Occupational risk deriving from mycotoxin contaminated environment: an update

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OCCUPATIONAL EXPOSURE TO MYCOTOXINS

✓ Occupational exposures to mycotoxins are supposed to be very frequent but rarely reported in the scientific literature.

✓ Exposure to mycotoxins was shown in animal production and food processing sectors confirming that occupational exposure can be non negligible.

Autrup 1981; Brera et al., 2002; Halstensen et al. 2006; Mo et al., 2014

✓ It is of extreme importance to characterize the mycotoxins exposure:
  ❖ Identify the mycotoxins related to each setting
  ❖ Concentration
  ❖ Duration
  ❖ Factors that may influence the exposure.
PUBLISHED DATA

✓ Extensive search was performed to identify scientific papers, available in different scientific databases (PubMed and Web of Science).

✓ Fifteen papers were found between the years of 1981 and 2017 reporting occupational exposure to mycotoxins.

✓ After 2000 the number of papers increased and the focus changed from studying one mycotoxin to several mycotoxins in the same sample.

✓ All the studies demonstrated the presence of mycotoxins in workplace environments and that there was the possibility for the workers being exposed to mycotoxins through inhalation.

Viegas et al. to be published
CRITICAL OCCUPATIONAL SETTINGS FOR MYCOTOXINS PRESENCE

- Occupational contexts with high and diverse fungal contamination constitutes an important risk of exposure to mycotoxins. These workplaces should be targeted for mycotoxin exposure assessment.

  ✓ Feed industry due to raw material processed or stored.

  ✓ Animal production due to feed and animal density.

  ✓ Waste industry due to permanent availability of nutrients.

  ✓ Specific food industry with products contaminated with fungi, such as coffee, onions and other like sugar, grain products, spices and nuts.

  Viegas et al., 2015
POSSIBLE EXPOSURE ROUTES

✅ Inhalation and dermal (occupational settings)
✅ Ingestion (food consumption)

WHAT PROMOTES OCCUPATIONAL EXPOSURE?

✅ Mycotoxins exposure occurs during tasks involving **high exposure to organic dust**.
  Viegas et al., 2012-2016

✅ Dermal absorption can occur in settings where the workers use short clothes and large skin areas are exposed allowing dust deposition, or even, when hands are in contact with solutions containing mycotoxins.
  Boonen et al., 2012; Viegas et al., 2016
PREVIOUS STUDIES

✓ Occupational settings with high fungi diversity and high contamination with organic dust.
PREVIOUS STUDIES

✓ Occupational exposure to aflatoxin B₁ (AFB₁) found in animal production (swine and poultry), slaughterhouses and waste management.

✓ Higher exposure found in the waste management setting.
PREVIOUS STUDIES

Dermal intake can be also an important exposure route in poultry slaughterhouses.

Viega et al., 2012-2016
PREVIOUS STUDIES

More recent – Multibiomarker approach

✓ In waste management it was found exposure also to other two mycotoxins: Enniatin B and Ochratoxin A.

✓ Probably food consumption has also an important role.

Viegas et al., 2017

Enniatin B and ochratoxin A in the blood serum of workers from the waste management setting

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RELEVANT ASPECTS TO CONSIDER IN OCCUPATIONAL EXPOSURE TO MYCOTOXINS

✓ Absence of OELs for mycotoxins (exposure occurs essentially by inhalation).

✓ These compounds are rarely monitored in occupational environments.

✓ Even if the mycotoxin concentration in a product or material is low, the handling of high amounts can cause an elevated mycotoxin concentration in a specific moment or task, that endures depending on how the tasks are developed.

✓ Peak exposures during specific tasks. Level of exposure can greatly vary between the different tasks within the same industry.

✓ Exposure is frequently characterized by a co-exposure to several mycotoxins.

✓ Fungi are often used as an indirect indicator of mycotoxins presence. This approach is incorrect since mycotoxins can be present in the environment long after fungal elimination and not all fungi produce mycotoxins.

Mayer, 2015 in Viegas et al., 2015; Viegas 2012-2016
TASKS THAT CAN INVOLVE HIGHER EXPOSURE
ONGOING STUDIES

Multibiomarker approach

✓ Cork Industry (n= 19)
✓ Artisanal Bakeries (n=24)
✓ Industrial Bakerie (n=21)
✓ Swine (n=25)
Aspergillus spp. prevalence in different Portuguese occupational environments: What is the real scenario in high load settings?

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CONCLUSIONS UNTIL NOW

- Need of recognizing mycotoxins as occupational risk factor. Mycotoxins should be included for occupational biomonitoring programs.

- Multibiomarker approach generates important data to perform exposure assessment – Real life exposure scenario = co-exposure to several mycotoxins.

- Multibiomarker approach allows identifying the most common mixtures present and what substances interactions should be studied.

Risk Assessment Paradigm for Mixtures: In Addition to Issues for Single Chemicals

- Hazard identification:
  - consider potential interaction effects
  - identify effects from total mixture dose.

- Exposure assessment:
  - account for internal dose of several mixture components at target tissue
  - evaluate changes in mixture over time (e.g., environmental degradation)

- Dose-response:
  - consider potential for effects below individual chemical thresholds
  - incorporate toxicologic judgment of similar toxicity within or between mixtures.

Note: Dose-response & exposure assessment are interdependent

Risk characterization:
- evaluate data support for assumptions about interactions, exposure, and similar toxicity of mixtures or their components.

EPA, 1992
CHALLENGES TO TACKLE FOR FURTHER RESEARCH

✓ What mycotoxins and mixtures to consider in the different occupational settings?

✓ Even at low levels (food consumption contribution) can we expect negative health effects due to mycotoxins interactions?

✓ Challenges related with the lack of toxicokinetic data for some mycotoxins generating several additional questions. Not a straight line!!

✓ What to expect regarding peak exposures? The same toxicokinetic?

✓ Climate changes will also affect exposure in occupational settings!
THANK YOU!

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