IAFP & ILSI EUROPE WEBINAR ON REACTIONS AND POTENTIAL MITIGATION OF MYCOTOXINS DURING FOOD PROCESSING

IMPACT OF PROCESSING TECHNIQUES ON MYCOTOXINS OCCURRENCE IN FOOD

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Spoilage and toxin formation can occur in the field, during storage of agricultural commodities and the processing of foodstuffs. A variety of fungal species mostly from the genera *Aspergillus, Penicillium, Fusarium, Alternaria* or *Claviceps* can produce mycotoxins. Most important in terms of toxicity and occurrence are aflatoxins, ochratoxin A (OTA), fumonisins, deoxynivalenol (DON) and other trichothecenes (TCs), zearalenone (ZEN), patulin (PAT) and ergot alkaloids (EAs). Good agricultural practices, plant diseases management and adequate storage conditions reduce mycotoxin levels in the food chain, yet do not eliminate mycotoxins completely.

In 2014, the *International Life Sciences Institute Europe (ILSI Europe) Process-related Compounds and Natural Toxins Task Force* started a project dedicated to understand the possibility in mitigating mycotoxins, correspondently improving the safety of the food commodities. The main task defined was to critically review the state of the art about mycotoxin reduction by food processing and this activity can be now considered almost completed.

In fact, in order to prevent losses of otherwise suitable feed materials and foodstuffs due to mycotoxins, decontamination processes have been developed and applied over the years.

Food processing can impact mycotoxins in raw material in different ways: i) physical elimination (e.g. cleaning, sieving), ii) chemical transformation or interaction with food matrix which can result in metabolites of either lower or higher toxicity than the parent compound, iii) release from masked or entrapped forms which may increase bioavailability, iv) enzymatic detoxification, and v) adsorption to bacterial cell walls which may be reversed during further processing or digestion.
The objective of this presentation is therefore to give an overview about the aspects indicated above and the correspondent work carried on by the ILSI dedicated expert group, targeting worldwide solutions scientifically available. Gaps in knowledge will be identified; the need for prioritization of further research, as well as for risk assessment procedures with regard to product safety for consumers will be discussed.

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PROMISING DETOXIFICATION STRATEGIES TO MITIGATE MYCOTOXINS

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Yearly surveys demonstrate that mycotoxin contamination of foods and feeds represent a worldwide public health issue. Moreover, analytical progress demonstrated that this problem could be more important than previously estimated due to the presence of masked and/or modified toxins that were not taken into account. Finally, global climatic changes also make the situation more complex, leading to the appearance of known toxins in areas that were considered as not present (i.e. aflatoxin B1 in corn in Central Europe).

Despite the identification and publication of relevant good agricultural practices in official guides, the observed levels of contamination demonstrate that this approach is not sufficient to ensure food safety. In the same way, the use of pesticide to control the development of toxigenic fungi is also debatable due to the appearance of resistance in target organisms and the toxicity of these products and the strong societal will to reduce their use in Europe.

Therefore, there is a stringent need to look for new strategies to limit mycotoxin contamination. Recent progress in the knowledge of fungal eco-physiology and mycotoxin metabolism allowed the development of new promising approaches to limit both human and animal exposure to these contaminants.

The first approach aims to limit mycotoxin synthesis. For that, the use of atoxigenic strains and competing organism has been extensively studied. Another promising approach is to identify natural compounds able to specifically inhibit toxin production without interfering fungal development. This approach would allow ensuring food safety without perturbation of biodiversity and limiting the risk of emergence of new hazards.
Some plant extracts were demonstrated to inhibit toxin production, mostly aflatoxin B1, with limited impact on fungal development. Although their mechanisms of action were only rarely precisely identified, it seems that they could act at transcriptional level. The identification of the cellular signals that lead to down modulation of the toxin production is now of importance to screen new natural compounds on the basis of a clear structure function relationship and to identify the key points of fungal secondary metabolism to target to block toxin production.
The second important stage were mycotoxin toxicity can be mitigated is later, directly in the intestine by modifying absorption or transforming toxins into non-toxic compounds.

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MANAGEMENT OF FOOD INDUSTRIAL TECHNOLOGIES REDUCING MYCOTOXINS WHILE KEEPING THE QUALITY OF FINISHED PRODUCTS

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The various food processing that may have mitigating effects on mycotoxins include cleaning, washing, steeping, milling, brewing, fermentation, cooking, baking, frying, roasting, flaking, nixtamalization (alkaline cooking), and extrusion. In order to reduce the high levels of mycotoxins, addition of a number of chemicals has been studied: acids, alkaline agents, oxidizing and reducing agents which most of the time reduce the mycotoxin level but have a negative effect on the nutritional value, taste and color of the final product.

In currently applied food grade industrial processes, chemical agents are added in an adapted way to steer these processes to provide for food ingredients as corn flour for the production of masa, corn wet milling to provide for food grade starch and crude oil processing to refined vegetable oils.

The objective of this presentation is to give an overview about the effect of a number of chemical agents that provide for metabolites and their fates in a number of large scale food processes.
The following examples of reduction of mycotoxins will be described in this presentation:

1) Nixtamalization of corn in production of masa;
2) Reduction of Fusarium mycotoxins in corn starch obtained through corn wet milling;
3) Removal of aflatoxins in refinement of vegetable oils.