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Food Safety and Underestimation of the Possible Hazard of Masked Mycotoxins and Joint Mycotoxin Exposure

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Description of the Problem

Cereals are invaded by fungi both in the field and after the harvest and can be contaminated simultaneously by several mycotoxins. The formation of each particular mycotoxin depends on various factors but particularly on the climate, the type of cereal, drying at harvest and storage conditions. Thus cereals may be contaminated by any of the main mycotoxin groups that include aflatoxins, ochratoxin A, deoxynivalenol and other trichothecenes, zearalenone, fumonisins or moniliformin. These mycotoxins can occur in barley, rye, triticale, wheat, oats, sorghum, maize, etc. Part of these mycotoxins are produced by the fungi encountered in the crop before harvesting and therefore development of the same fungi, mainly belonging to *Fusarium, Alternaria* and *Aspergillus* genera, is often difficult to control. It is much easier to prevent the formation of those mycotoxins that arise during storage, mainly formed by species belonging to *Aspergillus* or *Penicillium* genera, that could be realized by drying of crops at harvest time in order to safe moisture contents as soon as possible. However, sometimes this is not easily done or if it is done, the subsequent poor storage practice may result in mold growth and mycotoxin formation.

With a big concern we have to pay attention to the circumstance that various mixtures of mycotoxins usually have additive or synergistic toxic effect and the same are often produced by some target fungi. The presence of multiple toxins in various feedstuffs or foods presents a new important concern and challenge because the data available on the toxicological effects of simultaneous exposure are still very scarce and limited. It seems that in a diverse diet, animals or humans will be often exposed to multiple mycotoxins in low contamination levels on an intermittent rate over long periods of time [1,2]. Presently time, the ultimate effect of such a continuous exposure is still unknown or very limited, although there is some evidence of strong synergistic or additive effect between some mycotoxins such as ochratoxin A, penicillic acid, fumonisin B_1 and citrinin found simultaneously in some feeds in farms with nephropathy problems [3,4]. Simultaneous exposure to those mycotoxins even in low contamination levels might be an important circumstance for the development of chronic renal diseases in animals and humans, especially after long-term exposure.

Another big concern in risk assessment and possible hazard for humans are masked mycotoxins contaminated various foods or food products. The masked mycotoxins or their derivatives can be hardly detected or are at least underestimated by the conventional analytical methods, which are usually designed only for parent (native) mycotoxins.

Masked mycotoxins often present a large part of total mycotoxins and after ingestion could turn back to their native forms after a kind of microbial transformation or animal metabolism. Having in mind this circumstance it can be concluded that the registered amounts of target mycotoxins in food products or feedstuffs are actually much higher, because no masked mycotoxins have been measured [5].

The masked mycotoxins comprise two different forms, eg. extractable conjugated- and bound (non-extractable) varieties. Unfortunately, extractable conjugated varieties can be found by appropriate analytical technics only when their chemical structure is well known and the respective standards are available. The bound varieties of mycotoxins, however, must be initially separated from the matrix by enzymatic or chemical treatment and subsequently exposed to chemical analysis.

Therefore, masked mycotoxins should be transformed into their parent forms in order to use the traditional methods for chemical analysis. This transformation is usually performed via carefully selected type of hydrolysis. Unfortunately, there is not a single hydrolysis technic, which could be applied to all varieties of masked mycotoxins. The masked varieties of mycotoxins might be less toxic in comparison to their parent forms, but they might be also much more toxic and dangerous than the parent mycotoxins, e.g., when they have a longer haf-life [5]. With a big worry we have to emphasize, that currently there are no sufficient toxicodynamic and/or toxicokinetic investigations done in order to assess the hazard of masked mycotoxins and to perform an appropriate risk assessment for these mycotoxins in foods or feedstuffs, because of the lack of data on their toxic properties.

Conclusion

Currently, it is of a particular importance to introduce new regulations and limits in regard to combined contamination of food by several mycotoxins having in mind their possible interaction and increased hazard for humans as well. That's why, simultaneous analysis of food for co-occurrence of target mycotoxins should be initiated worldwide and the real hazard of such co-occurrence for human health should be carefully assessed. Moreover, new critical limits at critical control points should be introduced by the Hazard Analysis and Critical Control Point (HACCP) system in EU and in all over the world having in mind the interaction of target mycotoxins co-contaminated various foods or feedstuffs [6,7].

The recognition of the toxicological significance of masked varieties of mycotoxins, along with the evaluation of the hazard of co-occurrence of target mycotoxins in food products and feedstuffs is a new big challenge that should be taken into account by the respective food manufacturers, monitoring authorities and regulatory bodies in order to protect the health of consumers and to evaluate human health hazard.

In regard to different kinds of animals and chickens, we should have in mind that the guidance mycotoxin values for feedstuffs have been determined for the most tolerant animal species and are therefore considered as upper guidance value, whereas for the feedstuffs intended for more sensitive animals the lower guidance values should be applied by the manufacturers.

Some mycotoxins such as aflatoxin B_1, ochratoxin A and zeqralenone would represent safety hazard twice, due to the possible transmission in milk of lactating cows of either parent toxin of toxic metabolites as aflatoxin M_1 or α zearalenol as well as due to the possible transmission of many mycotoxins in eggs or meat [8,9]. It seems, that establishment of national rules for prevention, control and monitoring of mycotoxin content based on the evaluation of the respective situation in each separate country is not enough this time. The circumstances that are compromising the quality of the food commodities and feedstuffs, and simultaneous facilitating the mycotoxins production by molds could be assessed using appropriate surveillance studies, and state-of-the-art internationally recognized biomonitoring methods for proper evaluation the human/animal exposure to various single mycotoxins or mycotoxin combinations. The need for networking for both, dissemination of information and staff training at regional and international basis are often identified as important activities to be sustained in the future.

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