Zearalenone Content in Cereals

Adrian MILĂSAN, Ioan Gh. OROIAN*, Daniela BORDEA, Ioan BRASOVEAN, Constantin MIHAI - OROIAN

Faculty of Agriculture, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, 3-5 Manastur St., 400372 Cluj-Napoca, Romania; neluoroian@gmail.com

Abstract. Mycotoxins are metabolic products of toxinogene mycetes and from chemical point of view, they are: polypeptides, terpenic compounds, derivatives of oxalic acid, alkaloids, quinones derivatives, coumarin, etc. In any part of the world, where grown cereals, fodder of any kind, where climatic conditions are favorable for their development, including humidity, temperature, position, location, cultivation system, harvesting and storing, certainly presence of one or more types of fungi that can contaminate the substrate and thus produce mycotoxins. The zearalenone is a mycotoxin, an acid lactone resorcylate and has chemical structure similar to steroid hormones. It has relatively high stability in neutral medium and high temperatures (80 - 120 °C). Grains and grain-based foods, in particular grains and grain milling products, bread and fine bakery wares, made the largest contribution to the estimated zearalenone exposure. Vegetable oils also made an important contribution to the zearalenone exposure. The mycotoxins that usually co-occur with zearalenone do not have oestrogenic effects. Combined effects of zearalenone and other mycotoxins are not expected to arise in humans at dietary exposures below the respective health-based guidance values of the individual toxins. The possible impact of combined exposure to zearalenone with other oestrogenic substances in food or the environment could be additive or antagonistic.

Keywords: zearalenone, wheat, exposure

INTRODUCTION

Mycotoxins are metabolic products of toxinogene mycetes and from chemical point of view, they are: polypeptides, terpenic compounds, derivatives of oxalic acid, alkaloids, quinones derivatives, coumarin, etc. Mycotoxins are regarded as natural substances, but are referred to as replacement products, which occur during the development of parasitic fungi on plants in the field or the material stored and then used to feed humans and animals (Fig. 1). They may also be considered as primary metabolites, toxic for both humans and animals.

Fig. 1. Fungi species; Source: www.milhaiberca.ro

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location, cultivation system, harvesting and storing, certainly presence of one or more types of fungi that can contaminate the substrate and thus produce mycotoxins.

The zearalenone is a mycotoxine, an acid lactone resorcylate and has chemical structure similar to steroid hormones. It has relatively high stability in neutral medium and high temperatures (80 - 120 °C). In alkaline environments (pH = 11) heat treatment destroys zearalenone in tens of minutes.

Zearalenone and can be destroyed by oxidizing agents such as hydrogen peroxide. The mycotoxin zearalenone (ZEA) and its derivatives, alpha and beta-zearalenol (alpha and beta-ZOL) are synthesized by genera Fusarium.

The zearalenone, alpha and beta-zearalenol are secondary metabolites produced by this genus. They often occur as contaminants of cereal grains and animal feeds. Average concentrations in various grains in zearalenone are between 14 and 18 μg/kg.

The aim of our study is to present a review of current state of zearalenone content in cereals.

MATERIAL AND METHOD

In order to emphasize the state of art of zearalenone content in cereals ourdays, a bibliographical study was carried out. Available data from literature were analyzed.

RESULTS AND DISCUSSIONS

Zearalenone contamination is a global phenomenon, which produces mold grows easily in all weather, but preferentially at low temperatures. Doses estimated based human ZEN global eating habits. ZEN is produced by strains of Fusarium in Australia, Europe and North America (Vesonder et al., 1991), New Zealand (di Menna et al., 1999), the Philippines, Thailand and Indonesia. ZEN also has been detected in food from South America (Dalcero et al. 1997 Molto et al., 1997), Africa (Doko et al., 1996), Taiwan, China and Russia (Ueno et al., 1986).

From a quantitative perspective, ZEN and its metabolites were found in grains and derived products in Europe, in quantities ranging from a few micrograms per kg to 8,000 mg/kg (Placinta et al., 1999).

Using chemical methods to reduce mycotoxin levels in food is limited by adverse effects on food quality. Why studied and applied physical methods are have the advantage that does not affect the quality of food or feed undergone treatments. In the case of cereals and oilseeds may apply physical methods: separation of grains affected, washing, milling, solvent extraction.

Separation of damaged grains (crushed, discolored, moldy) contributes greatly to reducing mycotoxin content. Separation can be done manually, mechanically or electronically. Grains infected with fungi identification is achieved by examining fluorescence when exposed to UV radiation.

Typically, the effective separation of the contaminants, in the case of peanuts is performed by manual separation associated with electronic methods. Other possibilities for separation and removal of the fungal contaminated grain and to reduce the mycotoxin content (especially DON, Zearalenone and aflatoxins) are floating and separation based on density differences in water and in a saturated solution of sodium chloride.
Washing the beans is a simple reduction of Fusarium mycotoxins produced content (DON, ZEN, fumonisins) of corn, barley. The liquid may be used distilled water and sodium carbonate solution.

For example, the barley seed wash three times with distilled water, reduces the content of dioxinivelanol of 65 - 69%. This method is not recommended for products to be milled as drying for optimum grinding is too expensive. In the case of apples, washing the product providing for the transfer of mycotoxins in the washing water, so the patulin concentration can be reduced from 920 - 190 ng/g.

Manual removal of the cereal area affected by mold, washing with distilled water associated with the fruit, leading to lower patulin from 2335 - 55 ng/g.

Grinding is a method that can reduce the contents of mycotoxins in cereal. Distribution of toxins in different parts of the kernel provides, during the grinding process, the content of fractions with low levels of mycotoxins. Experimentally, it was found that OTA produced by P. verrucosum in wheat flour goes into the 66%, the degree of extraction flour with smaller, 40% of the initial OTA (Cavret and Lecoeur, 2006).

Various solvents or mixtures of solvents are capable of dissolving and extracting mycotoxins in food (peanut, cotton-seed oil): acetone, 90% solution in water, ethanol, 95% isopropanol, 80% solution in water, hexanes - methanol, methanol, water, acetonitrile - water, hexane - ethanol - water, acetone - hexane - water, etc.

The drawback of this method, in addition to high costs, involves the simultaneous extraction of components of the food, the lower its biological value.

Activated carbon and bentonite were tested in order to reduce the mycotoxin content of the food products. Thus, the activated carbon in a concentration of 3 - 5 g/L significantly reduced patulin content of apple juice (Doko et al., 1996; Duca et al., 2009). Also, the bentonite may be reduced content of milk AFM1 65 - 79%. Other authors have experienced kaolin, novasilul and atapulgite as adsorbents for aflatoxin present in peanut oil.

Thermal inactivation method is applied to reduce contamination with mycotoxins. Most mycotoxins are relatively stable at the temperatures to which they are subjected during the conventional culinary (80 - 121 °C). Thermal sensitivity of mycotoxins in foods is influenced by the water content, pH, ionic activity. Thus, thermal treatment at 150 - 200 °C (baking, frying) for 30 minutes reduces to 20 - 60 % initial content of mycotoxins. Thus, the percentage of patulin decreases by 26 % fruit juice by boiling for 20 minutes at 100 °C (Hedman et al., 1997), roasting peanuts at 150 °C for 30 minutes (Hedman et al., 1997) in AFB1 reduced 38 - 47 %.

Aflatoxins are decomposed at temperatures of 237 - 306 °C, depending on the moisture content of the food in which they are embedded, the humidity in food promotes lactone ring opening of AFB1, the appearance of the carboxyl group and then elimination. Thermal extrusion is considered a method of food content is low in mycotoxins potentially present. For example, by thermal extrusion of corn, Zearalenone content decreased in proportion to the temperature used.

Microwave Treatment of groundnuts (1 kW for 15 minutes) reduces AFB1 content of groundnuts by 53 - 97% without affecting the properties of the food. In conclusion, heat treatment of food can contribute decisively to reduce mycotoxin contamination and thus increase food security of the population, appropriate precautions are avoiding change the nutritional value of food and the formation of pyrolysis products harmful to the body.

The highest concentrations of zearalenone were reported for wheat bran, corn and products thereof (e.g. corn flour, cornflakes). Grains and grain-based foods, in particular grains and grain milling products, bread and fine bakery wares, made the largest contribution
to the estimated zearalenone exposure. Vegetable oils also made an important contribution to the zearalenone exposure.

CONCLUSION

The mycotoxins that usually co-occur with zearalenone do not have oestrogenic effects. Combined effects of zearalenone and other mycotoxins are not expected to arise in humans at dietary exposures below the respective health-based guidance values of the individual toxins. The possible impact of combined exposure to zearalenone with other oestrogenic substances in food (such as phytoestrogens in soya) or the environment could be additive or antagonistic.

REFERENCES

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