

Risk assessment of multiple mycotoxins in infant food consumed by Portuguese children – the contribute of the MYCOMIX project

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MYCOMIX



There is a growing concern within public health about mycotoxin involvement in human diseases, namely those related to children and scarce data are available on this issue. To fill this gap, the MycoMix Project (2013-15) "Exploring the toxic effects of mixtures of mycotoxins in infant food and potential health impact" aims to study the occurrence of multiple mycotoxins in infant foods and cereals consumed by the Portuguese children and its toxicity interactions. This project aims to answer three questions:

- 1) Are children exposed daily to one or several mycotoxins through food?
- 2) Can this co-exposure affect children's health?
- 3) Are there interaction effect between mycotoxins?

Occurrence data

The occurrence data of 12 mycotoxins (aflatoxins, ochratoxin A, fumonisins and trichothecenes) were quantified in 26 Breakfast Cereals (BC), marketed in 2014 in Lisbon (PT), using HPLC-FLD, GC-MS and LC-MS/MS.¹

- 92% (24/26) of the analyzed BC revealed the presence of two to six mycotoxins, simultaneously, in the same sample.¹
- 19% of samples (4/26) were contaminated with six mycotoxins simultaneously.¹
- The mycotoxins mixture with highest incidence (3/26) was AFB₁, AFB₂, OTA and DON.¹
- Results were all below the maximum legislated limits.¹



Consumption data

Infant foods consumption data were obtained in a pilot study including 103 child (0-3 years old) from the Primary Health Care Unit of Cidadela, Cascais. A 3 day food diary was applied and data introduced in a web-based platform - OPEN PORTUGAL². For Breakfast Cereals consumption, a subsample of 75 children aged between 1 to 3 y old was used.

- 56% of children aged 1-3 years old consumed breakfast cereals at least one time in 3 days as reported in the food diary.³
- 40% of children aged 1-3 years old presented a mean weight of 13.39 kg and a mean consumption of breakfast cereals of 5.62 g day⁻¹.³

MYCOMIX

Gathering all data obtained within Mycomix, a more accurate risk assessment of mycotoxins in infant foods consumed by Portuguese children was achieved.

The cumulative risk assessment of multiple mycotoxins present in breakfast cereals samples suggests an **urgent need to establish legal limits and control strategies** regarding the presence of multiple mycotoxins, in order to ensure the safety of infant health.

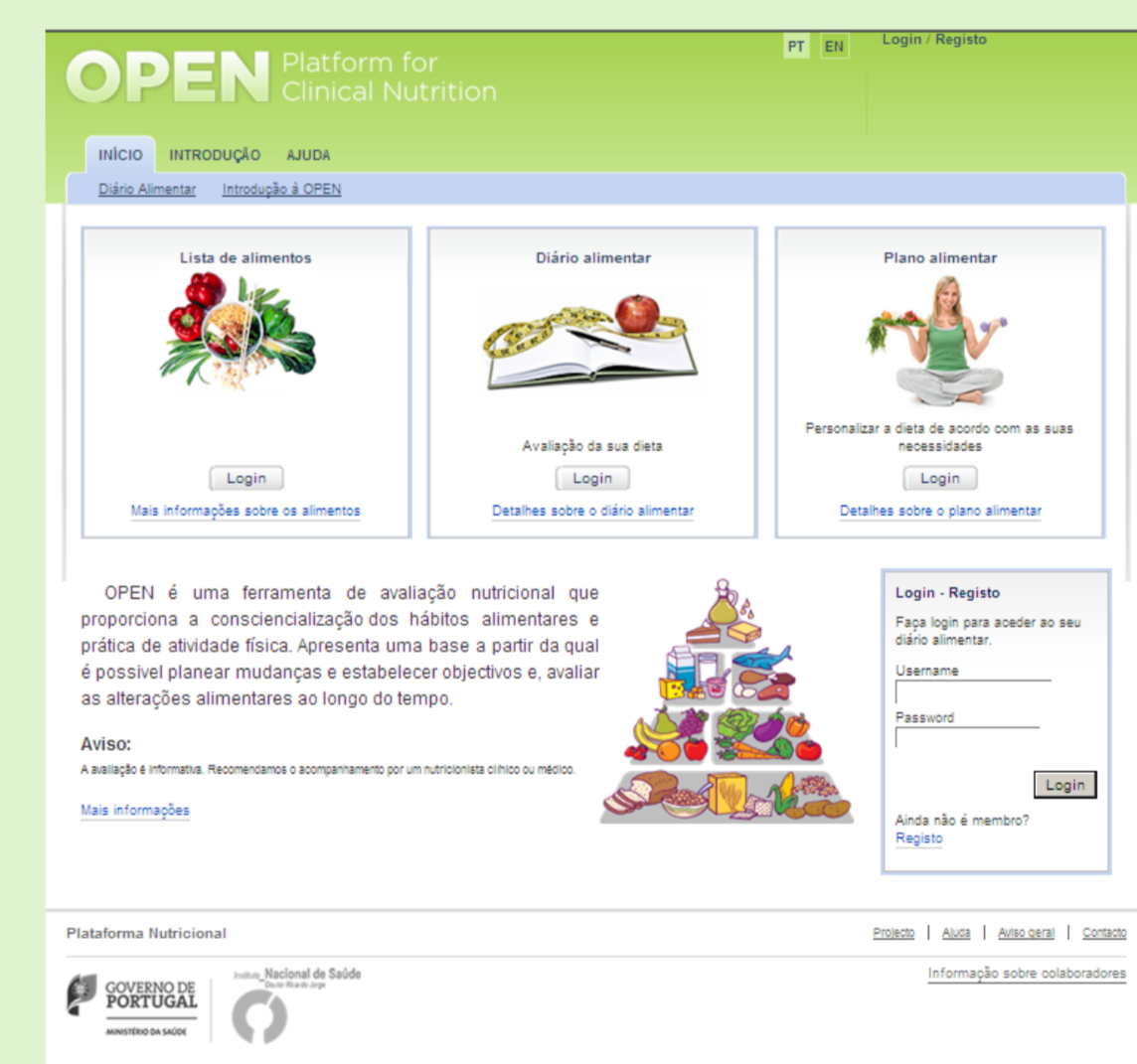


Figure 2 – OPEN Portugal – web-based platform

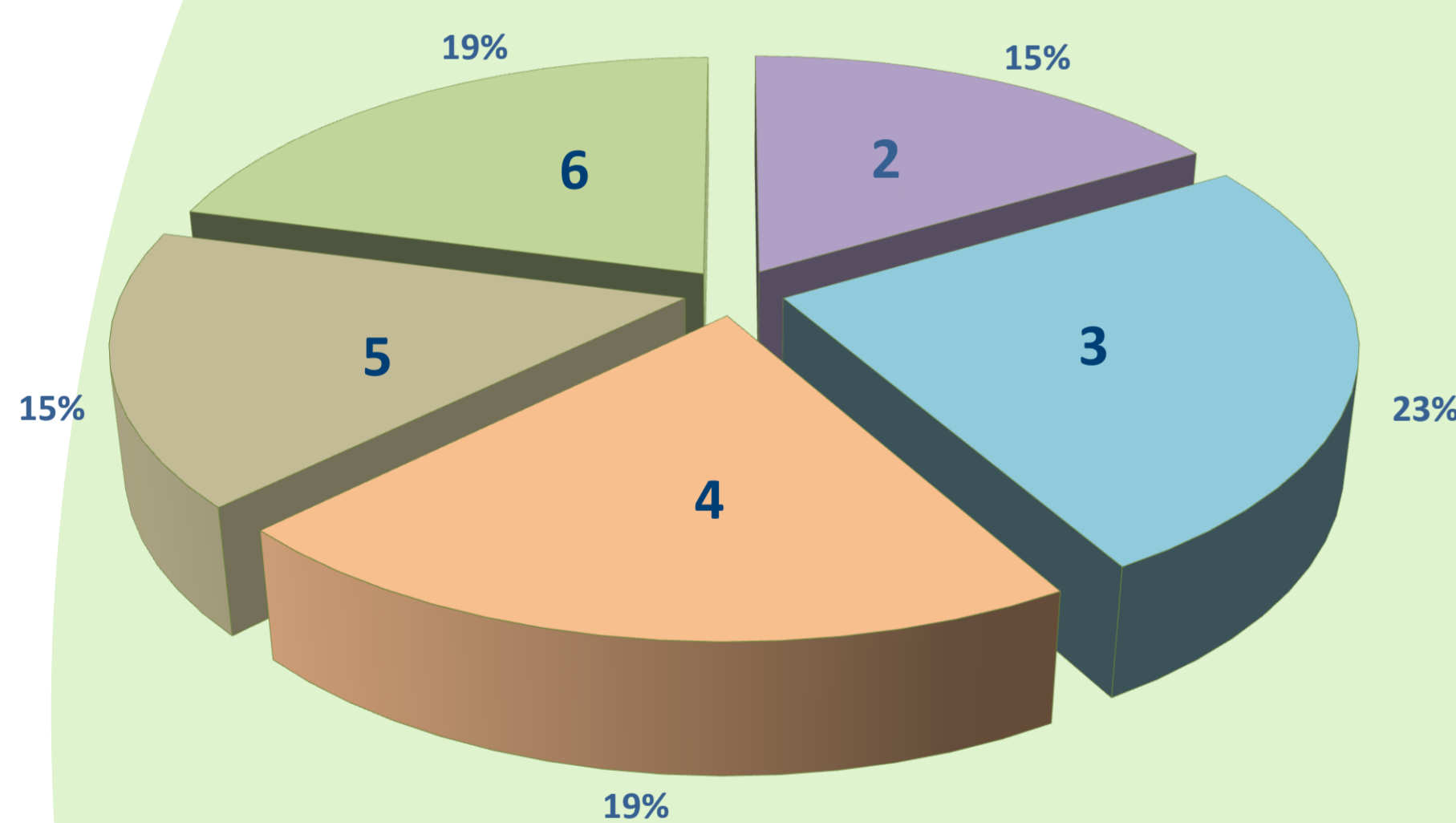


Figure 1 – Co-occurrence of mycotoxins in analyzed breakfast cereal samples, including the number of mycotoxins determined in the same sample (inside the plot) and the respective percentage. Results present only the co-occurrence of 2 or more mycotoxins.¹

Toxicological data

Bioaccessibility studies

Harmonized *in vitro* digestion model simulating the human digestion (oral, gastric and intestinal phases) was applied to determine the mycotoxin bioaccessibility.

Bioaccessibility values for single mycotoxins ranged:

- 40 and 72 % for patulin in cereal based foods.⁴
- 86 and 104% for aflatoxin M₁ in infant formulae.⁴

Cito and genotoxicity studies (Caco-2, HK-2, HepG2)

Citotoxicity studies performed using neutral red and MTT assays. Genotoxicity studies performed using comet assay. Interactions between mycotoxins were evaluated using the Concentration Addition Conceptual model.

Toxicity studies on the detected mycotoxins provided evidence on the interaction effect between binary mixtures of AFM₁ & OTA⁵ and OTA & FB₁⁶.

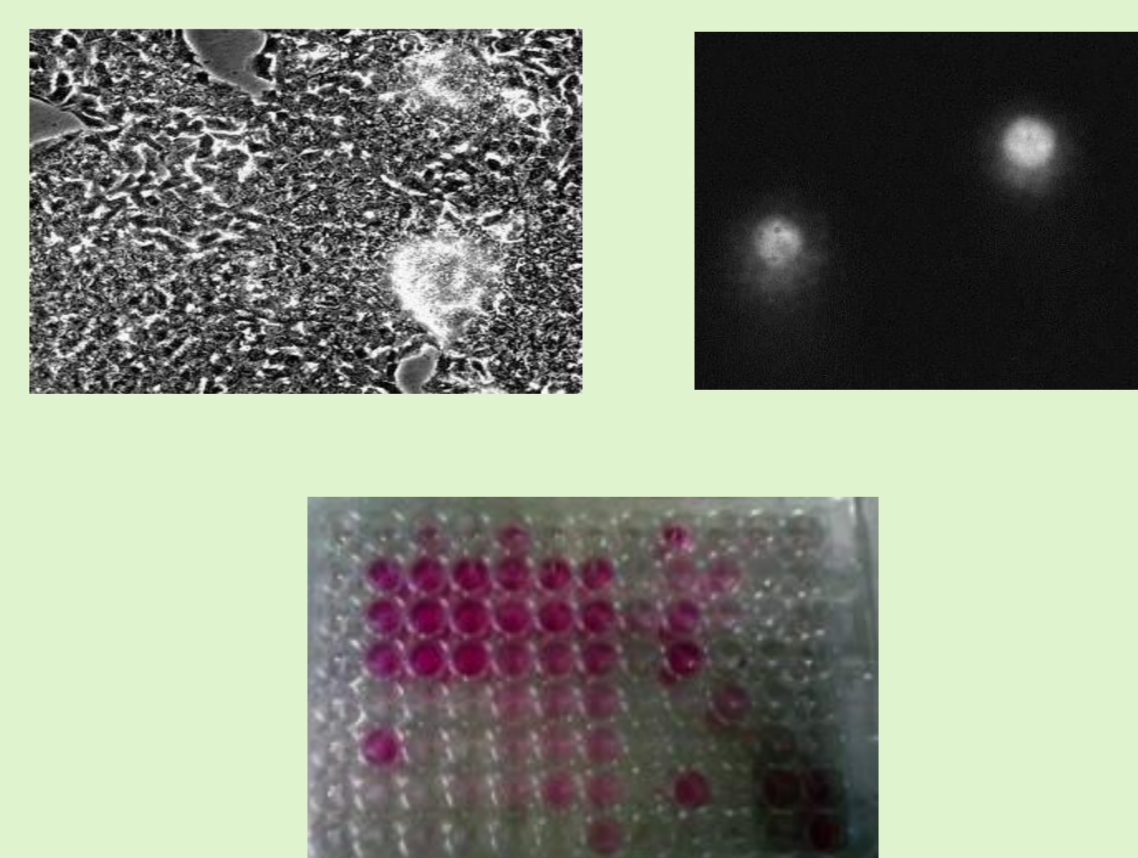


Figure 3 – ???

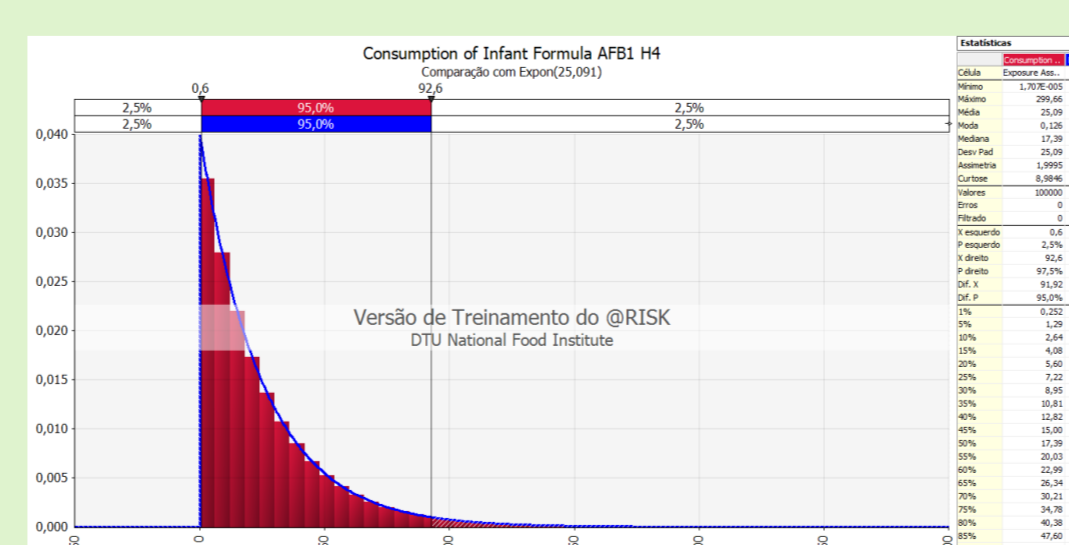


Figure 4 – Probabilistic approach for mycotoxins risk assessment using @RISK software.

Exposure assessment data

Two mathematical approaches: deterministic and probabilistic (Monte Carlo simulation) will be used for the computation of the exposure assessment for mycotoxins.

Different exposure scenarios for the mycotoxin dietary exposure assessment in relation to the data treatment of the non-detects (< LOD, limit of detection) will be included.

Daily exposure of children to ochratoxin A, fumonisins and trichothecenes showed no health risks to the children population considering individual mycotoxins (hazard quotients below 1).²

Cumulative risk assessment suggest an urgent need to establish legal limits for multiple mycotoxins in breakfast cereals.