MYCOTOXIN REDUCTION IN THE FOOD AND FEED CHAIN

CHALLENGES AND PERSPECTIVES IN A CHANGING WORLD

Prof. Sarah De Saeger, Dr. Arnaud Vidal, Dr. Marthe De Boevre
Content of presentation:
1. Introduction on mycotoxins
2. Mycotoxins: history and today
3. Challenges in Sub-Saharan Africa
4. MYTOX-SOUTH: an intercontinental partnership striving to solve mycotoxin problems
5. Conclusions and recommendations
INTRODUCTION ON MYCOTOXINS
2.1 By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round

2.2 By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons
MYCOTOXINS: AN IMPORTANT FOOD SAFETY CHALLENGE

• They are produced by fungi in food and feed
• They cause different health effects
  - Retard growth
  - Depress immunity
  - Negatively affect reproduction
  - Cause cancer (various kinds)
• They are responsible for huge economic losses (US > 1 billion dollar/year)
**MYCOTOXINS:**
**AN IMPORTANT FOOD SAFETY CHALLENGE**

- Aflatoxins, fumonisins, trichothecenes, ergot alkaloids, zearalenone, etc...
- Produced by *Aspergillus, Fusarium, Claviceps, Penicillium* species
AFLATOXINS:
Tropical climate; pre- and post-harvest
Carcinogenic (group1 IARC) - liver
B1, B2, G1, G2 in maize, pistachio, Brazil nuts, dried figs, chilli pepper ...
M1 in milk

MYCOTOXINS:
AN IMPORTANT FOOD SAFETY CHALLENGE

Door: redactie
11/03/13 - 19h05  Bron: belga.be © brunopress. In de melk van de Belgische runderen die veevoeder kregen waarin mais verwerkt zat met de kankerverwekkende stof aflatoxine is geen overschrijding van de Europese norm vastgesteld. Dat blijkt uit analyses van het Federaal Agentschap voor de Veiligheid van de Voedselketen (FAVV). Het FAVV gaat bij de Europese Commissie een onderzoek aanvragen naar wie in Duitsland in gebreke is gebleven bij de melding van de besmetting. Bemefa, de beroepsvereniging van mengvoederfabrikanten, laat onderzoeken of ze zich burgerlijke partij kan stellen.
Een deel van de met de kankerverwekkende stof aflatoxine besmette mais kwam in België terecht. Het grootste deel van deze gecontamineerde zending, 53.000 ton mais, werd geblokkeerd. Het andere deel werd verwerkt in voeder voor varkens, pluimvee en in mindere mate in rundveevoeder.

Monsters
Het FAVV kwam eerder al op basis van de beschikbare info tot de vaststelling dat in de melk de zeer strenge norm voor aflatoxines niet overschreden werd. "Niettegenstaande dit werden er door het FAVV bij de bedrijven die verdacht voeder hadden gekregen monsters van de melk genomen om te laten analyseren op het gehalte aan aflatoxine M1. Alle resultaten bleven onder de Europese norm van 0,05 parts pro billion (ppb) voor aflatoxine M1."
MYCOTOXINS: AN IMPORTANT FOOD SAFETY CHALLENGE

Origin

Fungi
- 3-acetyldeoxynivalenol
- 15-acetyldeoxynivalenol
- α-zearalenol
- β-zearalenol

Plant

Food processing
- norDON A
- norDON B
- norDON C
- norDON D
- 14-(R)-ochratoxin A

Animal

Deoxynivalenol-3-glucoside
- Nivalenol-3-glucoside
- Zearalenone-14-glucoside

Deoxynivalenol-3-glucuronide
- Deoxynivalenol-15-glucuronide
- Ochratoxin alpha
MYCOTOXINS: HISTORY AND TODAY
Ergotism

- St Anthony’s fire
- Ergot of rye - *Claviceps purpurea*: ergot alkaloids in rye
- Necrosis of limbs - hallucinations

**Turkey X disease**

- Death of about 100,000 poultry birds in UK in 1960
- Investigations – mycotoxins (aflatoxins) in groundnut meal feed imported from Brazil
The International Agency for Research on Cancer convened a Working Group of world-leading experts to review the health effects of aflatoxins and fumonisins and to evaluate intervention measures. The panel concluded that these mycotoxins not only are a cause of acute poisoning and cancer but also are a likely contributor to the high levels of stunting in children in affected populations.
Crop pests and pathogens move polewards in a warming world

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MYCOTOXINS: TODAY

Cape Town drought declared a 'national disaster'

© 13 February 2018

South Africa has declared the drought which has seen Cape Town hurtling towards “Day Zero” a national disaster.

OPEN

Aflatoxin B₁ contamination in maize in Europe increases due to climate change

P. Battilani³, P. Toscano³, H. J. Van der Fels-Klerx³, A. Moretti⁴, M. Camardo Leggieri³, C. Brera⁴, A. Rortais⁵, T. Goumperis⁵ & T. Robinson⁴

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Accepted: 24 March 2016
MYTOX: an interdisciplinary research platform on mycotoxins and toxigenic moulds. Research on:

- Toxigenic moulds
- Mycotoxins
- Effects on animal health
- Effects on human health

13 Research Laboratories (UGent & HoGent)
CHALLENGES IN SUB-SAHARAN AFRICA
Mycotoxin control in SSA

• Mycotoxin regulation limited to aflatoxin
• Biocontrol – Aflasafe
• Partnership for Aflatoxin control in Africa (PACA)

But .... Not only aflatoxins .... There are many more mycotoxins and combined toxic effects are possible

Cases of *Fusarium* mycotoxins and modified forms in commodities from SSA (Matumba et al., 2014, Hove et al., 2016, Chilaka et al., 2017)
Challenges associated with mycotoxin control in Africa are:

1) consumers, (small-scale) farmers and informal markets are not aware of the potential harm caused by mycotoxins;
2) continued focus on food productivity (sustainable intensification) as prime driver of agriculture
Challenges associated with mycotoxin control in Africa are:

3) there is an increasing stringent list of EU regulated mycotoxins, and SSA laboratories are not always up-to-date with corresponding analytical tests;

4) adopting EU regulations requires sensitive and accurate methods such as mass spectrometric methods;

5) EU regulations are a serious trade barrier with some African markets having collapsed
Challenges associated with mycotoxin control in sub-Saharan Africa are:

6) analytical tests are expensive; there is a lack of expertise, or a limited number of laboratories performing the tests;
7) there is a lack of technical support from companies selling analytical instruments;
8) there is a lack of affordable analytical calibrants, certified reference materials and proficiency testing schemes

Africa Food Safety Workshop, June 4-8, 2018, Pretoria
MYTOX-SOUTH: AN INTERCONTINENTAL PARTNERSHIP

STRIVING TO SOLVE MYCOTOXIN PROBLEMS
MYTOX-SOUTH – ITN, GHENT UNIVERSITY, GLOBAL MINDS

MYTOX
Belgium (13)

North
Italy, Spain, USA & China (6)

South
Africa (16)
South-America (1)

MYTOX

South

North

GHENT UNIVERSITY

MYTOX-SOUTH

SOUTH
WHO IS WHO?

GHENT UNIVERSITY – CoE in Mycotoxicology and Public Health – info@mytoxsouth.org

Prof. Dr. Sarah De Saeger & Dr. Marthe De Boevre (coordinator)
Dr. Arnau Vidal (Operations Manager)
WHO IS WHO?

**BioIntellipro Inc.**
Dr. Martin Lo

**WFPC**
Dr. Charlie Wilson

**USDA, Arizona**
Dr. Peter Cotty

**ISPA-CNR, Italy**
Dr. Antonio Moretti

**CAS, Shanghai**
Prof. Aibo Wu

**Complutense Uni, Madrid**
Dr. María C. Moreno-Bondi

**GHENT UNIVERSITY**
WHO IS WHO?

Prof. Sheila Okoth & Dr. Johanna Lindahl - Dr. Delia Grace ILRI (Kenya)
Prof. Obadina Adewale & Prof. Atanda Olusegun & Prof. Hussaini Makun & Prof. Yemisi Jeff-Agboola (Nigeria)
Prof. Loveness Nyanga (Zimbabwe)
Dr. Limbikani Matumba (Malawi)
Prof. Ashagrie Woldegiorgis (Ethiopia)
Dr. Lindy Rose & Prof. Patrick Njobeh & Prof. Mulunda Mwanza (South Africa)
Dr. Happy Magoha & Prof. Martin Kimanya (Tanzania)
Dr. Richard Echodu (Uganda)
Prof. dr. Andrea Patriarca (Argentina)

(PAEPARD) Platform for an Africa-Europe Partnership for Agricultural Research for Development (François Stepman)
WHAT IS MYTOX-SOUTH AIMING AT?

• Educating and training young students & scientists from developing countries with programs suited for their countries
• Building infrastructural capacity
• Conducting research and developing innovative technologies in terms of suitable mitigation strategies applicable in their countries
KEY-topics

• Training in analytical methods for mycotoxin detection
• Surveys on mycotoxin occurrence & mycotoxigenic fungi diversity
• Biomonitoring studies to assess human mycotoxin exposure
• Influence of traditional food processing on (modified) mycotoxin occurrence
• Identification and toxicological assessment of Aspergillus flavus resistant local maize varieties

Countries in Africa with (ongoing) cooperation

• Burkina Faso
• Cameroon
• DR Congo
• Egypt
• Ethiopia
• Kenya
• Malawi
• Nigeria
• South-Africa
• Tunisia
• Zimbabwe
• Botswana
MYTOX-SOUTH...1 YEAR LATER (3 PHDS + >8 new PhDS)

...FOCUS ON HUMAN HEALTH (INTERVENTION & OBSERVATIONAL)
Dr. Melody Ndemera, ZIMBABWE, ‘Human dietary exposure to mycotoxins in Zimbabwe and related risk assessment and management’ - PhD September 2017

Dr. Cynthia Chilaka, NIGERIA, ‘Fusarium mycotoxins and their masked forms in Nigerian foods: occurrence and influence of traditional processing methods’ – PhD November 2017

AWARD Trainees: Olotu Ifeoluwa (South Africa) and Marguerite Niybituronsa (Rwanda)

MYTOX SOUTH 2018 awardees: Sefater Gbashi (South Africa) and Maria Agustina Pavicich (Argentina)
MYTOX-SOUTH...1 YEAR LATER (DISSEMINATION TO POLICY-MAKERS)

Harare, Zimbabwe, 02/2018
MYTOX-SOUTH...1 YEAR LATER (DISSEMINATION TO POLICY-MAKERS)

Mombasa, Kenya, 06/2018
CONCLUSIONS AND RECOMMENDATIONS
CONCLUSIONS AND RECOMMENDATIONS

In order to reduce mycotoxin exposure in SSA ...

- Spreading mycotoxin literacy
- Advocacy to policy makers and politicians in SSA
- Development of human and infrastructural capacity building
- Need for locally developed solutions
- Preserving Africa’s food heritage and biodiversity as first line of defense
- Focus on diversification of diet

Thank you for your attention!
Prof. Sarah De Saeger

CENTRE OF EXCELLENCE IN MYCOTOXICOLOGY AND PUBLIC HEALTH

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