

Fusarium mycotoxins co-occurrence in corn-based breakfast cereals and exposure in children.

Main author: Claudia Foerster (University of O'Higgins (UOH))

Co-authors: Liliam Monsalve

INTRODUCTION

Fusarium species infect crop plants in moderate climate zones all around the world, such as central Chile. These fungi species can produce three main classes of mycotoxins as secondary metabolites: type A and B trichothecenes (such as T-2/HT-2 toxins and deoxynivalenol (DON) respectively), zearalenone (ZEN) and fumonisins (FUM), which can have digestive, reproductive or neurological effects on humans and animals that have consumed contaminated food. The effects of mycotoxins can be most severe in children, representing a unique combination of a restricted range of food types, a high-calorie intake on a bodyweight basis and a decreased ability to eliminate toxins due to the immaturity of excretory and metabolic processes. Currently, infants and other vulnerable populations are not specially protected by Chilean regulations. For cereals, the limits are 200 µg/kg for ZEN, 750 µg/kg for DON and 1000 µg/kg for FUM, and there are no regulations for T-2/HT-2 toxins.

The present study aims to assess the risk associated with exposure to the main Fusarium mycotoxins (DON, T-2/HT-2, ZEN and FUM) in a corn-based breakfast cereal consumed by Chilean children (2 to 13 years old).

METHODOLOGY

Sampling was based on Commission Regulation (EC) 401/2006 on mycotoxin sampling in cereals at retail, with a minimum of n=3 incremental samples and a minimum of 1 kg aggregate sample weight. In total, 10 batches of the cereal were sampled on three different occasions, amounting to 30 batches and a total of 90 samples. Each batch was milled in a Romer Serie II Mill in order to increase homogeneity and representativeness. For the detection and quantification of the mycotoxins, we used an ELISA Neogen's Veratox®, according to the manufacturer's instructions. The children's probable daily intake (PDI) of mycotoxins was estimated according to the Codex Alimentarius (2014) formula using the mycotoxins levels (ng/g) found in the cereals, multiplied by the daily consumption of each foodstuff (g/person/day) and divided by body weight. Concentrations were assumed to be in <LOD a LOD/2, and in <LOQ, the mean value between LOD and LOQ. For risk assessment, we

estimated the Hazard Quotient (HQ), i.e. the PDI divided by the tolerable daily intake (TDI) according to EFSA. An HQ > 1 was considered to present a health risk.

RESULTS

Occurrences and samples over the limit of quantification (LOQ) were respectively: 92 % and 20 % for ZEN, 97 % and 17 % for FUM, 90 % and 3 % for DON and 100 % and 7 % for T-2 /HT-2. The mean levels found were 51.33 ng/kg, 1504 ng/kg, 860 ng/kg and 29.23 ng/kg respectively. Seventy percent (70 %) of the cereals contained all four mycotoxins, and all cereals had two or more mycotoxins. PDIs were calculated by a probabilistic estimation of the levels found in the cereals for two age groups: 2-5 years old (mean 15 kg of body weight and 73.7 g/day cereal consumption) and 6 to 13 years old (mean 35 kg and 63.4 g/day). Health risk (HI > 1) was found in the 2-5 year-old group with the median PDI of DON and in the worst-case scenario (P95) for FUM in both groups.

DISCUSSION

A high percentage of co-occurrences was found between the main *Fusarium* mycotoxins in the corn-based cereal. In general, levels were below the Chilean regulatory limits, but above the limits set by EU regulation for children. A risk to children was observed for DON exposure, which is consistent with a urine biomarker study conducted in Chile, where DON was the most prevalent mycotoxin found. Five FUM samples were over the regulation limits and could present a risk to children. Moreover, studies have shown that combinations of these mycotoxins could produce additive effects at low concentrations. If assuming additive effects, HQ combinations of two of the mycotoxins presents a further risk to the children, especially for the 2-5 year-old group. These mycotoxins are usually co-occurring, and humans and animals are exposed to a wide variety of mycotoxin combinations in general life, which must be taken into account for risk management.