

# The Importance of Qualitative and Quantitative Biological Methods for Evaluation and Screening of Mycotoxins

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## Abstract

Mycotoxins are toxic compounds and the secondary products of the metabolism of various fungal species that grow and develop on substrate of animal or plant origin. The chemical nature (of most mycotoxins) makes them highly liposoluble compounds, that can be absorbed by the gastrointestinal and respiratory tracts and through the blood stream, where they can be passed throughout the body and accumulated in different organs such as the liver and kidneys. The degree of intoxication varies between individuals, mostly depending of the amount of food contaminated with mycotoxins, ages of the subjects, sex, their general health, physiology and immunity. Having in mind the confirmed hepatotoxic and carcinogenic effect of the

mycotoxins on the one hand and the conclusions arising from the latest research on the other hand, it is very important to emphasis the need for constant monitoring, the importance of evaluation and screening of the mycotoxins in food, especially in cereals and dairy products, with only one intention to prevent mycotoxicosis. The intention of biomedicine and food biotechnology is to find a faster, much simplified and exact methods for rapid evaluation and screening of mycotoxins, which can be very useful for permanent human biomonitoring and a healthy population.

**Keywords:** mycotoxins, intoxication, biological methods, evaluation, screening

## INTRODUCTION

Mycotoxins are toxic compounds and the secondary products of the metabolism of various fungal species that grow and develop on substrate of animal or plant origin. Their name comes from a greek "mykes", which means fungus and lat. "toxicum", which means poison. The most common foods and compounds that can be contaminated with mycotoxins are: cereals (rye, wheat, corn, barley, rice), oilseeds (peanuts, soy, sunflower), nuts (walnuts, hazelnuts, almonds), dried fruits (figs, grapes), beer, wine, spices, cocoa and especially milk and dairy products (1-4). The chemical nature (of most mycotoxins) makes them highly liposoluble compounds, that can be absorbed by the gastrointestinal and respiratory tracts and through the blood stream,

where they can be passed throughout the body and accumulated in different organs such as the liver and kidneys (5,6). There are 400 different types of mycotoxins that differ by the type of fungus that they synthesize, their chemical structure, the mechanism of action and the degree of toxicity, but there are a few mycotoxins that are a huge threat to the human health, they are: aflatoxins, ochratoxin A, patulin, fumonisins, zearalenone and nivalenol/deoxynivalenol (7-9).

### *Mycotoxicosis*

Diseases caused by mycotoxins are called mycotoxicosis and from aflatoxins, they are called aflatoxicosis, respectively. The typical and most common symptoms of mycotoxin intoxication are fever, gastrointestinal pain, and immunosuppression (Figure 1).

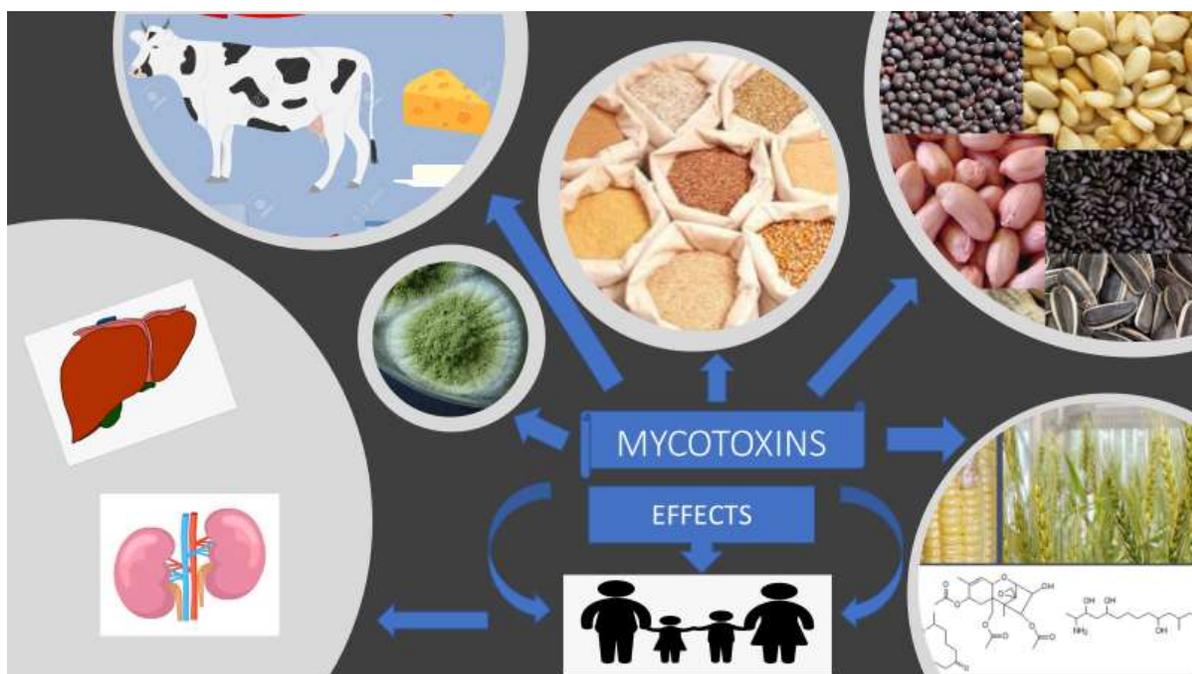


Figure 1. Common effects of Mycotoxins

Mycotoxicoses can be defined as acute or chronic. Acute toxicity generally has a rapid obvious toxic response, while chronic toxicity is characterized by low-dose exposure over a long time period, resulting in cancers and other generally irreversible effects. The adverse effects of mycotoxins in humans can induce liver cancer, reduction of immunity, alterations in the protein metabolism, gangrene, convulsions, and respiratory problems, among others (10, 11). Radovanovic et al., (12) linked mycotoxins as one of the risk factors for tumor of urinary organs in a focus of Balkan's endemic nephropathy. The last studies (13-15) observe that mycotoxicosis may eventually result in death. The most common and most toxic mycotoxins are aflatoxins, which can be produced by several species of fungi: *Aspergillus flavus*, *Aspergillus parasiticus* or *Aspergillus nomius*. Aflatoxins are confirmed carcinogens that belong to the first group of carcinogens according to the classification of the International Agency for Research on Cancer (IARC) (16,17). Aflatoxins (AF), as mycotoxins, have a hepatotoxic, immunosuppressive, teratogenic and mutagenic effects. There are different types of AF. AF-B1 is more mutagenic and carcinogenic than AF-G1, reflecting the fact that the AF-B1 8,9- exo -epoxide intercalates more readily into DNA, yielding higher levels of adducts for a given dose. AF-B2 and AF-G2 are generally considered to be far less biologically active due to the absence of an 8,9 double bond and consequently 8,9-epoxide formation ( 18,19). The most favorable conditions for growth and

development of these fungi that increase concentration of mycotoxins are: high temperature and humidity, especially during transport and storage of crops or inadequate hygiene or storage of food products of plant or animal origin. Also, the degree of intoxication between individuals mostly depends on the amount of food contaminated with mycotoxins, ages of the subjects, sex, their general health, physiology and immunity. Previous research and studies indicate that every human can be exposed to intoxication of mycotoxins, but the most vulnerable group are children that have a daily intake of dairy milk products, that are contaminated with mycotoxins (20).

#### **DESCRIPTION OF TECHNOLOGY / METHODOLOGY**

As a modern and very rapid methods for screening of aflatoxins and other mycotoxins are:

- high performance (pressure) liquid chromatography (HPLC) with fluorescence detector
- enzyme linked immunosorbent assay (ELISA)
- liquid chromatography-mass spectrometry (LC-MS)

In the latest decade, the mostly used method for screening of mycotoxins was thin layer chromatography (TLC), but according to its limitations for quantification and impossibility to repeat the procedure, it is neglected as a method in the process of evaluation of mycotoxins (21-24). Enzyme-linked immunosorbent assay (ELISA) approaches are typically less expensive, but an additional issue is a lack of commercially

available kits or antibodies. While LC-MS provides robust data, the analytical costs are prohibitive for most laboratories (25). The choice of the methods is determined by the aim of the screening procedure, need of qualification or quantification and the types of the food for analysis.

## **DISCUSSION**

The stability of mycotoxins to various preservatives and emulsifiers used in the process of preparation and packaging of the food, also affects the degree of their toxicity and the process of evaluation and screening (26-28). World health Organization (WHO) and Food and Agriculture Organization of the United States”, FAO underline that daily intake of aflatoxin of 2 µg/kg present a potential health risk for humans. Medina et al.2015 (29) in their study conclude that in recent years, certain mycotoxins have appeared in atypical agricultural commodities and associated food products and/or unusual regions/climates and global warming is likely to play a very important role in this.

Due to the growing awareness of consumers for their health, the food contamination with mycotoxins has become an important topic for both consumers and subjects in the food business and academic and professional public. Apart from the adverse effects to the health of people and animals, it can also have a significant implications and negative economic effect.

According to these, it is essential and necessary to keep the public informed about presence of

mycotoxins in food and feed and negative effects of mycotoxins on human health, it is essential to perform organized food control and take preventive measures in production and warehousing of plant and animal products.

## **CONCLUSION**

Having in mind the confirmed hepatotoxic and carcinogenic effect of mycotoxins on the one hand and the conclusions arising from the latest research on the other hand, it is very important to emphasis the need for consistent monitoring, importance of evaluation and screening of mycotoxins in the food, especially in cereals and dairy products, with only one intention to prevent mycotoxicosis. The intention of biomedicine and food biotechnology is to find faster, much simplified and exact methods with high sensitivity for rapid evaluation and screening of mycotoxins, which can be very useful for permanent human biomonitoring and healthy human population.

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## **Conflict of interest:**

None declared.

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