The Influence of the Environmental Factors on the Mycotoxic Supply Provided by Food Products Obtained from Cereals

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Abstract. The paper aims to emphasize the last decade status of the most frequent mycotoxic contaminants of the common crop cereals: maize, wheat, barley, two row barley, soy, rye, etc. The structure of the main mycotoxins treated in this paper (ochratoxin, zearalenone, aflatoxin, trichotecene, patulin, fumonisine) is presented, mentioning the producing organisms. The limits stipulated by Romanian authorities are comparatively presented with those present in EU. The importance of the environmental factors (clime, temperature, moisture, storage conditions, etc.) on mycotoxic cereal contamination is also treated.

Keywords: crops, cereals, mycotoxin, fungi, environment

INTRODUCTION

The mycotoxins are secondary toxic metabolites producing toxic effects in humans and animals. They are represented by a large diversity of species produced by mushrooms during their development on crops and seeds during storage. Even more than 300 mycotoxins were described, only few can be analyzed (Oroian, I., 2008).

The chemical structure of the main mycotoxins analyzed in this paper considerably differs, but they generally are organic compounds with small molecular weight:
The mycotoxicosis is a disease produced by mycotoxins, secondary metabolites of the mushrooms, which produce moulds. The mycotoxin exposure is frequent by ingestion, but may also occur by inhalation or dermal contact.

The mycotoxicoses are often hard to diagnose, except the situation when lots of individuals are affected. The severity of the mycotoxicosis depends on several factors: the mycotoxin toxicity, type of exposure, age, nutritional state of the organism and presence of possible synergic effects of the chemicals to who was exposed.

In last decade, the European Union launched important programmes for supplying feed quality, especially since dioxin problem was present in Belgium.

THE ACTION OF THE MYCOTOXINS FROM CREREAL DERIVED FEED PRODUCTS

The general, incipient symptoms of the mycotoxicosis in humans and animals are: loose of appetites, weight loose, feed refuse, diarrhoea and bleeding. The mycotoxicoses are generally characterized by the following traits (Anyanwu, E. C., 2009):
- the disease is not contagious
- the drugs and antibiotics have low influence in disease control
- the manifestations are seasonal
- the problem is associated to specific feeding
- the feed analyses indicate the presence of the toxic metabolites.

Among thousands of mushrooms, only about 100 are known as mycotoxin producers. *Aspergillus*, *Penicillium* și *Fusarium* are fungi genus, which appear to currently produce mycotoxins (Fig. 1).

![Fig. 1. The relationships between pathogenic fungi and produced mycotoxins](image-url)
The maximum admitted doses for mycotoxins in Romania and EU (Oroian I., 2006) were established according to Romanian regulation represented by the Order no. 975/16.12.1998, chapter VI, and (Fig. 2). For the aflatoxins in cereal seeds and flour the Romanian limit is 10 µg/kg product (6 µg/kg product in EU), and in feed for children up to 3 years maximum 5 µg/kg product.

For ochratoxin, the maximum admitted limit in cereal seeds and flour, and pork meat in Romania is 20 µg/kg product (5 µg/kg product in EU). In natural juices, the maximum admitted limit for patulin is 50 µg/kg product. For zearalenone, trichotecenes and toxin T2 in cereal seeds and flour is 20 µg/kg product in Romania (Tab. 1).

### THE ENVIRONMENTAL FACTORS INFLUENCING THE MYCOTOXIN PRESENCE

In some environmental conditions some toxigenetic moulds can produce mycotoxins during crops vegetation or after harvesting, during storage (Cotty, P.J. et al., 2007). The cereal seeds, soy, peanuts and forages are manly affected. The seeds contaminated with mycotoxins are important due to the potential action on the main products of human feed (bread, flour, flakes, bakery products, etc.) and animal food, which indirectly affects the human feeding, meaning meat and meat derivatives (Fig. 2).

From climatic point of view, the last decade was favourable for mycotoxin formation. By entire areas, the wheat and maize were affected by mycotoxin attack. As consequence, the European Union started a program for mycotoxin monitoring, and in the mean time research patterns were initiated in order to identify the steps of mycotoxin production, and ways of dissemination by trophic chain to humans, as well as contamination methods in forages and feed.

### Tab. 1

<table>
<thead>
<tr>
<th>Product</th>
<th>Mycotoxins – legal limits in Romania and EU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mycotoxins admitted concentration&lt;br&gt;(µg/kg product)</td>
</tr>
<tr>
<td></td>
<td>Romania</td>
</tr>
<tr>
<td>Cereal seeds and flour</td>
<td>6</td>
</tr>
<tr>
<td>Dry vegetables, oilaginous seeds, peanuts, hazelnuts, nuts, coffe, vegetal protein concentrates and isolates</td>
<td>10</td>
</tr>
<tr>
<td>Peanuts before selection or processing for consumption</td>
<td>23</td>
</tr>
<tr>
<td>Nuts and dry fruits before selection or processing for consumption</td>
<td>15</td>
</tr>
<tr>
<td>Feed for children up to 3 years</td>
<td>10</td>
</tr>
<tr>
<td>Pork meat</td>
<td>5</td>
</tr>
<tr>
<td>Milk</td>
<td>0,05</td>
</tr>
<tr>
<td>Vineyard dried fruits (currants, sultanins)</td>
<td>10</td>
</tr>
<tr>
<td>Natural fruit juices</td>
<td>50</td>
</tr>
</tbody>
</table>
Fig. 2. Factors advantaging the mycotoxin formation and trophic chain to humans
The mycotoxin production starts in field and continues during cereal storage (Magan, N. et al., 2003). A series of factors affect the mycotoxin producing in field (Fig. 2):

- soil tillage system
- fertilizing system
- crop rotation
- variety (varieties with short straw produce more mycotoxins)

In storage houses, the main role is occupied by the ratio temperature - moisture and storage duration (Ribeiro J.M.M. et al., 2006). The contaminated feed from agricultural production is dangerous in two cases (Berca M., 2003):

- when super intensive and intensive agriculture are practiced. The harmful effect is produced by “forcing the biological limits” of the plants cultivars and animal breeds, due to the use of conventional inputs, which damaged the ecological balances, production and feed quality. This harmful effect may be enhanced by the presence of over dimensioned residues of fertilizers, pesticides, hormones, etc., or changes created by genetic mutations unfavourable for humans.

- when non performant agriculture is practiced, in undeveloped or during development countries. In this case the harmful effects are produced by the lack of disease, mites and natural mycotoxin producing weeds control, based on use of productive plants varieties with high sensibility together with incomplete technologies.

Because in Romania the wheat production is 2,500 kg/ha in average, framing within the second risk group, we expect our grains to contain 100 – 500 µg/kg mycotoxins in average, and this value is close to the apparition of the chronic toxicity.

In Romania, the last decade was similar from climatic point of view with Western Europe and favourable for mycotoxin production. According to Berca M. (2003) doses over 1,000 ppm and even over 10,000 ppm were recorded in wheat and derivative wheat products (bread, pasta, biscuits).

The fungi infection is produced during plants vegetation, and during technological flow, when the seed become feed. It depends on:

- climatic conditions – which cannot be directed, but if we know them we can obtain valuable information on the incidence of the fungi infection of the crops during the analyzed year. This allows the adopting of suitable measures by technological flow of the row material – wheat, maize, barley, two row barley, and rye seeds.

- technology used during vegetation, which can be beneficially directed from phytosanitary point of view, reducing in this way the mycotic charge

- conditions of storage and manipulation of both raw material and finished products (flour, flakes, pastry derivates, bread, etc.). During this time interval, over the mycotic charge gained in the field typical storage house infections with mycotoxic fungi are overlapped.

CONCLUSIONS

Very careful monitoring is imposed in Romania for bakery cereals, fodder cereals and derivate feed, in order to obtain an accurate knowledge of the mycotoxin status in Romanian feeding stuffs. The physicians and nutritionists must tightly collaborate with the phytosanitary control specialist and corroborate data concerning the climatic and technologic parameters in each year in order to reduce the incidence of the mycotoxicological fungi.
The most frequent mycotoxic contamination sources are maize, wheat and forage. The farmers must be informed about the mycotoxin problem, which is tightly connected with cereal crops, wheat and maize products which result from the farm processing activities or are included in livestock diets. The mycotoxin problem is often aggravated by precarious storage conditions.

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