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Mycotoxins: Biomonitoring versus Dietary Exposure, Risk Assessment and Mitigation

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Abstract

Mycotoxins are secondary metabolites of fungi that contaminate aliments in its several production stages and their increasing presence in food chain requires control. Even most of the mycotoxin exposure assessment studies are based on analysis of foodstuffs, and evaluation of dietary intake through food consumption patterns, human biomonitoring methods are rising as a reliable alternative to approach the individual exposures, overcoming the limitations of the dietary assessment.

This presentation summarizes total diet studies (TDS) carried out in different countries for assessment of mycotoxins human exposure through processed diet as an important component of food safety strategies. TDS are sorted out by sample preparation taking into account local culinary habits, mycotoxins analysis and dietary exposure evaluation focusing on the predominant and the most sensitive techniques used for their determination. Food commonly analyzed are cereals, meat, vegetables, fruits, nuts and beverages and the mycotoxins most reported are Ochratoxin, trichothecenes, aflatoxins, zearalenone, fumonisins, patulin, enniatins, and beauvericin respectively. The findings in food are often in below the current European legislation, except for some sporadic samples of wine and milk meaning less than 1% of the total of reported samples.

The mycotoxins exposure assessment has been traditionally evaluated based on their occurrence in food products combined by consumption data. The probable daily intake (PDI) of mycotoxins is expressed in µg/kg body weight (bw) and it is compared with the tolerable daily intake (TDI). Dietary exposure evaluated through the estimated daily intake mycotoxin evaluation and risk assessment point out that relatively scarce toxicological concern may associated to mycotoxins exposure. However, a special attention should be paid to meat and cereal products high percentile consumers.

Exposure to mycotoxins can also originate from the ingestion of their masked forms (mycotoxins covalently or non-covalently bound to matrix component) that can be released in the gastrointestinal part into parent and bioavailable mycotoxin. However, only a certain fraction of the compound reaches the blood stream and exert toxic effects. As a consequence, monitoring of mycotoxins in urine as biomarkers leads to a more realistic scenario in order to assess the exposure by an easy and non-invasive sampling. In addition, it is also possible to detect mycotoxin metabolites in urine samples like α-zearalanol, ß-zearalanol, ß-zearalenol and α-zearalenol, some of them are more estrogenic than the parent compound. Analysis of mycotoxins in human urine is another important data source for exposure assessment as well as it is an easy and non-invasive sampling. For instance, aflatoxin metabolites detected in human urine were related dose dependently to aflatoxin intake and urinary deoxynivalenol (free DON + DON metabolites) have also been associated with DON ingestion. Urinary occurrence of some mycotoxins, such as DON, has been lately investigated in European countries such as Spain, Portugal, Italy and United

Kingdom. These indicators could reveal the human mycotoxin exposure level in a more accurate way than food analyses. Furthermore, additive or synergistic interactions of co-occurring mycotoxins should be taken into account.

Nowadays, the food processing industry is looking for technologies that can remove hazardous chemicals, such as mycotoxins from food materials. In this sense, researchers all around the world are exploring the applicability of innovative food processing technologies for mycotoxin reduction or elimination without producing toxic residues or affecting the nutritive value, the palatability or the technological properties of the products treated.

Currently, food industry is highly interested on the innovative non-thermal techniques, such as high pressure processing (HPP) and pulsed electric fields (PEF), as a green alternative for food processing. HPP was used to inactivate effectively the ascospores of *Byssochlamys nivea* on strawberry puree, ascospores of *Neosartorya fischeri* on apple juice samples and ascospores of *B. nivea* and *N. fischeri* in strawberry puree and apple juice, respectively, resulting in up to 3.3 log reductions. On the other hand, *Aspergillus flavus* and aflatoxins G1 and B1 could be removed (up to 83% reduction) after one day of PEF processing in treatment periods comprised between 0.5 to 24 hours, showing that the increase of exposure periods increased gradually the reduction percentage in total aflatoxins production. HPP and PEF treatments contributed also to significant reductions of AFs in treated grape juices. Reduction percentages between 14 and 29% were obtained after HPP treatment, and between 24 and 84% were reached under PEF treatment. The reductions were similar for AFB1 and AFG2 employing both treatments, however higher reductions were reached for AFG1 and AFB2, 72 and 84% respectively, with PEF. Both, HPP and PEF treatments allowed in a shorter application time similar reduction to those obtained with thermal processing, being more ecological friendly and keeping some organoleptic and nutritional advantages turning these technologies worth exploring for mycotoxins decontamination.

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Biography: Dr Houda Berrada

Houda Berrada Ramdani, holds a degree in Biology, a degree in Pharmacy and a doctorate in food science and technology from the University of Valencia in 2002. She is currently an Associate Professor, develops her teaching and research work in the Department of Preventive Medicine and Public Health, Food Sciences, Toxicology and Legal Medicine of the University of Valencia, and he has been an elected member of the board of the Spanish Association of Toxicology (AETOX) since 2013, and she is a current member of the board of Spanish Agency for Food Safety and Nutrition.

During her training steps, she enjoyed a research grant for the Training of Research Personnel of a predoctoral studies (AECI, 1997-2000) and another grant from the Council for Education and Sports (The regional education ministry) for a postdoctoral stay of six months in Proteobio Mass Spectrometry Center for Proteomics and Biotoxin Research of the Cork Institute of Technology, Cork, Ireland, 2007.

Her professional career is related to the evaluation of toxicological risks in the field of food safety, highlighting as the main lines of research the evaluation of risks related to exposure to pesticide residues, veterinary drugs and mycotoxins since the development and validation of methods analytical, until the final risk assessment, exploring procedures and techniques to reduce the presence of these contaminants in food with emerging technologies such as electrical pulses.

In this context, to highlight her participation in 12 research projects of regional, national and European

calls, being the researcher responsible for one of them), the direction of 4 doctoral theses and the publication of 58 articles in journals of high impact factors in the area stands out. of Food Science and Technology (Journal Citation Reports, ISI Web of Knowledge), reaching an h-index of 24(SCOPUS).