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Conference Paper · August 2022

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AIR POLLUTION BY MYCOTOXINS IN AGRICULTURE

Abstract

Many agricultural products can be contaminated with mycotoxins. There is a well-known example of contamination of corn from the genus 2012 in Serbia with aflatoxins, which then caused milk contamination. The consequences of this event on air quality and on the health of the population have not yet been investigated. Previous decades of research in the Scandinavian countries have shown that in the dust generated by threshing, as well as storage of cereals, there are from 0 to more than 2,000 micrograms of mycotoxins per kg of dust. Mycotoxins are resistant to all processes of processing agricultural products, including fermentation and cooking.

Key word: air, pollution, mycotoxins, agriculture

Introduction

Mycotoxins are secondary and mostly highly toxic mold metabolites (microscopic multicellular fungi; Micophyta = fungi = from some species of Penicillium, Aspergillus, Fusarium, Stachybotrys, Chaetomium, Cladosporium and others.

By 2005, over a hundred mycotoxins had been detected. Mycotoxins are mainly specific for certain types of molds and are found in virtually all parts of their body as well as in spores. Many fragments of mold and spores are small (dust category), but can also belong to reportable, aerosol particles. For that reason, mycotoxins can be transferred to the air through spores or fragments of the organism. From the ecotoxicological point of view, mycotoxin-producing molds are divided according to their findings, into two, but insufficiently differentiated groups:

1. Mycotoxins originating from molds in closed and damp rooms (houses, apartments, basements, laundries, bathrooms, stables, feed preparation rooms, bunkers, manholes, air conditioners, ventilation pipes and devices). The main precursors of these mycotoxins are: hetoglobosin A, satratoxin X, sterigmatocystin, trichodermoli, trichothecene, verrucarini. Most of these mycotoxins belong to a broader group known as macrocyclic trichothecenes and are produced primarily by the mold Stachybotrys chartarum and some species of Aspergillus. Exposure to this group of mycotoxins occurs by living in polluted rooms, when cleaning walls and appliances in such rooms, but

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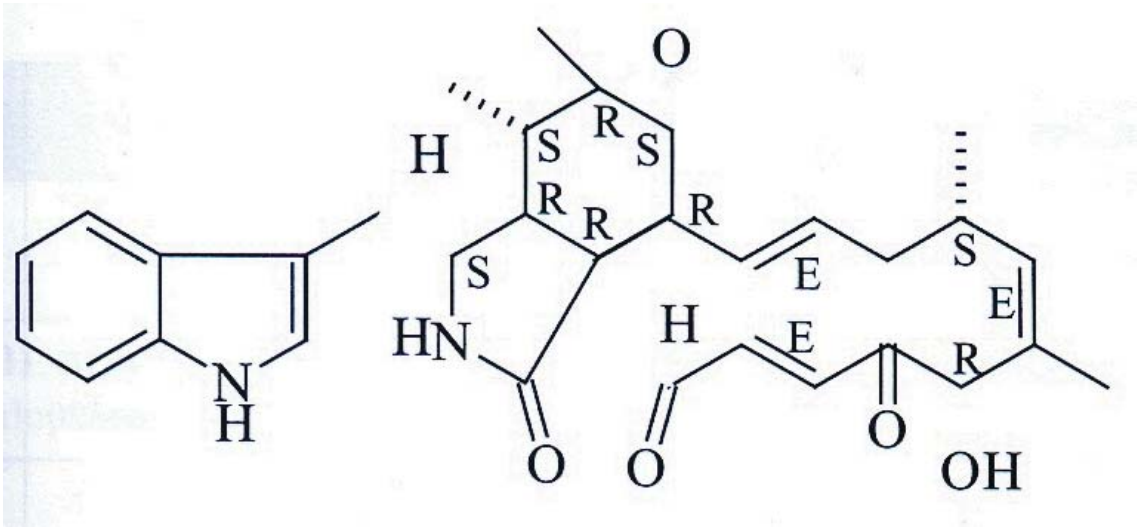
also outside polluted rooms due to the way aerosol particles spread. However, there are situations when group 2 mycotoxins are found indoors and in damp areas, and vice versa, molds that produce mycotoxic groups 1 are associated with group 2 molds. Thus, aflatoxins (group 2) were found in basements and in phase biomass. rotting or composting (for example, rotten hay, straw, wood) were found trichothecenes from group 1.

2. Mycotoxins originating from molds on various agricultural fruits and food products (all cereals and their grinding products, peanuts, nuts, pepper, nuts, green coffee, cocoa, citrus fruits, bread, chips, cornflakes, flowers and raisins, wine , beer) - these are mainly products rich in cellulose or other carbohydrate fats, and low in protein. This group of mycotoxins includes aflatoxins, deoxynivalenol, fumonisins, ochratoxins and zearalenone. It is important to note that some of these mycotoxins are resistant to heat and over 3000 C. Direct exposure to this group of mycotoxins occurs during harvest, in rows in silos and warehouses, in grinding and other operations of processing and packaging of agricultural products, and in work on unprotected landfills. Particles with mycotoxins can be blown up over relatively long distances and are therefore traced everywhere in the air. However, it is of wider importance to enter through food products.

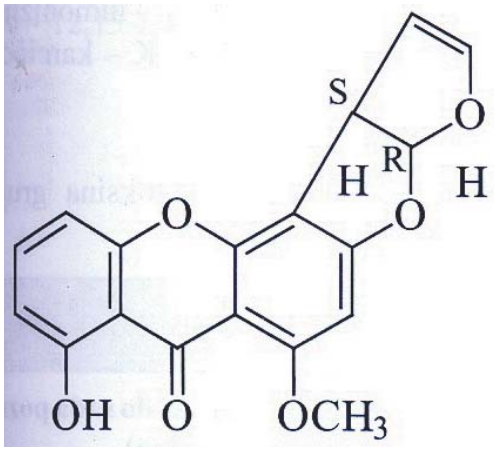
Structurally and chemically, mycotoxins are mainly complex molecules composed of polycondensed five-membered heterocycles, aromatic, six-membered alkane, alkene and heterocyclic rings as well as eight- and multi-membered unsaturated rings. Some rings carry methyl, hydroxy, epoxy and keto groups and / or contain an ether bond. Therefore, they are reactive systems and hence their extreme toxicity and potential carcinogenicity.

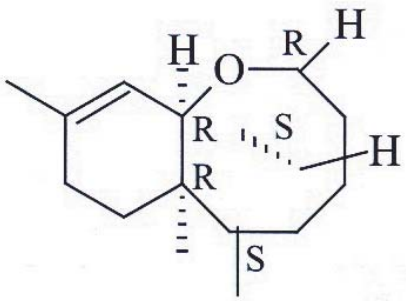
Mycotoxins from group 1. The most widespread are mycotoxins from the class of marocyclic trichothecenes, and the most important producer of these mycotoxins is Stachybotrys chartarum, a greenish-red mold. Among the most toxic representatives of group 1 mycotoxins are hetoglobosin A, sterigmatocystin and trichothecene. The main toxicological characteristics of mycotoxins of group 1 are asthmatic diseases, allergies with late blight, eye inflammation, inflammation and bleeding of the lungs, inhibition of antioxidants, suppression of the immune system, diseases of the nervous system. The structural formulas of some of the group 1 micotoxins are shown in the following text.

Hetoglobuzin A



Sterigmatocistin





Trihotecen

Mycotoxins of group 2. An overview of some characteristics of selected mycotoxins of this group can be found in Table 1, their toxicological effects in Table 2, and the formulas of important representatives are presented below.

Table 1.Characteristics of significant representatives of mycotoxins of group 2

Characteristic	AFL B1*	4-DON	FUM B1	OHR A	ZEAR
Melting point (^{0}C)	265 rasp.	152	/	169	164,9
Solubility in water (g/dm^3, 25^{0}C)	/	/	pH 1-7 2,4-1000	pH 1-10 0,006-320	pH 1-10 0,48-1000
Fb	1,29	1,0	1,0	pH 1-7 1790-1,0	pH 1-7 476-1,0
Toxicological characteristics	M, K, R	K, R	M, K, R	M, K, R	M, K, R
Carcinogen group	1	?	?	2B	3

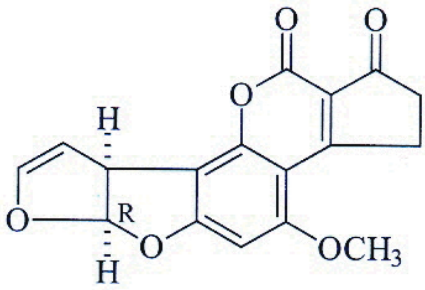
* AFL B1-aflatoxin B1, 4-DON-4-deoxynivalenol, FUM B1-fumonisin B1, OHR A-ochratoxin A, ZERA - zeralenone, ** M-mutagen, K-carcinogen, R-harmful effect on reproduction.

Table 2. Toxic effects of significant representatives of mycotoxins of group 2 (according to Jarvis in Miller. 2005)

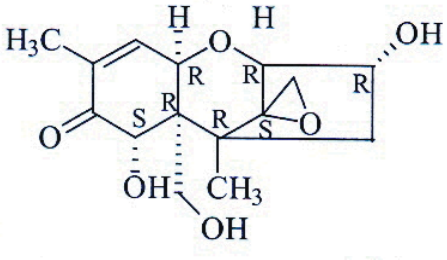
Mycotoxin	Mold	Effect
AFL B1*	Certain species *Aspergillus*	Hepatitis, liver cancer (the strongest known carcinogen of plant origin)
4-DON	*Fusarium graminearium*	Nausea, digestive disorders, loss of appetite
FUM B1	Certain species of Fusarium and Alternaria alternata	In certain animals: brain disease, pulmonary edema, liver cancer. In humans: esophageal cancer.
OHR A	Some species of Aspergillus and Penicillium	Renal and hepatic impairment, renal cell carcinoma, immune suppression, teratogenesis
ZEAR	Certain species of *Fusarium*	Estrogenic activity, harmful effect on reproduction.

* AFL B1-aflatoxin B1, 4-DON-4-deoxynivalenol, FUM B1-fumonisin B1, OHR A-ochratoxin A, ZERA ├ zeralenone, ** M-mutagen, K-carcinogen, R-harmful effect on reproduction.

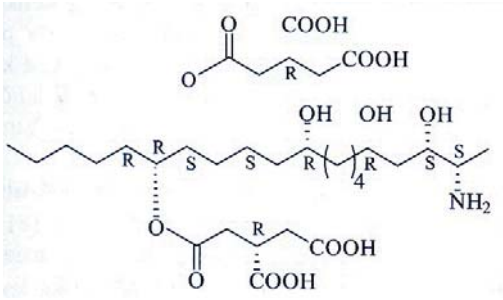
Aflatoxin B1



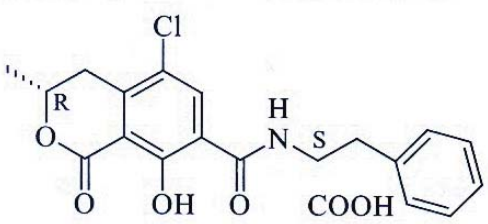
4-Deoxynivalenol



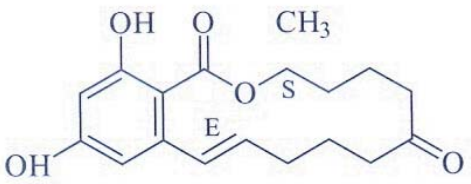
Fumonisin B1



Orhatoxin A



Zearalenone



Related to mycotoxins is mycocystin produced by a species of blue-green algae (Mycocystis spp.) In eutrophicated lakes. Mycocystin causes severe liver damage, and in chronic exposure to the nervous system (Shaw and Chadwick, 1999).

Conclusion

The paper shows that many agricultural products can be contaminated with mycotoxins. Many works of the authors show that the environment in Serbia has long been polluted with several types of mycotoxins (). There is a well-known example of contamination of corn from the genus 2012 in Serbia with aflatoxins, which then caused contamination of milk. The consequences of this event on air quality and population health have not yet been investigated. Over the past decades, research in the Scandinavian countries has shown that dust from threshing as well as storage contains from 0 to more than 2000 μg of mycotoxins per kg of dust. Mycotoxins are resistant to all processes of processing agricultural products, including fermentation and cooking.

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CIP - Каталогизација у публикацији
Народна библиотека Србије, Београд

327::911.3[338(4)(082)
351.861:614(4)(082)
351.861(4-12)(082)
338(4-12)(082)

МЕЂУНАРОДНА научна конференција Привреда и безбедно друштво (2022 ; Београд)
Istaknuti tematski zbornik radova vodećeg nacionalnog značaja [Elektronski izvor] = Proceedings / Međunarodna naučna konferencija Privreda i bezbedno društvo ; editor Slobodan Nešković ; [urednik zbornika radova Marina Protić]. - Beograd : Centar za strateška istraživanja nacionalne bezbednosti - CESNA B : Međunarodna Akademija Nauka, Umetnosti i Bezbednosti - MANUB ; Veliko Trnovo : Univerzitet "Sveti Kiril i Metodij", 2022 (Beograd : Belpak). - 1 elektronski optički disk (CD-ROM) : tekst, slika ; 12 cm. - (Edicija Bezbednost u postmodernom ambijentu ; knj. 37)
Sistemski zahtevi: Nisu navedeni. - Radovi na više jezika. - Tekst ćir. i lat.
- Slike autora. - Tiraž 200. - Str. VII-X: Predgovor / Slobodan Nešković.
- Napomene i bibliografske reference uz tekst. - Bibliografija uz svaki rad. - Rezime na više jezika.
ISBN 978-86-85985-50-8 (CESNA B)
а) Геополитика -- Економски аспект -- Европа -- Зборници б) Безбедносни сектор -- Здравствени аспект -- Европа -- Зборници в) Безбедносни сектор -- Југоисточна Европа -- Зборници г) Југоисточна Европа -- Приредни развој -- Зборници
COBISS.SR-ID 69957897