functioning.

Because ochratoxin is present in animal feed, its effects have been extensively studied in the agricultural literature. Pigs and chickens are especially affected by it in terms of growth and overall health.

Ochratoxin has a wide variety of health effects because it is toxic in fundamental ways. It creates high amounts of oxidative stress and lipid peroxidation, is damaging to the mitochondria, and is genotoxic with effects on DNA.

Most of the research and discussion in the literature focuses on ochratoxin as a contaminant of food. This appears to be appropriate with regard to Balkan Endemic Nephropathy and with regard to livestock.

However, in most human populations, food consumption does not seem especially correlated with ochratoxin levels in the body. It thus seems that exposures from living or working in moldy buildings may be even more important. Inhaled exposures are especially damaging compared to ingested ones, one study suggests.

Another possibility is that in some individuals, an Aspergillosis infection is causing the toxin to be produced internally. This has yet to be explored in the literature, however.

Common foods that are frequently contaminated with ochratoxin include cereals, coffee, raisins, grape juice, wine, beer, chocolate, salami, peanuts, milk and cheese. Pig liver/kidney and licorice can be especially high in this toxin. Several spices (including ginger, nutmeg, paprika and ginseng) also can be contaminated with it.

Legal limits for ochratoxin in foods are in place in the European Union, Egypt, Bosnia, Herzegovina, Russia, China, India, Nigeria and Kenya. No specific limits are in place in the U.S., Canada, Australia, New Zealand, Japan, Mexico or South Africa.
In some categories, the legal limit in Europe is relatively low compared to the amount of toxin that frequently can be present in food. For instance, a study in France found that some samples of coffee were very close to the legal limit in terms of ochratoxin level; in countries without such standards, coffee may greatly surpass the European standard in terms of the amount of the toxin present.

As is the case with other mycotoxins, probiotic bacteria can be effective in detoxifying ochratoxin. The more intensive exposure to these sorts of bacteria seems to be the explanation for why ruminants such as cows are less affected by the toxin than other farm animals.

Binders of various sorts (such as Cholestyramine in humans and Mycotix in livestock) appear to be at least somewhat effective in helping to move the toxins through the intestinal tract and out of the body.

Supplements that have been shown to be possibly helpful in reducing the effects of ochratoxin include Vitamins C and E, lycopene, flavonoids, zinc, melatonin, Coenzyme Q10, milk thistle, cyanidin and L-phenylalanine.

-Lisa Petrison, Ph.D.
OCHRATOXIN

MEDIA ARTICLE:

August 12, 2013
The New Yorker
Poisoned Land: On the Trail of a Mystery Disease in the Balkans
By Elif Batuman

http://www.newyorker.com/reporting/2013/08/12/130812fa_fact_batuman?
mbid=social_tablet_e&pink=zc-mdFe

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OCHRATOXIN

MEDICAL LITERATURE

Review Papers


Effects on Kidneys


Stachurska Anna, Kozakowska Magdalena, Jozkowicz Alicja, Dulak Jozef, Loboda Agnieszka. Aristolochic acid I and ochratoxin A differentially regulate VEGF expression in porcine kidney epithelial cells—the involvement of SP-1 and HIFs transcription factors. Toxicology letters. 2011;204:118–126.


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fragmentation in cultured Vero cells and on chromosome aberrations in mice bone marrow cells. Toxicology. 2008;251:1–7.


Rached Eva, Pfeiffer Erika, Dekant Wolfgang, Mally Angela. Ochratoxin A: apoptosis and aberrant exit from mitosis due to perturbation of microtubule dynamics? Toxicological sciences : an official journal of the Society of Toxicology. 2006;92:78–86.


**Balkan Endemic Nephropathy**


Stefanović Vladisav, Polenaković Momir. Fifty years of research in Balkan endemic nephropathy: where are we now? Nephron. Clinical practice. 2009;112.


Effects on Offspring


**Presence in Milk**


**Effects on Liver**


Guerra M. C., Galvano F., Bonsi L., et al. Cyanidin-3-O-beta-glucopyranoside, a natural free-radical scavenger against aflatoxin B1- and ochratoxin A-induced cell damage in a human hepatoma cell line (Hep G2) and a human colonic adenocarcinoma cell line (CaCo-2). The British journal of nutrition. 2005;94:211–220.


**Urinary & Bladder Effects**


Cancer


**Neurological Effects**


Oh Jae Ho H., Jung Hai Kwan K., Park Yun Ju J., et al. Inhibitory effects of ochratoxin A on nerve growth factor-induced neurite extension through downregulation of p38 MAP


Immune System Effects


Effects on Pathogens


Kumar Arvind, Jindal Naresh, Shukla Chhote L., Asrani Rajesh K., Ledoux David R., Rottinghaus George E.. Pathological changes in broiler chickens fed ochratoxin A and


Gastrointestinal Effects


Berger Valérie, Gabriel Anne-Françoise F., Sergent Thérèse, Trouet André, Larondelle Yvan, Schneider Yves-Jacques J.. Interaction of ochratoxin A with human intestinal

Maresca M., Mahfoud R., Pfahl-Leszkowicz A., Fantini J.. The mycotoxin ochratoxin A alters intestinal barrier and absorption functions but has no effect on chloride secretion. Toxicology and applied pharmacology. 2001;176:54–63.


Reproductive System Effects


**Endocrine Effects**


**Effects on Bones and Skin**


Blood Sugar Effects


Respiratory Effects


Adipose Tissue Effects

Lim Seyoung, Jang Hyun-Jun J., Kim Jung Kuk K., et al. Ochratoxin A inhibits adipogenesis through the extracellular signal-related kinases-peroxisome proliferator-


**Endothelial Cell Effects**


**Human Serum Albumin Effects**


**Genotoxic Effects**


**Oxidative Stress & Glutathione**


Hassen Wafa, Ayed-Boussema Imen, Bouslimi Amel, Bacha Hassen. Heat shock proteins (Hsp 70) response is not systematic to cell stress: case of the mycotoxin ochratoxin A. Toxicology. 2007;242:63–70.


Effects on Robustness and Growth


**Human Population Levels & Risk Assessment**


**Toxicokinetics**


Zepnik Herbert, Völkel Wolfgang, Dekant Wolfgang. Toxicokinetics of the mycotoxin ochratoxin A in F 344 rats after oral administration. Toxicology and applied pharmacology. 2003;192:36–44.


**Combined Mycotoxins**


Inhaled Ochratoxin


Ochratoxin in Food


**Treatment & Prevention Strategies**


**Probiotic Bacteria**


Binders


**Drugs & Supplements**


Atroshi F., Rizzo A., Westermanck T., Ali-vehmas T.. Effects of tamoxifen, melatonin, coenzyme Q10, and L-carnitine supplementation on bacterial growth in the presence of


Creppy E. E., Röschenthaler R., Dirheimer G.. Inhibition of protein synthesis in mice by ochratoxin A and its prevention by phenylalanine. Food and chemical toxicology : an


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