IzmailovaN.

Associate Professor of the Department of Biochemistry and Biotechnology

Sumy National Agrarian University

Sumy,Ukraine

OCCURRENCEOF STERIGMATOCYSTIN IN FOOD AND FEED

Introduction. Moulds are ubiquitous in nature. At the present time a great number of mycotoxins are known. Most of them are metabolites produced by fungi of the genus *Aspergillus, Penicillium,Alternaria*and *Fusarium.* The major mycotoxin groups, which are monitored, are aflatoxins, ochratoxins, trichothecenes, patulin, fumonisins and zearalenon. Due to their high toxicity and carcinogenetic effect, aflatoxins is the most important one among these groups. Their discovery and further investigation appears rather late, in 1960. After this finding, a huge amount of time and effort was invested into toxicological studies, the development of methods for routine control in food and feed. Despite all this preventive events, aflatoxin poisoning is still a problem.

The mycotoxinsterigmatocystin(STC) is a precursor in the biosynthesis of aflatoxin B_1 (AFB_1). The mechanism of molecular action of STC is very similar to AFB_1. However STC seems to be less toxic than AFB_1. According to the California Environmental Protection Agency and the Office of Environmental Health Hazard Assessment the No Significant Risk Intake (NSRI) value for STC is 0.02 μg/day. This is the intake associated with life time cancer risk of 1: 100 000 or lower for an adult who weighs 70 kg.

Up to now there is no harmonised regulation for STC within the EU. The European Commission has made a request to European Food Safety Organisation (EFSA) for a scientific opinion on the risk for animal and public health related to the presence of STC in food and feed. Depending on the opinion of the EFSA, appropriate changes might be done in the EU Legislation.

Occurrence. Making a comprehensive overview on STC natural occurrence is difficult due to several reasons. First of all only a limited numbers of systematic surveys have been conducted up to this moment. Secondly, due to mainly high LOD (limit of detection) of many methods, little information is available on the natural occurrence of STC at low levels of contaminations. In the following a summarization of some available studies on STC occurrence in different food groups are listed:

The occurrence of STC in feedstuffs, home grown cereals, barley, wheat and oats was reported in England and Wales. The survey was carried out in the frame of a routine mycotoxin analysis using TLC with a LOD of 20 μg/kg. Three percent out of 523 samples were positive for STC [1, p. 171-186].

The aim of another survey in England was to determine the presence of mycotoxin in rice bran used as a feedstuff component. Forty samples were studied using HPLC-UV method with a. LOQ of 50 μg/kg and a LOD of 20 μg/kg. No positive findings for STC were reported [2, p. 185-194].

Versilovskis et al. carried out a two-year study that indicated the occurrence of STC in typical Latvian grains from the harvests of 2006 and 2007. The usage of a sensitive LC–MS/MS method allows the determination of STC at very low levels (LOD = 0.15 μg/kg). In the year 2006 only four out of 95 samples were contaminated at levels between 25 and 200 μg/kg (what is comparable to the results of other authors) and 9 samples were positive at the lowest levels of 0.5-25 μg/kg. The investigation of the harvest of 2007 showed that 20 out of 120 samples were positive in the range of 25-200 μg/kg and 22 samples at the lowest level of 0.5-25 μg/kg. The differences between the results of these two years may be explained by varied weather conditions (temperature and humidity). The number of positive wheat samples was much higher in both years comparing to other cereals [3, p. 243-248].

The aim of an Indian study was to screenthe presence of mycotoxin-producing fungi in some common food grains, namely rice, pulses, and oil- seeds, which are regularly sold on the local markets of Calcutta for human consumption. Forty-five

samples were collected between 1988 and 1995. In pulses and oilseeds the sterigmatocystin-producing fungi was detected (*Aspergillus japonicus*). No findings in rice were reported [4, p. 275-277].

A Saudi Arabian study investigated the reduction of mycotoxin content after roasting green coffee beans. Three out of 13 samplescollected in 2009 were positive for STC (5, 11 and 13μg/kg). The reagent free derivatisation method with amino bond TLC plates was used.[5, p. 2101-2111].

In the original paper of Stroka et al. the LOD and LOQ of this method were reported to be 2 and 6 μg/kg for wheat flower, 4 and 11 μg/kg for rice respectively. However, LOD and LOQ for the coffee matrix were not investigated by Stroka et al. and also not reported by Bokrhari et al. Roasting coffee beans in the electrical oven showed in general a bigger reduction in all mycotoxins. A reduction of STC was not observed after 6 or 8 minutes of roasting. A reduction of 70% was detected after 15 minutes of roasting. Since the LOD and LOQ for the coffee matrix is not declared and the originally detected contamination was so low, the reduction of 70% is questionable [6, p. 71-78].

In 1995 in Egypt 120 samples belonging to 24 different spices were investigated for natural mycotoxin occurrence. The TLC method (silica gel plates with post derivatisation with Aluminium chloride) was used for the determination of STC. No LOD and LOQ was mentioned in this publication. STC was detected in three samples of red pepper, caraway and cumin and in one sample of marjoram (in concentrations ranging from 10 to 23 μg/kg). In caraway and marjoram a co-occurrence with aflatoxin B_1 and B_2 was found [7, p. 297-300].

The natural occurrence of mycotoxins (STC, AFBG) has been analysed in peanuts from Egypt obtained from the harvest of 2004. Sixty samples were collected, 20 samples of each untreated, roasted and roasted with salt peanuts. The TLC was used for qualitative detection purpose. Out of 60 samples 14 found to be contaminated with mycotoxins (5 untreated, 6 roasted and 3 roasted with salt samples). Two samples were contaminated with STC in roasted group, 12.2 and 14.8 μg/kg. And one sample was positive for STC in the roasted with salt group

with 12.2 μg/kg. LOD and LOQ of the method used are not defined in the publication. These samples were contaminated by *Emericellanidulans*var. *acristata*as STC-producing fungi [8, p. 349-358].

Country cured ham could also be contaminated by STC. In 1973 Halls et al. examined the capability of *A.versicolor*isolatesto produce STC in the laboratory media and also if cured ham could sustain STC production. Sixteen isolates from cured ham were investigated for potent STC production in the laboratory mediasCzapek-Dox solution (CDY), yeast extract sucrose (YES) and citrate glucose phosphate (CGP). Almost half of isolates showed STC production in different media. Three of them, which showed STC production in all three media were used to inoculate country-cured ham. Production of STC on ham was investigated under two different temperature conditions. After 14 days incubated by 20°C average of 5 μg (range between 4 and 8 μg) and 13.5 μg by 28°C (range between 6 and 20 μg) STC per slice of ham were detected. Fluorometric method has been used for STC detection with LOQ of 0.5 μg STC per slice of ham. The authors came to a conclusion that, even though there was no direct evidence that country-cured ham contain STC, the environment itself might providethe condition that a toxigenic mold such as *A. versicolor* grows and produce it's secondary metabolite like STC in product [9, p. 636-637].

Furthermore, STC have been reported to be found in cheese. With a very sensitive LC-MS method 13 Belgian and eight Latvian cheeses were analysed. The LOD and LOQ were 0.03 and 0.1 μg/kg, respectively. Only two samples (of Belgian origin) were considered to be contaminated within a range of 0.52-1.23 μg/kg. The detecting of such small quantities has been possible only due to the very low LOD of this method [10, p. 127-133].

Determination of STC in beer was realized by the HPLC-UV-SPE method. The LOD and LOQ were 0.26 μg/l and 0.68 μg/l respectively. In this Latvian study 26 samples of dark (9) and light (17) beer have been investigated. Two samples contained STC (4.0 μg/l in a light beer and 7.8 μg/l in a dark beer). The authors

came to the conclusion that, due to quite low amount the measured STC contamination cannot seriously affect consumer health [11, p. 161-166].

A lot of different methods for STC detection have been performed during last decades. The methods can be divided into two groups due to their mechanism: immunochemical and chromatographic.

The both mentioned methods require an improvement to increase the accuracy of the data.

Literature

1. Buckle, A. E., The occurrence of mycotoxins in cereals and animal feedstuffs. *Veterinary Research Communications* **1983,***7* (1-4).

2. Scudamore, K. A.; Nawaz, S.; Hetmanski, M. T.; Rainbird, S. C., Mycotoxins in ingredients of animal feeding stuffs: Iii. Determination of mycotoxins in rice bran. *Food Additives and Contaminants* **1998,***15* (2).

3. Versilovskis, A.; Bartkevičs, V.; Miķelsone, V., Sterigmatocystin presence in typical latvian grains. *Food Chemistry* **2008,***109* (1).

4. Begum, F.; Samajpati, N., Mycotoxin production on rice, pulses and oilseeds. *Naturwissenschaften* **2000,***87* (6).

5. Stroka, J.; Dasko, L.; Spangenberg, B.; Anklam, E., Determination of the mycotoxin, sterigmatocystin, by thin-layer chromatography and reagent-free derivatisation. *Journal of Liquid Chromatography & Related Technologies* **2005,***27* (13).

6. Bokrhari, F. M.; Aly, M. M., Evolution of traditional means of roasting and mycotoxins contaminated coffee beans in saudi arabia. *Advances in Biological Research* **2009,***3* (3-4).

7. ElKady, I. A.; ElMaraghy, S. S. M.; Mostafa, M. E., Natural occurrence of mycotoxins in different spices in egypt. *Folia Microbiologica* **1995,***40* (3).

8. Youssef, M. S.; El-Maghraby, O. M. O.; Ibrahim, Y. M., Mycobiota and mycotoxins of egyptian peanut (arachis hypogeae l.) seeds. *International Journal of Botany* **2008,***4* (4).

9. Halls, N. A.; Ayres, J. C., Potential production of sterigmatocystin on country cured ham. *Applied Microbiology* **1973,***26* (4).

10. Versilovskis, A.; Van Peteghem, C.; De Saeger, S., Determination of sterigmatocystin in cheese by high-performance liquid chromatography-tandem mass spectrometry. *Food Additives and Contaminants Part a-Chemistry Analysis Control Exposure & Risk Assessment* **2009,***26* (1).

11. Versilovskis, A.; De Saeger, S.; Mikelsone, V., Determination of sterigmatocystin in beer by high performance liquid chromatography with ultraviolet detection. *WorldMycotoxinJournal***2008,***1* (2).