

## Mycotoxins in food

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### Abstract

Mycotoxins can be found frequently in different types of foodgrains. They can be harmful for tissue and may even cause cancers. Hence, they are highly relevant to food science.

**Keywords:** mycotoxins; aflatoxin; fumonisin

### Introduction

Mycotoxins are compounds found in different types of fungi growing in foodgrains like peas, maize, rice and other grains (1). They are secondary metabolites released by molds. They act as biological contaminants in foodgrains. Mycotoxins pose various health hazards and are hence very important from public health viewpoint.

Common mycotoxins found in foods are listed below:-

**a. Aflatoxin:** It is one of the commonest mycotoxins, implicated in hepatitis and hepatocellular carcinoma. It is produced by *Aspergillus flavus* and *Aspergillus parasiticus*(2). It is found commonly in foodgrains like maize, peas, groundnuts and rice, and found more commonly in warm and humid regions (3). Dietary exposure to aflatoxins is of public health concern owing to their carcinogenic, acute and chronic effects.

Inside our body, Aflatoxin is converted to epoxide moiety, which causes the DNA damage and may thus cause resultant malignancy.

Aflatoxins are of 3 types: - Aflatoxin B1, G1 and M1. They can be differentiated according to the type of fluorescence under UV light.

**b. Fumonisin:-** Fumonisin is a group of naturally-occurring mycotoxins produced by the fungi *Fusarium verticillioides* (formerly called *F. moniliforme*), *Fusarium proliferatum* and other *Fusarium* species(4). They can cause liver damage.

**c. Zearalenone:-** It is an estrogen-like compound. It is a toxin produced by *Fusarium* species and is an estrogenic compound also called F-2 toxin (5). It is liberated mostly by fungi growing in maize (Zea mays). It can cause signs of hyperestrogenism in males, like gynaecomastia.

**d. Trichothecene:-** Trichothecenes are a family of over 200 toxic sesquiterpenoids produced by species belonging to multiple fungal genera(6). One important trichothecene, nivalenol is discussed later.

**e. Patulin:-** Patulin is a mycotoxin found mostly in rotten apples. Other fruits like apples, pears, peaches, and grapes may also contain Patulin. It is a lactone metabolite which causes brown rot in apples. It is produced mainly by the fungal genera of *Penicillium* spp., *Fusarium* spp. and *Aspergillus* spp. Patulin may cause a range of health-related adverse effects like agitation,

convulsions, edema, dyspnea, pulmonary congestion, ulceration, hyperemia, distension of the gastrointestinal tract, and others (7).

**f. Ochratoxin:-** Ochratoxins can be found in food items like grapes. Ochratoxin has been implicated in nephropathy. It is commonly produced by *Aspergillus carbonarius*(7). Other fungi may also act as source of Ochratoxin, like *Aspergillus ochraceus* and *Penicillium verrucosum*. Various studies have associated Ochratoxin A (OTA) exposure with the diseases Balkan endemic nephropathy (BEN) and chronic interstitial nephropathy (CIN)(8). The kidney is the major target organ for OTA. It is a potent renal carcinogen as found in several animal species.

**g. Nivalenol: -** It is a type B trichothecene produced by many species of *Fusarium* spp(9). Crops, like wheat, barley, and corn are usually contaminated with NIV, since these crops are more susceptible to the growth of NIV-producing fungal species (9).

Why are mycotoxins found in foodgrains?

Grains stored in cold, dark and humid conditions gather growth of molds or filamentous fungi, which release various mycotoxins according to the type of grains and also the type of mold. This is commonly seen on cold storage.

### Detection:

Mycotoxins are detected in foodgrains by techniques like Thin layer chromatography (TLC) and HPLC (High Performance Liquid Chromatography). Culture for fungi will also help in detection of fungi like *Aspergillus flavus*.

In foodgrains, Aflatoxin B1 causes blue fluorescence in UV light whereas Aflatoxin G1 produces green fluorescence. The grains can be subjected to culture also to recover the fungi.

### Prevention:

A good agricultural and manufacturing practice should be applied during handling, storage and distribution of rice to make sure that aflatoxin contamination level is less in the final product. Moreover, a regular survey for aflatoxins occurrence in rice and biomarkers-based studies is

recommended to prevent and reduce its adverse health effects in the world population.

## Discussion:

Mycotoxins are produced by molds. The term mycotoxin was coined in 1962 in the aftermath of an unusual veterinary crisis near London, England, during which approximately 100,000 turkey poults died (22, 82). When this mysterious turkey X disease was linked to a peanut (groundnut) meal contaminated with secondary metabolites from *Aspergillus flavus* (aflatoxins)(10). Not all mycotoxins are harmful to man. Molecules like Penicillin, Cyclosporine and others like ergot alkaloids are also mycotoxins, which have witnessed many beneficial applications in the medical field (11). Moreover, mycotoxins have no typical odor and also do not alter the organoleptic characteristics of foods, and hence may be difficult to suspect and detect (12). They enter the food chain too frequently and cannot be ignored. More than 80% of the agricultural produce worldwide is contaminated by at least one mycotoxin (9). There are three types of **toxicogenic field fungi**: - plant pathogens like *Fusarium graminearum* (deoxynivalenol, nivalenol), fungi that grow on senescent or stressed plants, namely *Fusarium moniliforme* (fumonisin) and sometimes *Aspergillus flavus* (aflatoxin), and fungi that initially colonize the plant before harvest and predispose the commodity to mycotoxin contamination after harvest, such as *Penicillium verrucosum* (ochratoxin) and *A. flavus* (aflatoxin). They cause many adverse effects like hyperestrogenism, nephropathy and malignancies. Since temperature and humidity are important parameters for the growth of fungi, climate change is believed to impact the presence of mycotoxins in foodgrains (13). The global health issue arising from mycotoxins is still mostly ignored in many low-income countries, where mycotoxins affect staple foods (14). Aflatoxins that occur naturally are classified as human carcinogens (Group 1); ochratoxins and fumonisins are classified as possible human carcinogens (Group 2B). Trichothecenes and zearaleone are not recognized as human carcinogens (Group 3) (15). They can be detected by various methods.

**Conclusion:** Mycotoxins are harmful, and should be screened for, in foods like grains and cereals before consumption.

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