Mycotoxin contamination in cereals

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Abstract

Food or feed control focuses not only on the analysis of natural food components (carbohydrates, proteins, fats, vitamins), but also on the determination of harmful compounds, like mycotoxins. This group of contaminants, produced by fungi (commonly called moulds) can be dangerous to human and animal health causing diseases known as mycotoxicosis.

Fungi belonging mainly to Fusarium, Aspergillus or Penicillium genus produce several mycotoxins with different health risk. The European Commission has proposed regulatory limits for Aflatoxins, DON, T-2/HT-2 Fumonisins, and OchratoxinA for various raw cereals and their processed products, and for nuts, dried fruits, coffee and some other ingredients of food.

There is the need to survey the present situation and deal with the problem of mycotoxin polluted food in the various countries. Results of mycotoxin analysis (cereals, mixed feeds, raw materials) performed in the Central Laboratory of the University of Debrecen, are presented in this paper.

Keywords: Mycotoxins, cereals, contamination, polluted food

1. Introduction

Fungi can be found throughout nature. For reproduction they need appropriate humidity, temperature and also organic materials what they can find in cereals. During reproduction, fungi produce secondary metabolites called mycotoxins. Many of them may cause undesirable physiological response in humans and animals. Exposure to toxins occurs predominantly by the ingestion of contaminated food, especially cereals and grains. Mycotoxins can be very stable during food processing, and can be found in final products [5].

Depending on the type of soil, the most common plough-land fungi belong to the Fusarium genus, which can infect cereals either on the field or during storage in Europe. Some fungi, belonging to Aspergillus and Penicillium genus, do not infect cereals before harvest, their reproduction and mycotoxin production is the consequence of inappropriate storage[1].

The different mycotoxins have variable effect on human and animal health. Ochratoxin A is formed by fungi of the species Aspergillus and Penicillium. Apart from a marked nephrotoxicita, it displays hepatotoxic teratogenic, carcinogenic and immunosuppressive properties. Aflatoxins are secondary metabolites of the fungi species Aspergillus flavus or parasiticus, they are the strongest natural occurring carcinogenic substances [2]. Zearalenone (F-2 toxin) is formed by fungi of the genus Fusarium. Because its oestrogenic properties, Zearalenone may induce fertility disorders in animals, with clinical signs of hyperestrogenism. T-2 toxin is formed also by fungi of the genus Fusarium. Due to its cytotoxic and immunosuppressive mode of action T-2 toxin is a threat for human and animal health. Deoxynivalenol (DON) belongs to the trichotecene group of mycotoxins, it is formed by fungi of the genus of Fusarium. It has high cytotoxic and immunosuppressive properties [2].
Though mycotoxins are produced mainly on small grains cereals, such as wheat, barley, oats, rye and triticale or maize, toxic residues in animal originated products such as milk, meat, liver or eggs may be –through the food chain – harmful as well as the presence of mycotoxins means a real risk for human (and animal) health, their maximum allowable amount is regulated in the European Union (2006/576/EC, 1881/2006/EC, 1126/2007/EC) [6,7,8] and FAO/WHO [9].

Various techniques have been used for the extraction of mycotoxins and the subsequent purification of the extract. The most frequently used method for clean-up is solid-phase extraction (SPE), employing several adsorbent materials. So far different analytical methods, thin layer chromatography (TLC), high performance liquid chromatography (HPLC), gas chromatography (GC) and enzyme-linked immunosorbent assay (ELISA) have been applied for determination of mycotoxins [4].

2. Materials and Methods

The analysed samples originated from the eastern part of Hungary. Raw cereals (rice, winter wheat, maize,) and mixed feed were checked for the presence of different mycotoxins, total number of samples: 284.

For chromatographic separation a MERCK-HITACHI HPLC system was used with L- 4500 Diode-array Detector, D-7000 Chromatography Data Station Software, and RP-18 C18 (5µm), 125 x 4 mm column. For sample clean-up Vicam immunoaffinity columns were used. Traditional clean-up methods of mycotoxin analysis resulted a sample with several disturbing components that made the HPLC analysis complicated.

The immunoaffinity column contains a gel suspension of monoclonal antibody of the mycotoxins covalently attached to a solid support. The antibodies are specific for different mycotoxins. Following an extraction, sample extract is passed through the immunoaffinity column. Any mycotoxin which is present is retained by the antibodies. After a washing step, mycotoxins are eluted with an appropriate eluent. The eluate contains only the given mycotoxin, there are no disturbing components.

3. Results and discussion

The summarised result of the examinations are shown in Table 1. It can be seen, that from the checked 284 cereal samples the mycotoxin content was over the allowable limits in 12 cases, for Aflatoxin B1, Ochratoxin A, Zearalenone and T2 toxins. There was no detectable amount of the checked mycotoxins in 256 samples.

<table>
<thead>
<tr>
<th>Table 1: Examined cereal samples from 2005 to 2008</th>
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<tr>
<td>Examine samples (piece)</td>
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<tr>
<td>Aflatoxin B1</td>
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<tr>
<td>OTA</td>
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<tr>
<td>Zearalenone</td>
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<td>T2 toxin</td>
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<td>Values under detection limit (piece)</td>
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<td>Values over detection limit (piece)</td>
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<td>Values over allowable limit (piece)</td>
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The detailed results are shown in Figures 1-2.

Figure 1. Aflatoxin B1 and Ochratoxin A contamination in the examined cereals from 2005 to 2008.
4. Conclusion

Our results show that most of the analysed cereal samples proved to be safe, regarding the presence of the most often occurring mycotoxins. Nevertheless, the presence of mycotoxins means a real danger regarding food safety. Though the measured content is rarely high for the different mycotoxins, it is usual that there is more than one present in the cereals, therefore the total mycotoxin content of the samples can be over the limit. The analysis of the raw materials are recommended before food or feed processing.

As toxigenic fungi attack is climate dependent, by some experts it is expected that climate change may influence the present situation [3].

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References

7. 1881/2006 EC Regulation about the upper limits of certain contaminants in foodstaffs