

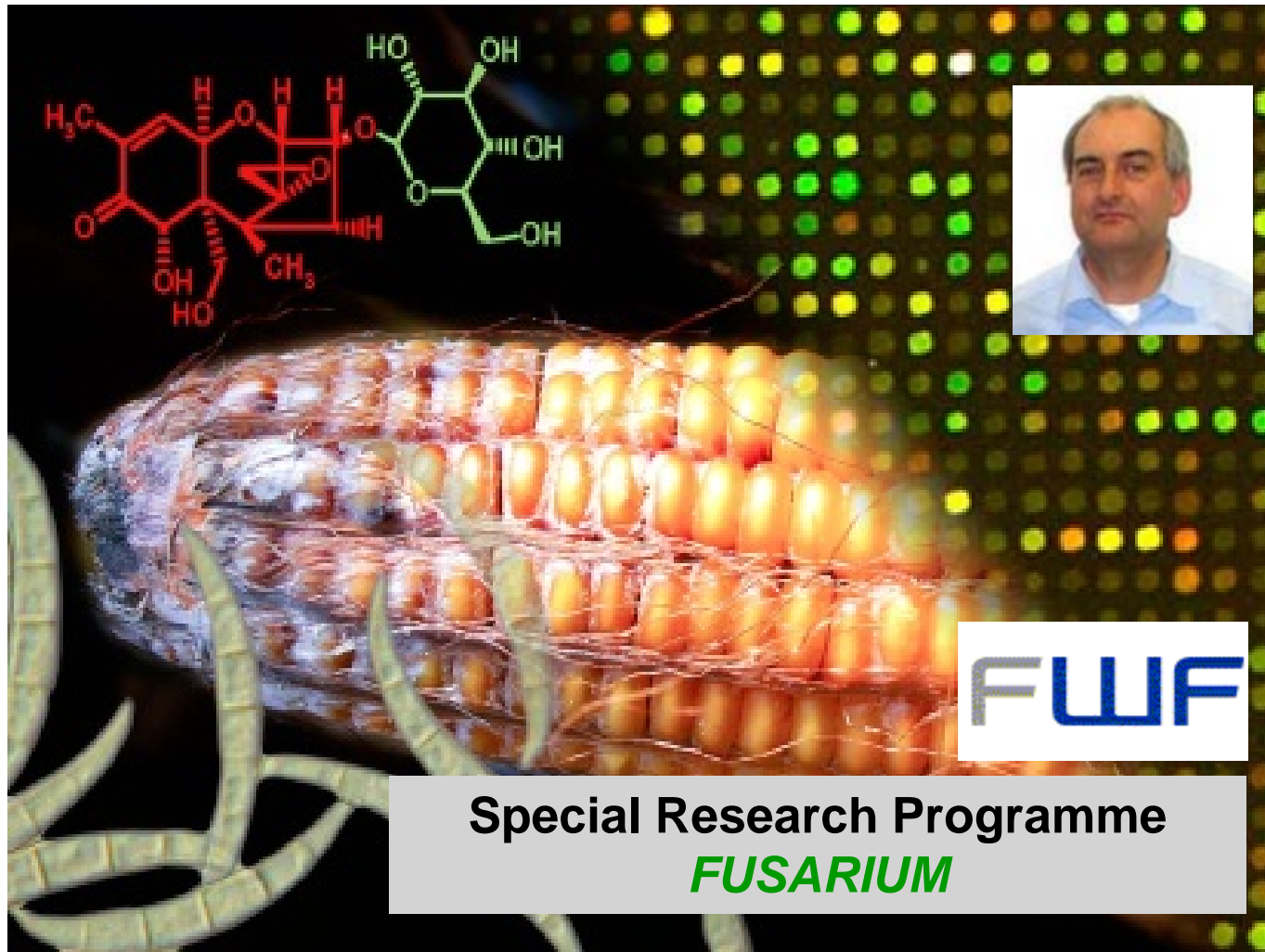
International collaborations: the key to detect, control and reduce mycotoxins in the food chain

Rudolf Krska

Center for Analytical Chemistry
Department of Agrobiotechnology (IFA-Tulln)
University of Natural Resources and Life Sciences, Vienna (BOKU)

Research

Mycotoxins and Metabolomics/Bioactive Substances

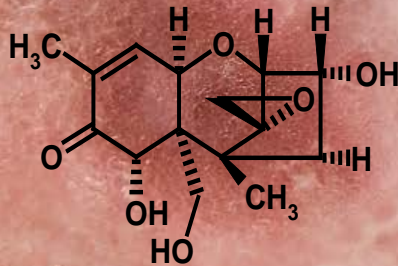


FWF

Special Research Programme
FUSARIUM



Mycotoxins are....



*... **toxic** secondary
fungal metabolites*

Aspergillus sp.
Penicillium sp.
Fusarium sp.
.....

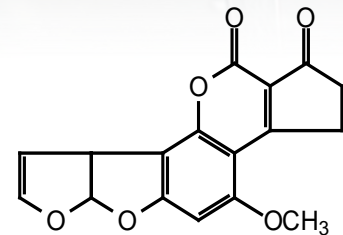
- 39 nations with known regulations
- Harmonized limits in the EU

1960: Turkey X disease – Entdeckung der Aflatoxine



ceased with the end of the turkey hatching season.

In August, 1960, a meeting of veterinary research workers, investigation officers, advisors to National Compounds,





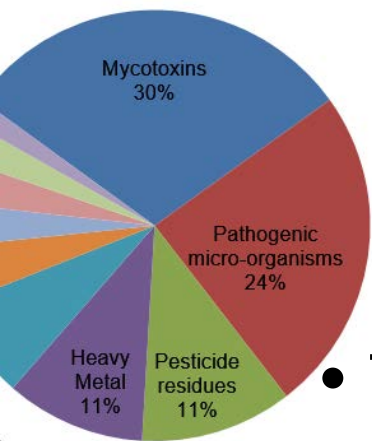
A new study finds that children, such as this young boy collecting water at a refugee camp in the eastern Democratic Republic of Congo, may be harmed by common fungal toxins on food.

Kate Holt/Oxfam (CC BY 2.0)

Fungal toxins are poisoning Africa's children, says new report

By **Catherine Maticic** | Feb. 18, 2016 , 5:15 PM

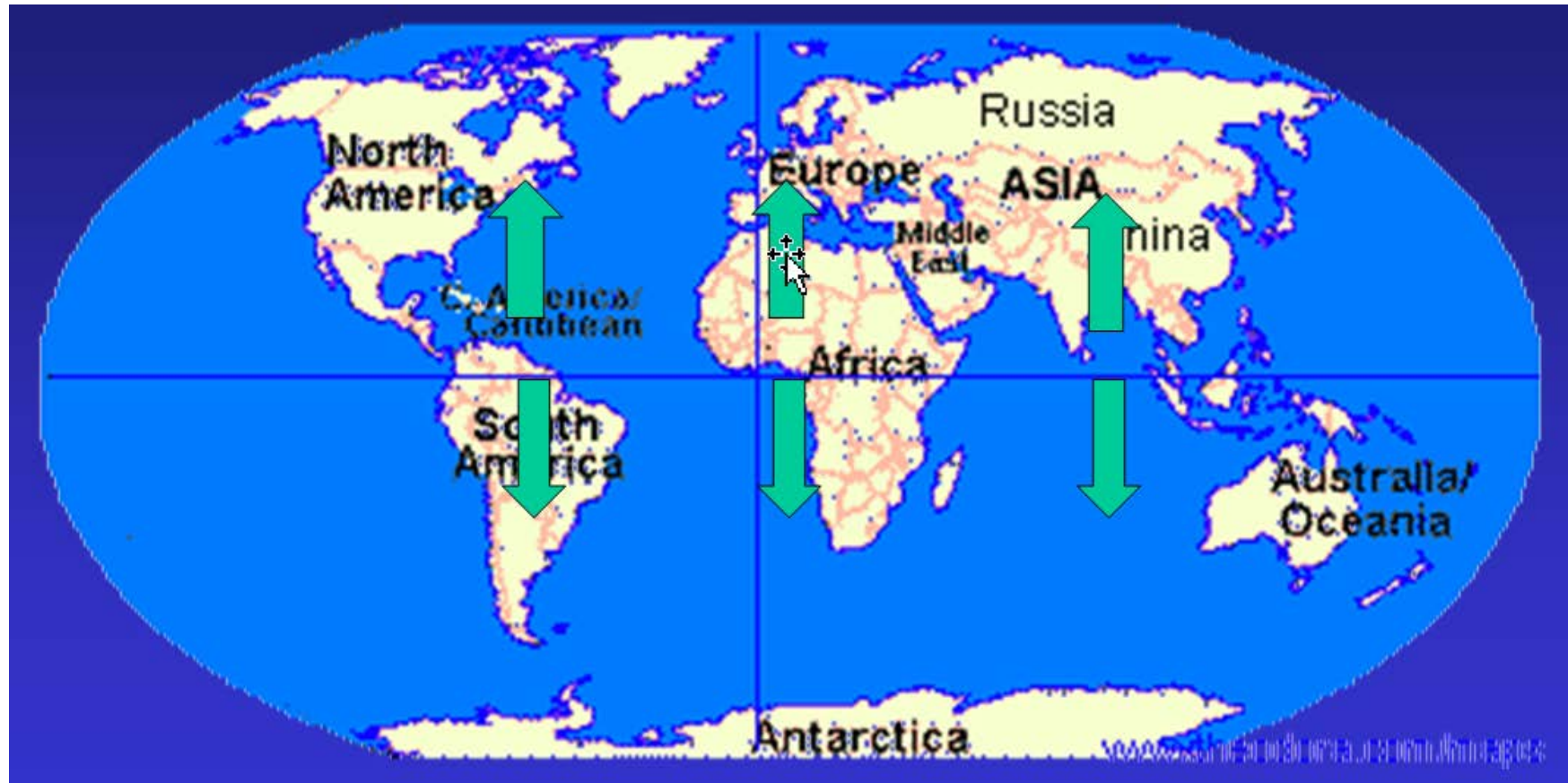
Science AAAS



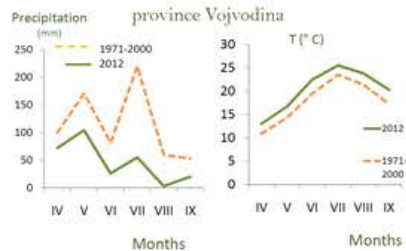
The mycotoxin issue in the EU

- The majority of EU's RASFF (Rapid Alert System for Food and Feed) rejections were due to mycotoxin contamination (highest risk: aflatoxins in nuts and dried fruits)
- Grain and foods based on these grains account for the largest contribution to mycotoxin exposure in all age classes of the EU population
- Considering an average EU-wide production of wheat, maize and oats of about 203 Mt since 2005 (worth about 32.95 billion €), losses can easily exceed 1.5 billion € per year

Climate change: plant pathogens and pests are moving at about 3-5 km/year towards the poles



Aflatoxin contamination in Serbia due to extreme weather conditions



Need for
drought
resistant maize



2012: Aflatoxins



2014: Deoxynivalenol



Germany: **Ban of milk** delivery due to carcinogen scare (Aflatoxin M1)

world **FOOD** RESEARCH & INNOVATION forum

F. Bagi, V. Stojšin, D. Budakov,
M. Grahovac. University of Novi Sad,
Faculty of Agriculture, Serbia

How can we manage the mycotoxins issue?



Swiss Food Regulation
13th Century

*“Fish which cannot be sold, can be
declared as such, and is allowed to
be sold to foreigners only”*





2016 – New web site and logo



ISM

International Society for Mycotoxicology

research on mycotoxin and toxigenic fungi

www.mycotox-society.org/

Welcome to ISM website.



Huge quantities of food are wasted every year because they are invaded by toxic fungi or undesired fungal products, like "mycotoxins". Mycotoxins can be produced on a wide range of agricultural commodities and under a diverse range of agronomic and ecological conditions worldwide. They have been estimated to affect a quarter of the world's food crops, including many basic foodstuffs and animal feeds, as well as cash crops such as coffee having high economic value. Mycotoxins accumulation in foods and feeds represents a major threat to human and animal health as they are responsible for a variety of toxic effects including the induction of cancer, and digestive, blood and nerve defects. Because of the scale of the problem, a consortium of international experts in 2005 decided to found the "International Society for Mycotoxicology" in order to more effectively disseminate knowledge and skills on Toxigenic Fungi and Mycotoxins. The Society is registered as a non-profit association in accordance with the Italian law from which it derives all rights as a legal entity.



Affiliated Journal



Executive committee



Interesting Links



Worldwide Upcoming Event



Membership information



Course and Conference



AIMS OF ISM

The Objectives of the Society are to **promote research on mycotoxins and toxigenic fungi** thereby leading to prevention and reduction in exposure to mycotoxins, enhanced food safety and a greater public awareness on this area.

The Society aims to **increase scientific knowledge** of mycotoxins and toxigenic fungi, through membership networking, scientific meetings, symposia, discussions, technical courses and publications.



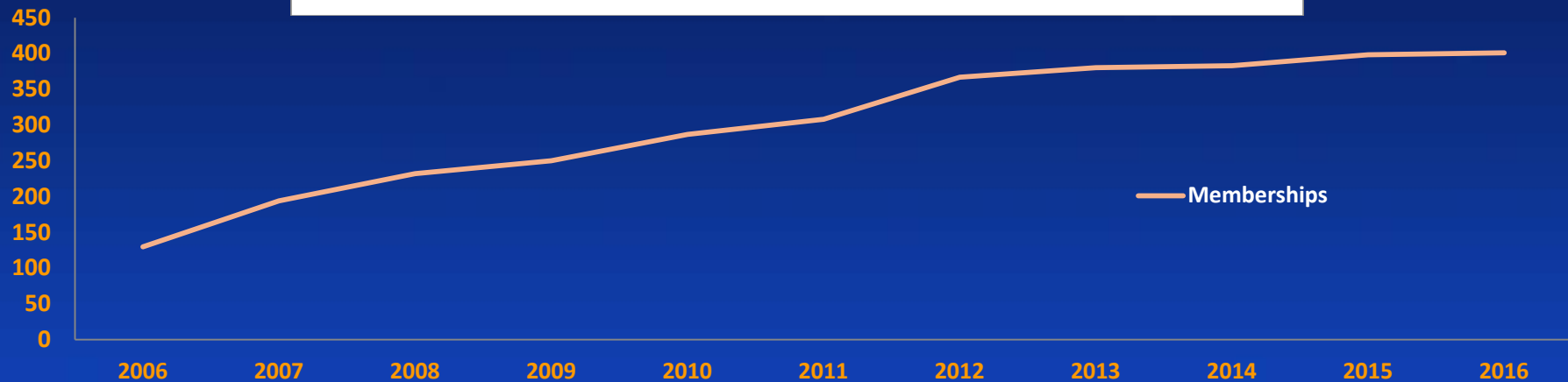
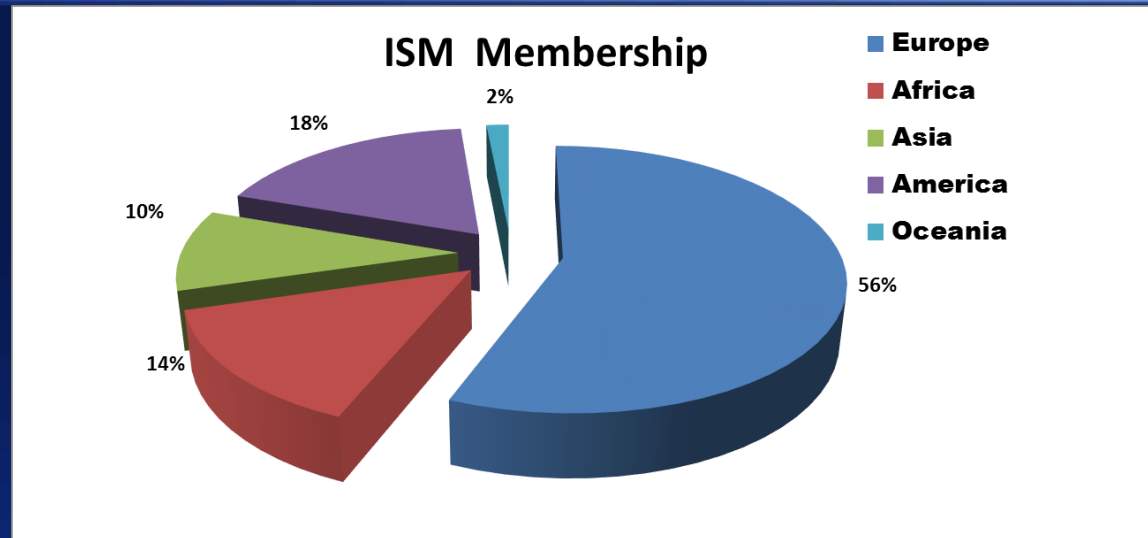
BENEFITS FOR ISM MEMBERSHIP

- Reduction of registration fees for conferences/workshops co-organised by ISM
- Individual ISM members are eligible to significantly reduced subscription rates and open access fees of three internationally recognised journals (FAC, TOXINS and WMJ).
- 20% reduction on deposit/request of fungal strains from ITEM Collection (<http://www.ispa.cnr.it/Collection>)
- Updating of all News related to ISM by e-mail
- Supporting prevention and solution of mycotoxins problems in Third World countries





MEMBERSHIP IN THE 10YEARS OF THE SOCIETY





Activities of ISM

 Agriculture and Agri-Food Canada / Agriculture et Agroalimentaire Canada  Canada

MYCORED NORTH AMERICA 2012

 Agriculture and Agri-Food Canada
www.agr.gc.ca



[français](#) | [Home](#) | [Contact Us](#) | [Help](#) | [Search](#) | [canada.gc.ca](#)

Global integration of research on mycotoxins and toxigenic fungi for food/feed safety

200-250 participants: scientists, policy makers, Industry, other stakeholders

 ISM-MYCORED Workshop - Training Course
Detection techniques for mycotoxins in the food chain 



 National Research Council of Italy
Institute of Sciences of Food Production

May 28 - June 1, 2012 – Bari, Italy

Fusarium Laboratory Workshop

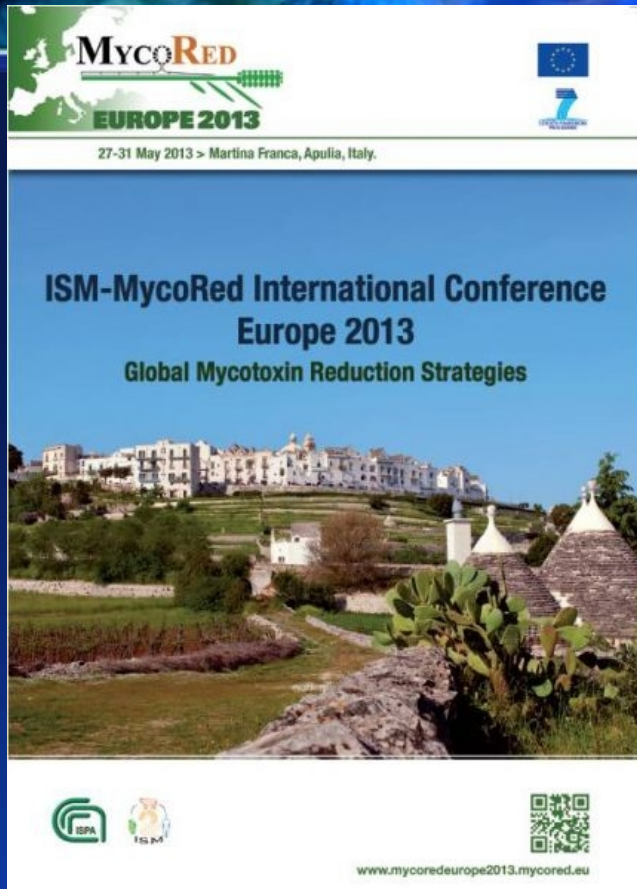
Bari, 3-8 June 2012



In two weeks **45** people actively participated at MycoRed – ISM training courses (*Detection techniques for mycotoxins in the food chain and Fusarium Laboratory Workshop*). **20 international experts** and assisted by **10 scientific tutors**, in a multicultural and multidisciplinary climate, being involved into practical learning and making a live experience in the CNR ISPA labs, in addition **Web-lessons** were followed also by **80 people**, worldwide distributed.



Activities of ISM



It was a big success **300** participants from more than **50** countries, having **73** lectures, **88** oral presentations, **110** posters, **10** exhibitors, **5** satellite meetings...

International Conference on Mycological Aspects of Food and Feed Safety (IC-MAFFS) 27 – 28 June 2013

Organized by :



Center of Excellent
of Mycotoxin Studies



Faculty of
Agricultural Technology
University Gadjah Mada

In Collaboration with :



ILSI Southeast Asia Region

Supported by



SEAMEO Biotrop



USM Penang, Malaysia



ISTITUTO DI SCIENZE
DELLE PRODUZIONI
ALIMENTARI



Centraalbureau voor
Schimmelcultures
Utrecht, The Netherlands



International Society
for Mycotoxicology

Location: Yogyakarta, Indonesia



Mycotoxin Alliances and Networks



International Society
for Mycotoxicology

African Mycotoxin Network

mycotoxins-Africa.groupsie.com

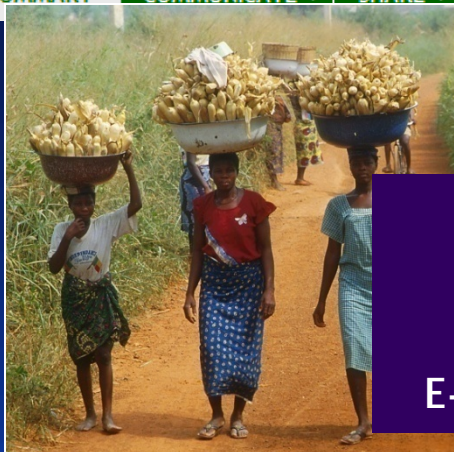
SUMMARY

COMMUNICATE ▼

SHARE ▼

NETWORK ▼

DISCUSSIONS



JOIN US AT:

[http:// www.mycotox-society.org](http://www.mycotox-society.org)

E-mail: ism-secretary@mytocox-society.org



MYCOTOXINS

日本マイコトキシン学会

Japanese Society of Mycotoxicology

European Mycotoxins Awareness Network



[Home](#) [About EMAN](#) [Basic Factsheets](#) [Expert Factsheets](#) [Events](#) [Useful Links](#) [Subscribe Free](#) [Search](#)



الجمعية المغربية لعلم سموم الفطريات
Société Marocaine de Mycotoxicologie
Moroccan Society for Mycotoxicology



[Home](#)[Aim](#)[Activities MYTOX-SOUTH](#)[NORTH Partners](#)[Toxigenic moulds](#)[Mycotoxins](#)[Mycotoxins and human health](#)[Mycotoxins and animal health](#)[SOUTH partners](#)[MYCOSAFE-SOUTH](#)[News](#)[Contact](#)

MycoSafe-South, the “European–African partnership for safe and efficient use of mycotoxin-mitigation strategies in sub-Saharan Africa”, intends to harness the expertise and infrastructure available in Europe by strengthening the capacity of the Southern partners to tackle the mycotoxin problem and the associated food safety issues. **This project will identify safe and efficient mitigation strategies to reduce aflatoxins (AFs) and fumonisins (FBs) exposure in Africa, with special focus on children.**

This project aims:

- (1) to provide safe-use options for AFs and/or FBs-contaminated food for children and adults through means of safe and efficient post-harvest intervention strategies, including nixtamalization, dehulling, fermentation and the usage of mycotoxin binders and/or modifiers investigated via *in vitro* and *in vivo* studies,
- (2) to develop intervention strategies to reduce human (paediatric) exposure to AFs through animal products (*i.e.* milk, meat and eggs), and
- (3) to improve sustainability of the acquired results by organizing education programmes and awareness campaigns that will facilitate best practices, transfer the acquired knowledge and help stakeholders to understand mycotoxin-associated health risks.



Coordinator
Antonio F. Logrieco

MycoKey and MytoolBox: a good cooperation



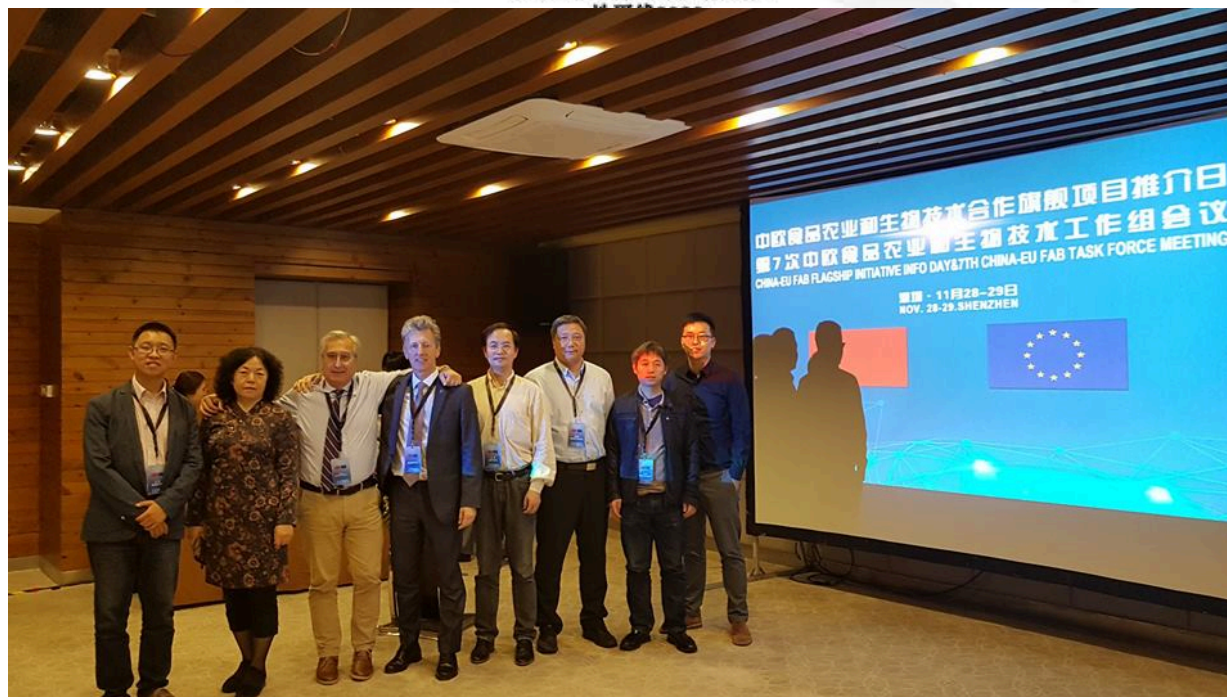
Memorandum of Understanding for Mutual Cooperation between the H2020-2015-SFS-13 project "MyToolBox" (grant n° 678012) and the H2020-2015-SFS-13 project "MycoKey" (grant n° 678781)

This Memorandum of Understanding (the "MoU"), is hereby established by and between the MyToolBox project represented by its coordinator Dr. Rudolf Krska (hereinafter referred to as "MyToolBox") and the MycoKey project represented by its coordinator Dr. Antonio Logrieco (hereinafter referred to as "MycoKey"). This MoU is not legally binding in the sense that it does not impose any obligations. However, the scope of the MoU is to establish a common ground for a fruitful cooperation between "MyToolBox" and "MycoKey" projects during their implementation, aiming at finding synergies for tackling more efficiently the main challenges identified by the SFS-13-2015 topic¹. Such an approach is welcomed by the EC/REA and it is intended to foster mutual collaboration aiming at reducing the risk of mycotoxin contamination in crops and all along the feed and food chains. Areas of collaboration identified will only cover activities whose results address the improvement of the state of the art of research and innovation knowledge in the mycotoxins area, excluding all aspects sensible in terms of IPR exploitation.

The tables below highlight each project details, and identify areas of potential collaboration:

| PROJECTS' DETAILS | | |
|------------------------|---|---|
| Acronym of the project | MyToolBox | MycoKey |
| Grant | 678012 | 678781 |
| Agreement n° | | |
| Start date | 01/03/2016 | 01/04/2016 |
| Duration | 48 months | 48 months |
| Total Cost | EUR 5 243 123,75 | EUR 6 431 361,25 |
| EU contribution | EUR 4 997 660,75 | EUR 5 000 000,00 |
| Coordinator | UNIVERSITAET FUER BODENKULTUR WIEN (AT) | CONSIGLIO NAZIONALE DELLE RICERCHE (IT) |
| N° of participants | 23 | 32 |

¹<https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/789-sfs-13-2015.html>



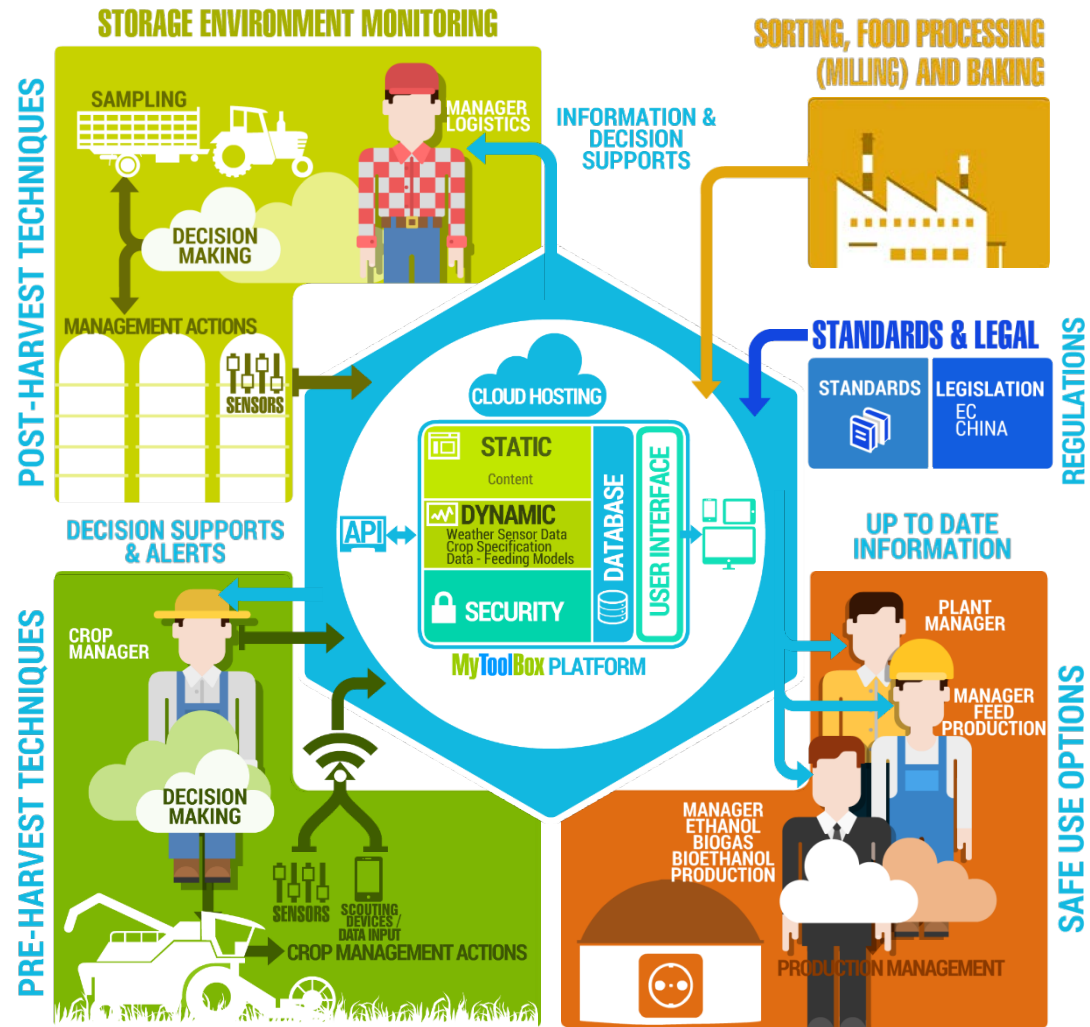
The Coordinators participated at Food, Agriculture and Biotechnology

FAB Flagship Initiative between the EU and China:

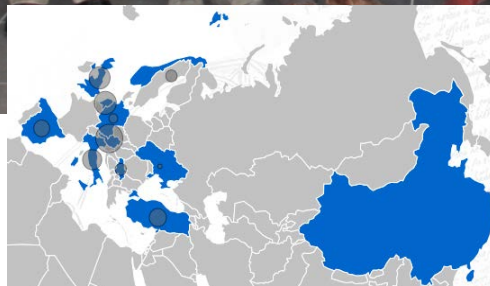
Info day WP2018-2020, Shenzhen, China, November 28th 2017

TASK FORCE Meeting 29 November 2017

Integrated multi-actor based approaches for safe food and feed



The MyToolBox consortium



Kick-off meeting
@ BOKU/UFT, Tulln





Research on fungal infection and mycotoxin formation

- Considerable **knowledge** accumulated on factors affecting fungal infection and mycotoxins
- **Mitigation measures** for pre- and post-harvest are well established

However:-

- Training and **implementation** of prevention measures by farmers and processors has been generally weak or lacking
- **Few incentives to producers to incur extra effort and additional costs to minimise mycotoxin contamination**



Good Agricultural Practice (GAP)

- **GAP** is well documented by CAC, FAO, Government Agriculture Departments
- Mostly they are lengthy detailed texts
- **NOT** in user-friendly format

Examples

CODE OF PRACTICE FOR THE PREVENTION AND REDUCTION OF AFLATOXIN CONTAMINATION IN DRIED FIGS

CAC/RCP 65-2008

INTRODUCTION

1. The elaboration and acceptance of a Code provide uniform guidance for all countries to manage contamination by various mycotoxins of importance in order to ensure protection of the consumer in producer and importer countries. All dried figs should be handled in accordance with the Recommended International Code of Practice for the Prevention and Reduction of Aflatoxin Contamination in Dried Figs, CAC/RCP 65-2008.

CAC/RCP 55 – 2004

Page 1 OF 7

CODE OF PRACTICE FOR THE PREVENTION AND REDUCTION OF AFLATOXIN CONTAMINATION IN PEANUTS

CAC/RCP 55 – 2004

1. SCOPE

1. This document is intended to provide guidance for all interested parties producing and handling peanuts for entry into international trade for human consumption. All peanuts should be prepared and handled in accordance with the Recommended International Code of Practice – General Principles of Food Hygiene¹, which are relevant for all foods being prepared for human consumption. These codes of practice indicate the measures that should be implemented by all persons that have the responsibility for assuring that food is safe and suitable for consumption.



MyToolBox

Advice to farmers can be provided through smart tools

- Selection of resistant **cultivars**
- **Cultural control** of mycotoxins - crop debris, soil tillage
- Soil & water management
- Use of **biopesticides**
- Optimum **timing** for fungicide spraying
- Atoxigenic **biocontrol** measures – Aflasafe, AflaGuard™
- Timely harvesting



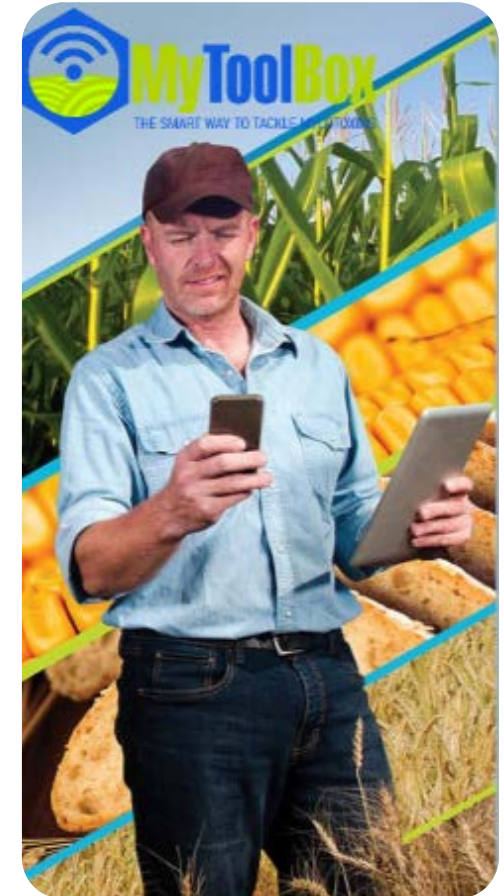
Pre-harvest




Post-harvest



Processing




Approach: MyToolBox-e-platform for Integrated Mycotoxin management


MyToolBox

[Login](#)
[Register](#)

MyToolBox Premium



MyToolBox

THE SMART WAY TO TACKLE MYCOTOXINS

Until recently, the prevailing view assumed Lorem Ipsum was born as a nonsense text. It is not Latin, though – it looks like it, and it actually says nothing. Before & After magazine answered a curious reader, ‘Its ‘words’ loosely approximate the frequency with which letters occur in English, which is why at a glance it looks pretty real.’


As Gkero would put it, ‘It ain’t, not so fast!’

The placeholder text, beginning with the line ‘Lorem Ipsum dolor sit amet’, conceals an extraordinary bit of history because in its youth, centuries ago, it was Latin.


Richard McClintock, a Latin scholar from Hamden-Sydney College, is credited with discovering the source behind the ubiquitous filler text. In seeing a sample of ‘lorem ipsum’, his interest was piqued by consecutive – a genuine, albeit rare, Latin word.

[Try it now!](#)


Integrated mycotoxin management




Pre-harvest




Post-harvest




Processing



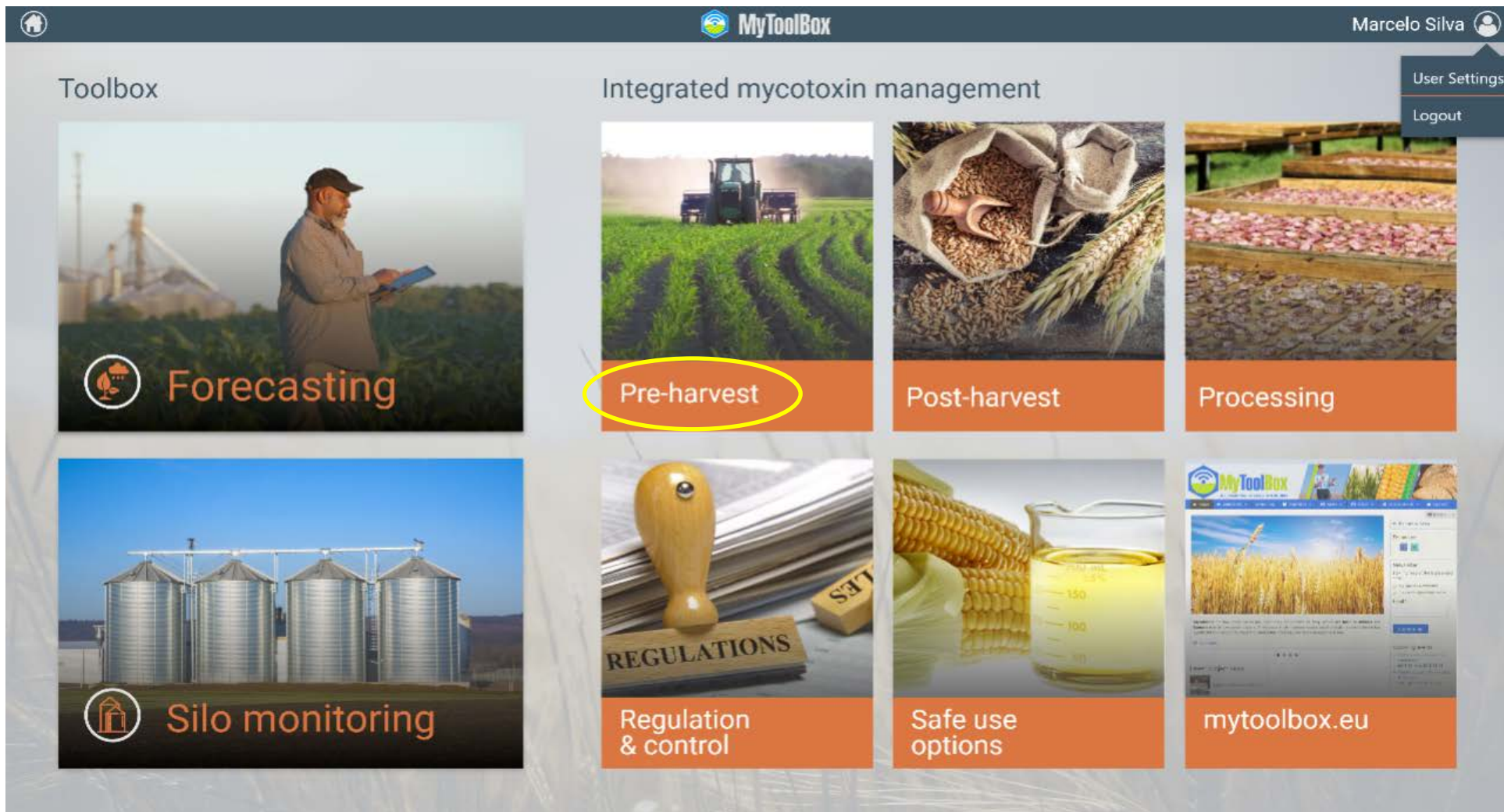
Regulation & control



Safe use options



mytoolbox.eu



The screenshot displays the MyToolBox e-platform interface. At the top, a dark blue header bar contains a home icon, the MyToolBox logo, and the user name 'Marcelo Silva' with a profile icon. Below the header, the main content area is divided into two sections. On the left, a 'Toolbox' section features two large tiles: 'Forecasting' (showing a farmer with a tablet) and 'Silo monitoring' (showing four large metal silos). On the right, a larger section titled 'Integrated mycotoxin management' contains six tiles arranged in a 2x3 grid. The top row includes 'Pre-harvest' (a tractor in a field, highlighted with a yellow oval), 'Post-harvest' (wheat in a sack), and 'Processing' (wheat in a wooden bin). The bottom row includes 'Regulation & control' (a wooden gavel on a book labeled 'REGULATIONS'), 'Safe use options' (corn cobs and a beaker of yellow liquid), and 'mytoolbox.eu' (a screenshot of the website). A vertical menu on the far right of the 'Integrated mycotoxin management' section contains 'User Settings' and 'Logout' options.

MyToolBox

Marcelo Silva

Toolbox

Forecasting

Silo monitoring

Integrated mycotoxin management

Pre-harvest

Post-harvest

Processing

Regulation & control







Safe use options



mytoolbox.eu




User Settings

Logout







 Wheat
  Maize
  Barley
  Peanut
  Fig

 MyToolBox
 Marcelo Silva 

 Cultivar
  Tillage and crop debris
  Crop rotation

- Do not rotate wheat directly with maize. Direct crop rotation with maize leads to the highest risk. Do not rotate directly with wheat, barley or oats either. These crops are all susceptible for Fusarium species. Having crops susceptible for Fusarium species on the field for several years in a row can lead to an inoculum that can infect the next crop.
- Use potatoes, legumes, onions or other vegetables as crop rotation. These crops are less susceptible for Fusarium species.



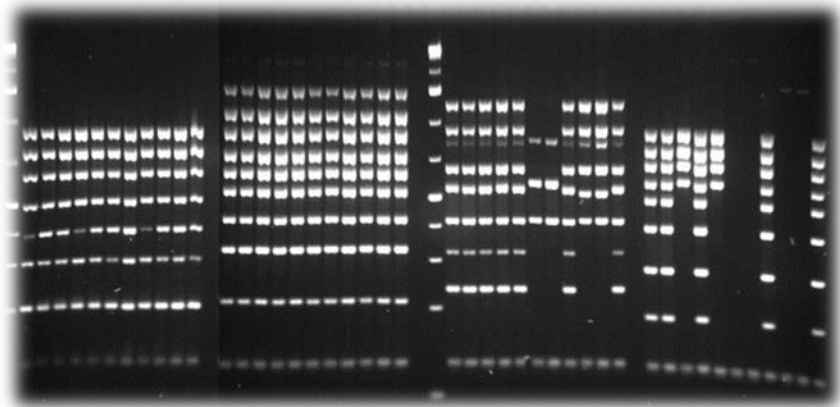
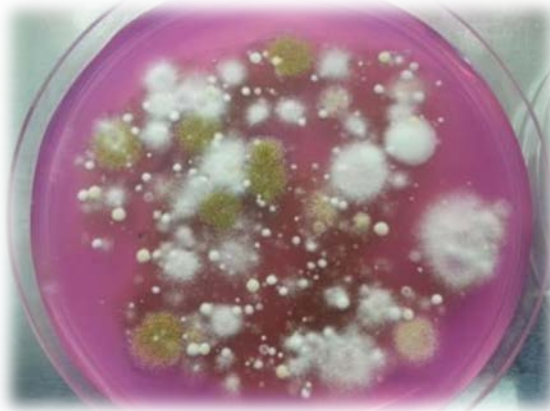
The MyToolBox Approach: Pre-harvest
Resistant plant cultivars



MyToolBox
THE SMART WAY TO TACKLE MYCOTOXINS

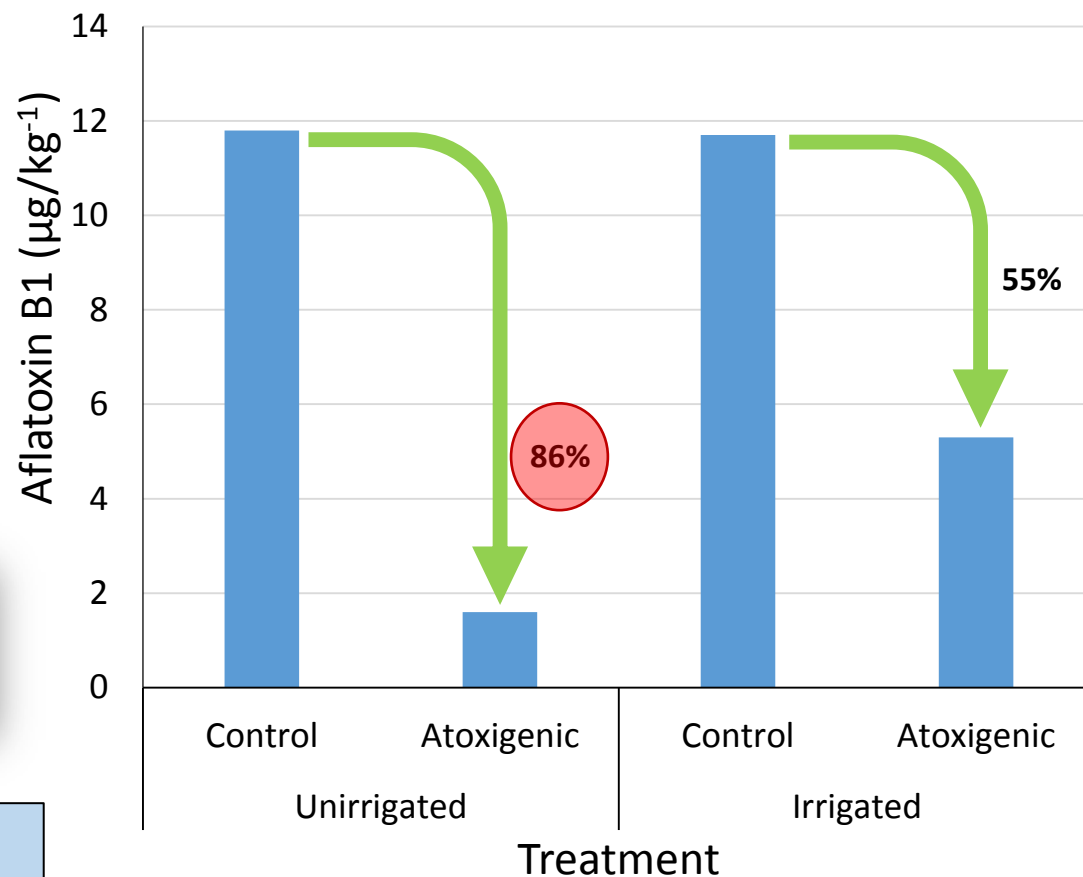


Atoxigenic isolates of *Aspergillus flavus*



Characterization of atoxigenic isolates of *A. flavus* from Serbia in cooperation with the Univ. of Arizona/USDA

Atoxigenic isolates of *Aspergillus flavus*

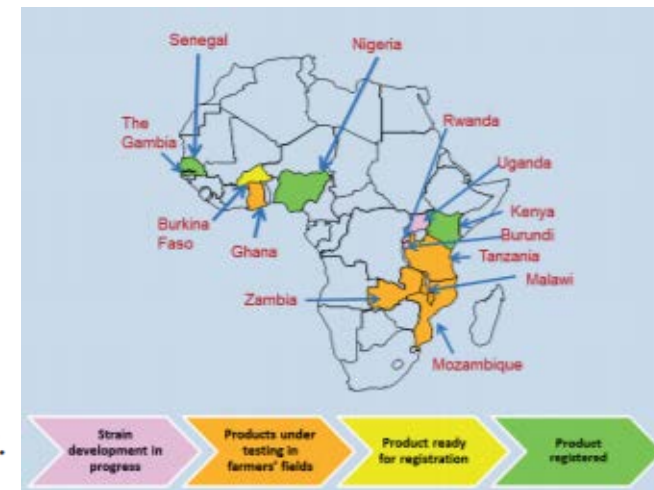


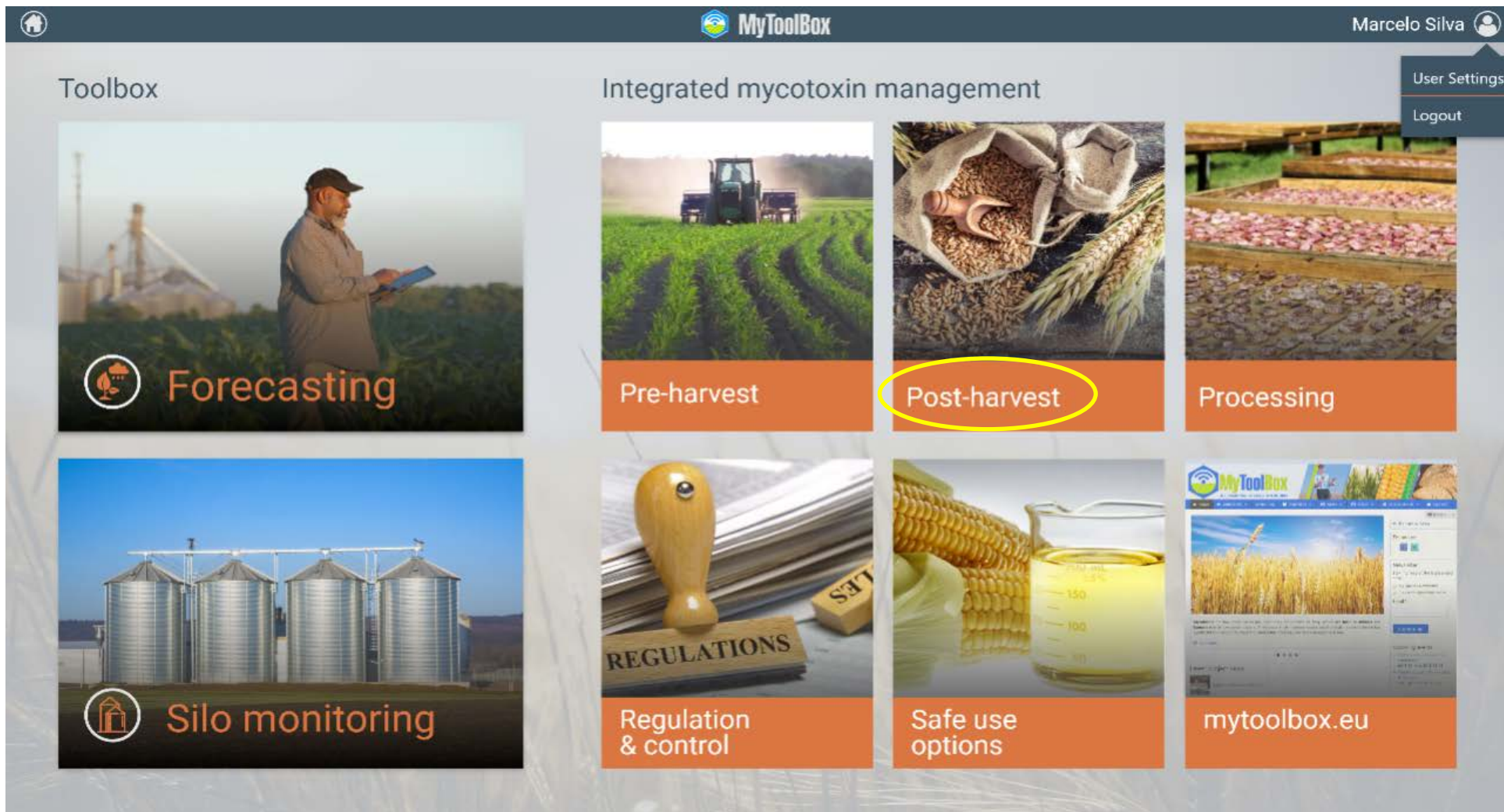
**Successful isolate already filed
for patenting!!**



Biological control of aflatoxins in Africa: current status and potential challenges in the face of climate change

R. Bandyopadhyay^{1*}, A. Ortega-Beltran¹, A. Akande², C. Mutegi³, J. Atehnkeng⁴, L. Kaptoge¹, A.L. Senghor⁵, B.N. Adhikari⁶, and P.J. Cotty⁶





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MyToolBox

Marcelo Silva

Toolbox

Forecasting

Silo monitoring

Integrated mycotoxin management

Pre-harvest

Post-harvest

Processing

Regulation & control

Safe use options

mytoolbox.eu

User Settings

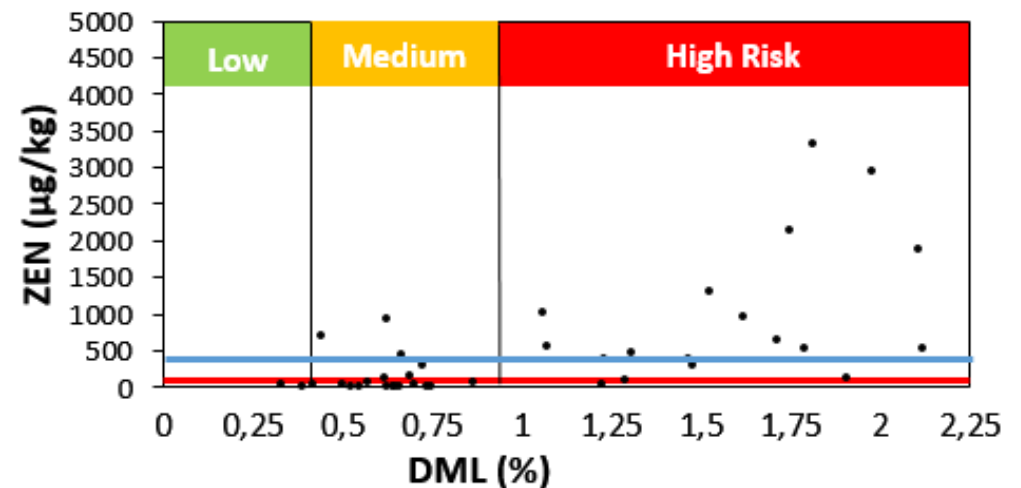
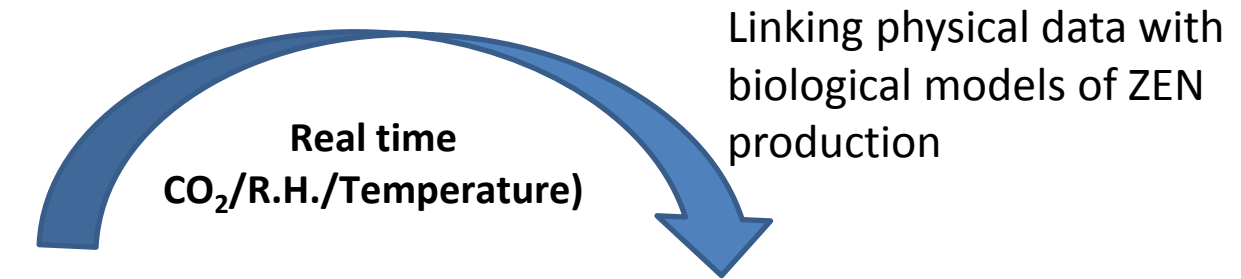
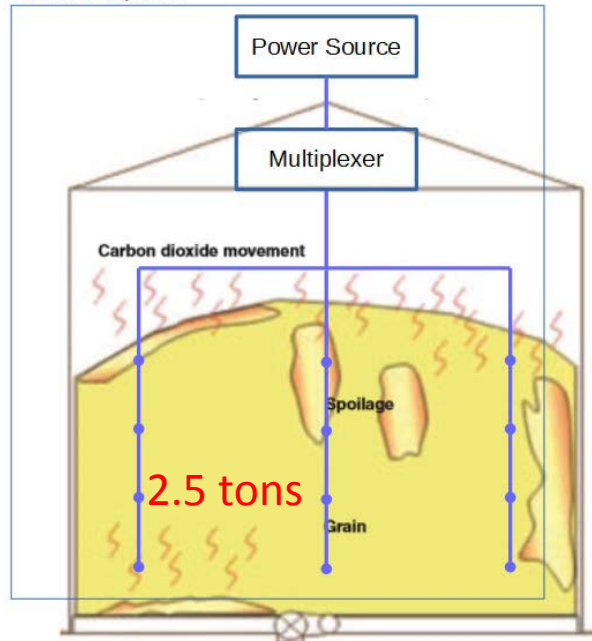
Logout

The MyToolBox Approach: Post-harvest

THE SMART WAY TO TACKLE MYCOTOXINS

Real time environmental monitoring system

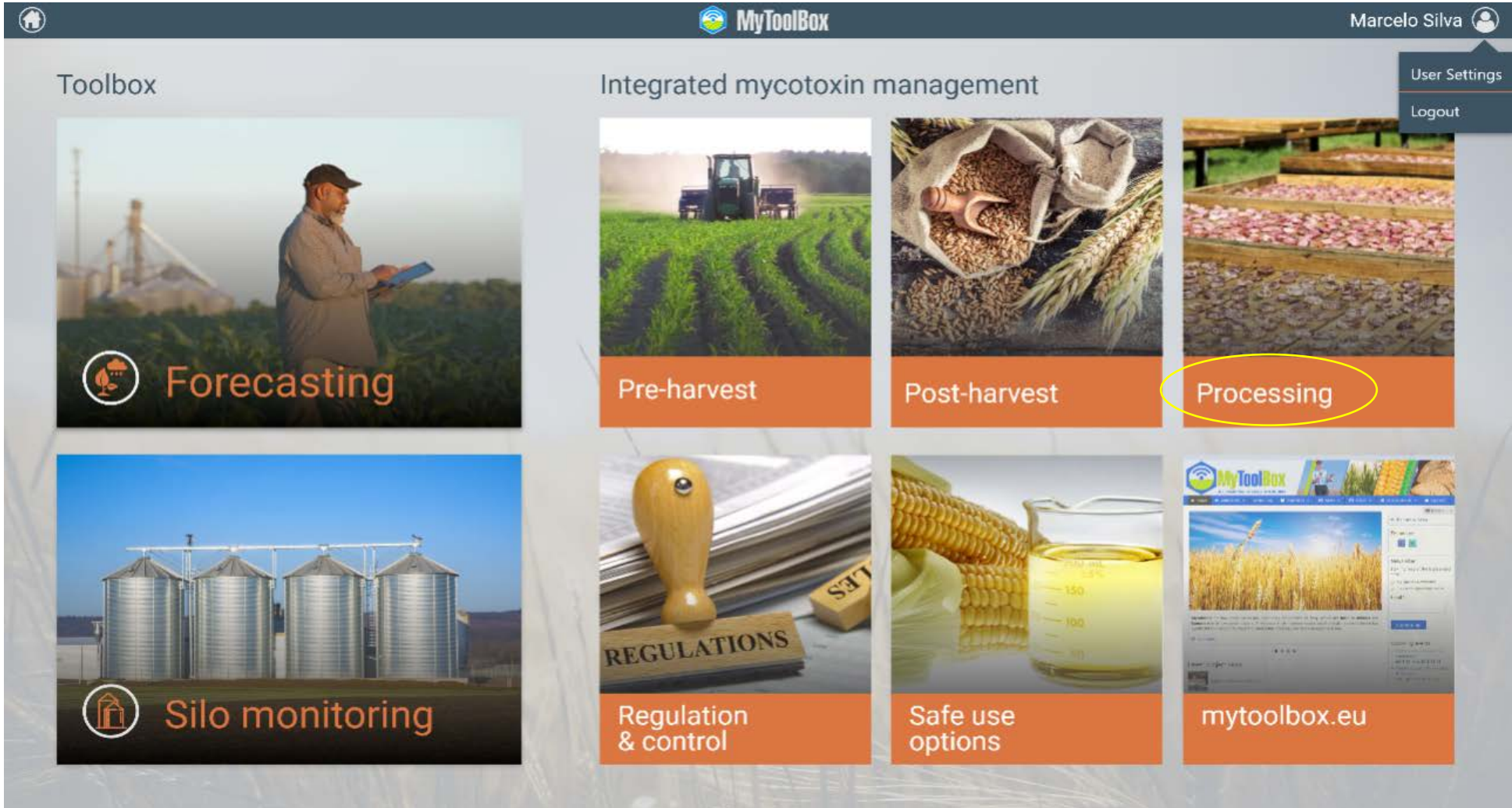
ATEX compliant



- CO₂ production linked to nutritional losses
- calculated as **dry matter losses**
- risk of **ZEN contamination above EU limit**

Large scale storage of grains in China





The screenshot displays the MyToolBox e-platform interface. At the top, a dark blue header bar contains a home icon, the MyToolBox logo, and the user name 'Marcelo Silva' with a profile icon. Below the header, the main content area is divided into two sections. On the left, a 'Toolbox' section features two large tiles: 'Forecasting' (showing a farmer with a tablet) and 'Silo monitoring' (showing four large metal silos). On the right, an 'Integrated mycotoxin management' section contains six tiles arranged in a 2x3 grid: 'Pre-harvest' (tractor in a field), 'Post-harvest' (wheat in a sack), 'Processing' (wheat on a conveyor belt, circled in yellow), 'Regulation & control' (a wooden gavel on a book labeled 'REGULATIONS'), 'Safe use options' (corn cobs and a beaker of yellow liquid), and 'mytoolbox.eu' (a screenshot of the website). A dropdown menu is open next to the user name, showing 'User Settings' and 'Logout' options.

MyToolBox

Marcelo Silva

Toolbox

Integrated mycotoxin management

Forecasting

Pre-harvest

Post-harvest

Processing

Silo monitoring

Regulation & control

Safe use options

mytoolbox.eu

User Settings

Logout



28/2/2017

Test GranoSalus: Don, Glifosate e Cadmio presenti negli spaghetti

Lo dicono le analisi
presenti negli spaghetti

| Tipologia | Denominazione | Conc. DON | Conc. Glifosato | Conc. Cadmio | Conc. Piombo | Giudizio |
|--|---------------|-----------|-----------------|--------------|--------------|------------|
| Formato | del Campione | (ppb) | (mg/kg) | (mg/kg) | (mg/kg) | GranoSalus |
| Spaghetti | Barilla | 161 | 0.102 | 0.032 | <0.01 | Negativo |
| " | Voiello | 180 | 0.050 | 0.036 | <0.01 | Negativo |
| " | De Cecco | 80 | 0.052 | 0.042 | <0.01 | Negativo |
| " | Divella | 381 | 0.110 | 0.044 | <0.01 | Negativo |
| " | Garofalo | 199 | 0.062 | 0.021 | <0.01 | Negativo |
| " | La Molisana | 253 | 0.033 | 0.035 | <0.01 | Negativo |
| " | Coop | 128 | 0.013 | 0.027 | <0.01 | Negativo |
| " | Granoro 100 | 99 | 0.039 | 0.018 | <0.01 | Negativo |
| Fonte: Laboratorio Europeo Accreditato; Elab. GranoSalus | | | | | | |

Le analisi sono state effettuate sugli spaghetti.

Sorting, food processing and baking

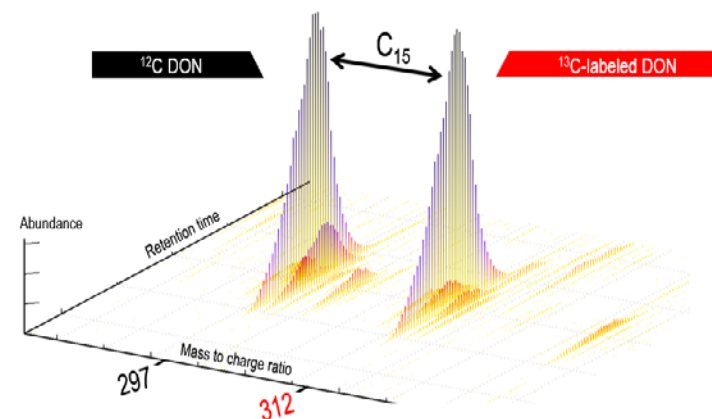
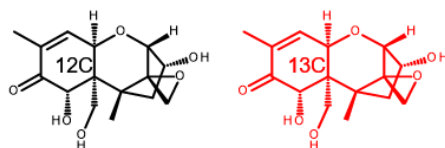
Baking biscuits, bread and crackers in pilot plant:

1st oven: 180°C for 8 min (caramelisation – browning)

2nd oven: 100°C for 10 min (reduce moisture)



+ ^{12}C DON / ^{13}C DON



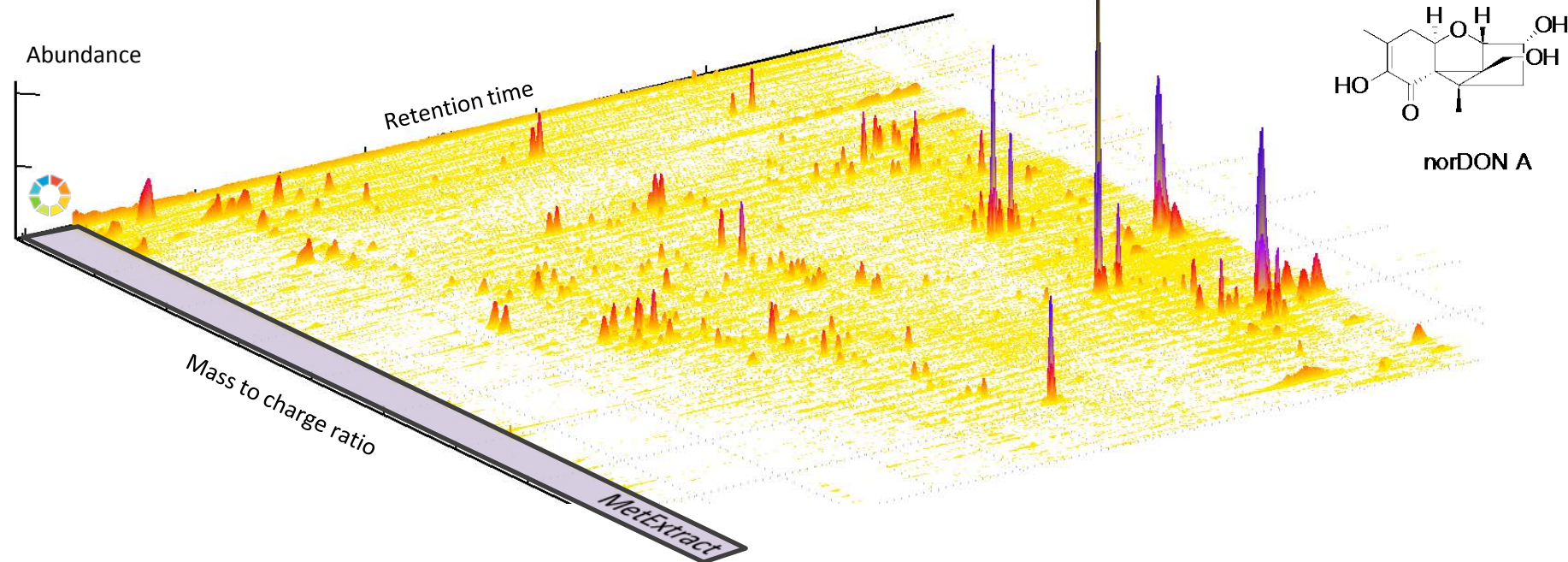
MetExtract: a new software tool for the automated comprehensive extraction of metabolite-derived LC/MS signals in metabolomics research

Christoph Bueschl^{1,2}, Bernhard Kluger¹, Franz Berthiller¹, Gerald Lirk², Stephan Winkler², Rudolf Krška¹ and Rainer Schuhmacher^{1,*}

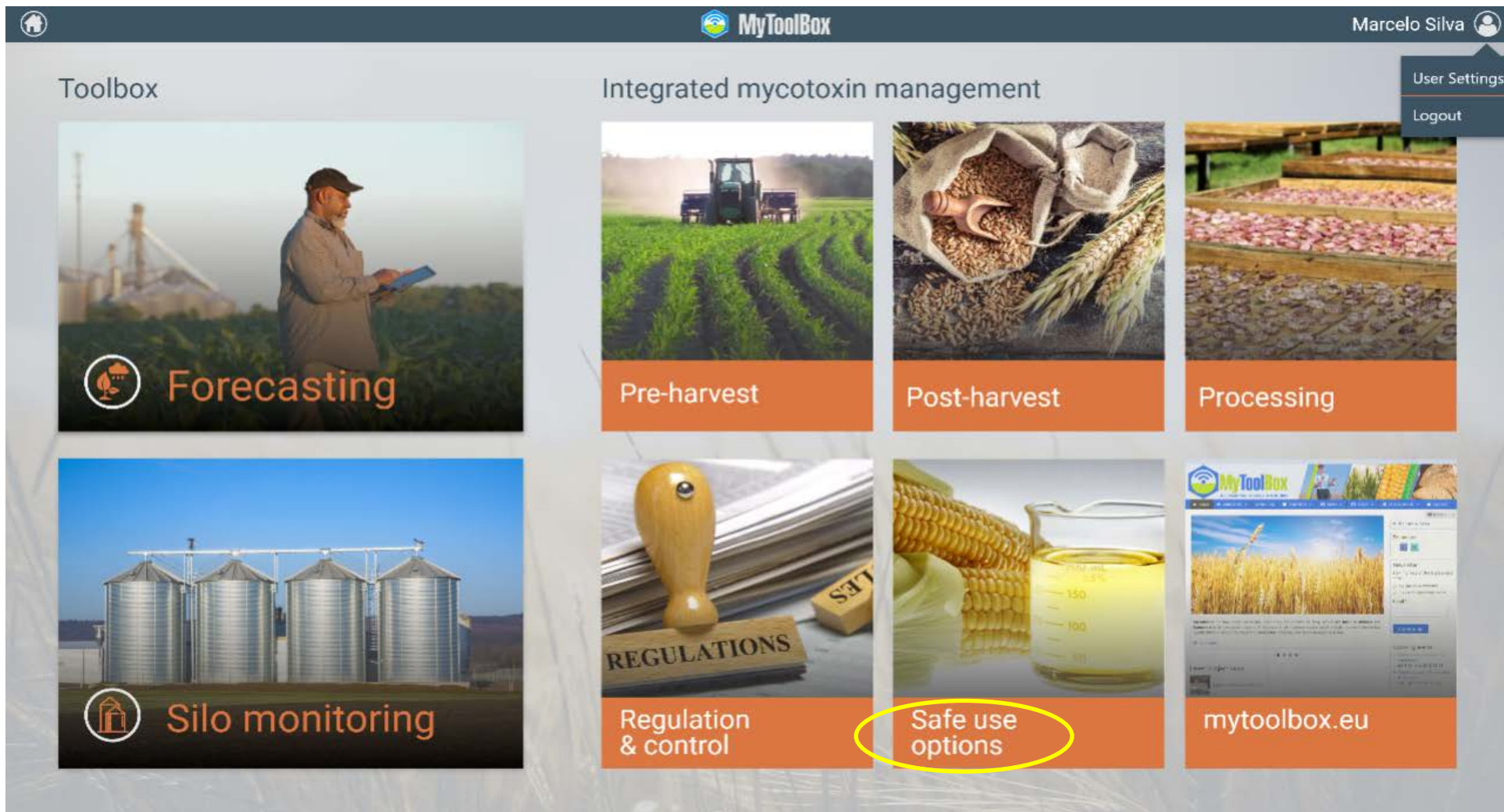
¹Center for Analytical Chemistry, Department for Agrobiotechnology (IFA-Tulln), University of Natural Resources and Life Sciences Vienna, Konrad Lorenz Strasse 20, 3430 Tulln and ²School of Informatics, Communications and Media, University of Applied Sciences, Upper Austria, Softwarepark 11, 4232 Hagenberg, Austria

Associate Editor: Martin Bishop

Searching for corresponding ¹²C- and ¹³C- mass pairs:



D. Stadler et al., Food Chem. (in press): DON degradation: 6 % in crackers, 5 % in biscuits) and 2 % in bread (isoDON up to 3.9 %, norDON B 0.9 % and norDON C 1.2 %.



The screenshot displays the MyToolBox e-platform interface. At the top, a dark blue header bar contains a home icon, the MyToolBox logo, and the user name 'Marcelo Silva' with a profile icon. Below the header, the main content area is divided into two sections. On the left, a 'Toolbox' section features two large tiles: 'Forecasting' (showing a farmer with a tablet) and 'Silo monitoring' (showing four large metal silos). On the right, an 'Integrated mycotoxin management' section contains six tiles arranged in a 2x3 grid: 'Pre-harvest' (tractor in a field), 'Post-harvest' (grain in a bag), 'Processing' (grain on a conveyor), 'Regulation & control' (a wooden gavel on a book labeled 'REGULATIONS'), 'Safe use options' (corn cobs and a beaker of yellow liquid, highlighted with a yellow circle), and 'mytoolbox.eu' (a screenshot of the website). A user menu on the top right of the main area includes 'User Settings' and 'Logout' options.

MyToolBox

Marcelo Silva

Toolbox

Forecasting

Silo monitoring

Integrated mycotoxin management

Pre-harvest

Post-harvest

Processing

Regulation & control

Safe use options

mytoolbox.eu

User Settings

Logout

Safe Use Options: Bioethanol by-products (DDGS) as feed ingredients

F. Wu et al., 2008:

Decreased weight gain in **pigs** (USA) due to including 20% DDGS contaminated with **fumonisin** in the feed

=> losses of up to 147 million US\$ annually



In 2013: 5.2 million m³ of **bioethanol** produced from grains in **Europe** => 4.2 million tons of **DDGS**. Estimated losses in feed production due to mycotoxin contaminated DDGS: **€15-20 million annually**

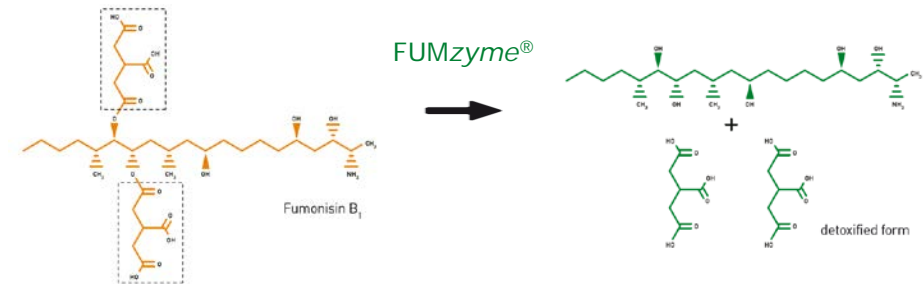


Application of MYCOzymes



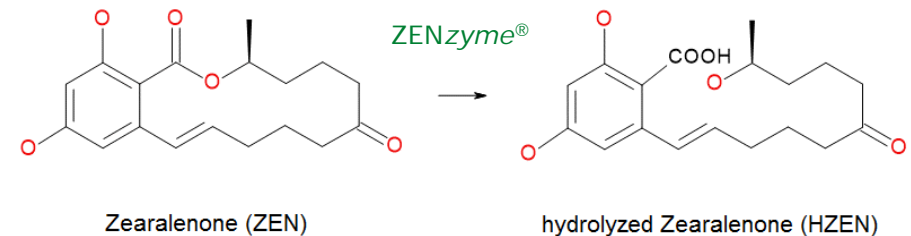
FUMzyme®

- purified enzyme that is unique and specific for the biotransformation of fumonisin B₁
- Degradation product: hydrolyzed fumonisin B₁ (HFB₁)
- EU authorization as feed additive for pigs and all avian species



ZENzyme®

- purified enzyme that is unique and specific for the biotransformation of zearalenone
- Degradation product: hydrolyzed zearalenone (HZEN)



Scope and proceedings



Aim

Evaluation of the applicability and effectivity of mycotoxin degrading enzymes during the bioethanol process to reduce the mycotoxin load in by-products



Lab-scale
process
simulation
development

Lab-scale tests
of MYCOzymes

Scale-up
(Südzucker)

Safe Use Options: Bioethanol by-products (DDGS) as feed ingredients

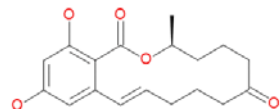
≡ **Biomin** ≡

SÜDZUCKER

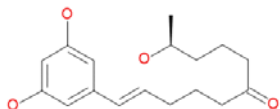
Grains →

Successful application of FUMzyme® and ZENzyme® in the bioethanol process in lab-scale:

FB₁ degradation up to 100%
ZEN degradation up to 89%



Zearalenone (ZEN)

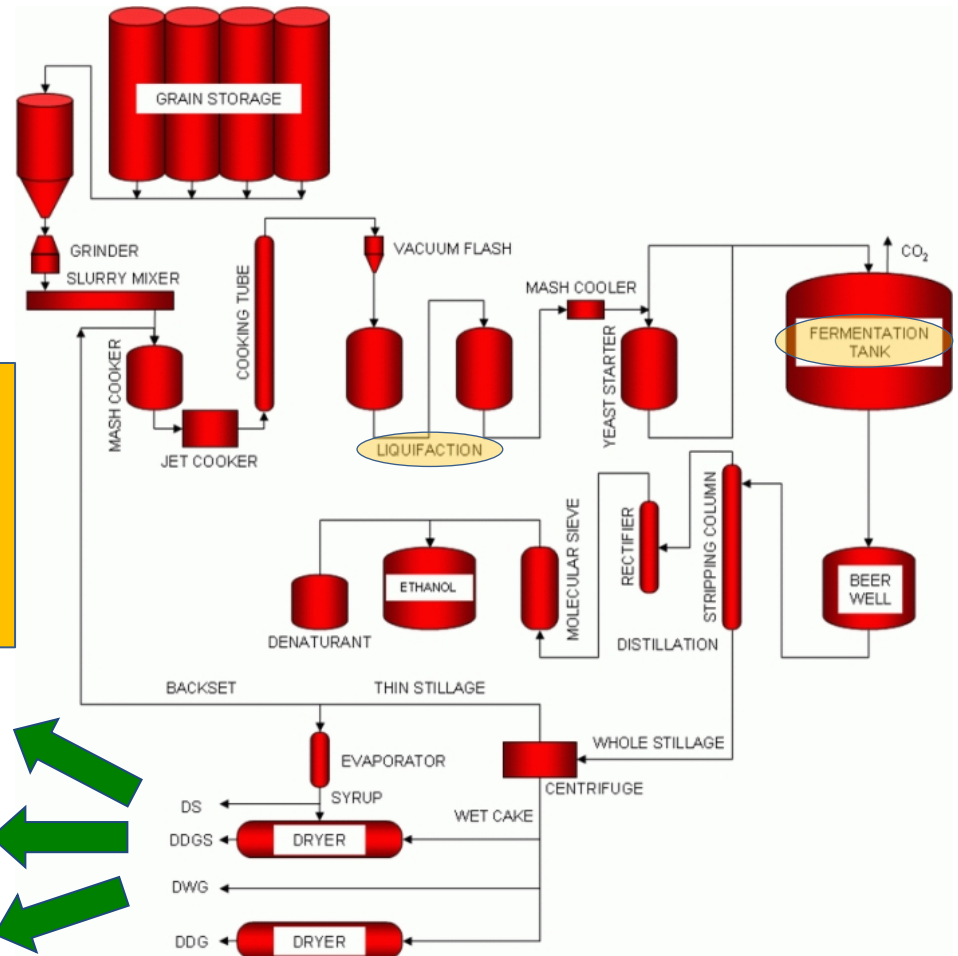


decarboxylated hydrolyzed Zearalenone (DHZEN)

1/3 DDGS

1/3 CO₂

1/3 EtOH



Other studies related to biogas



Bioresource Technology

Available online 21 May 2018

In Press, Corrected Proof ?



Short Communication

Fate of mycotoxins and related fungi in the anaerobic digestion process

Paola Giorni ^a, Amedeo Pietri ^b, Terenzio Bertuzzi ^b, Mariangela Soldano ^c

Sergio Piccinini ^c, Lorella Rossi ^d, Paola Battilani ^a

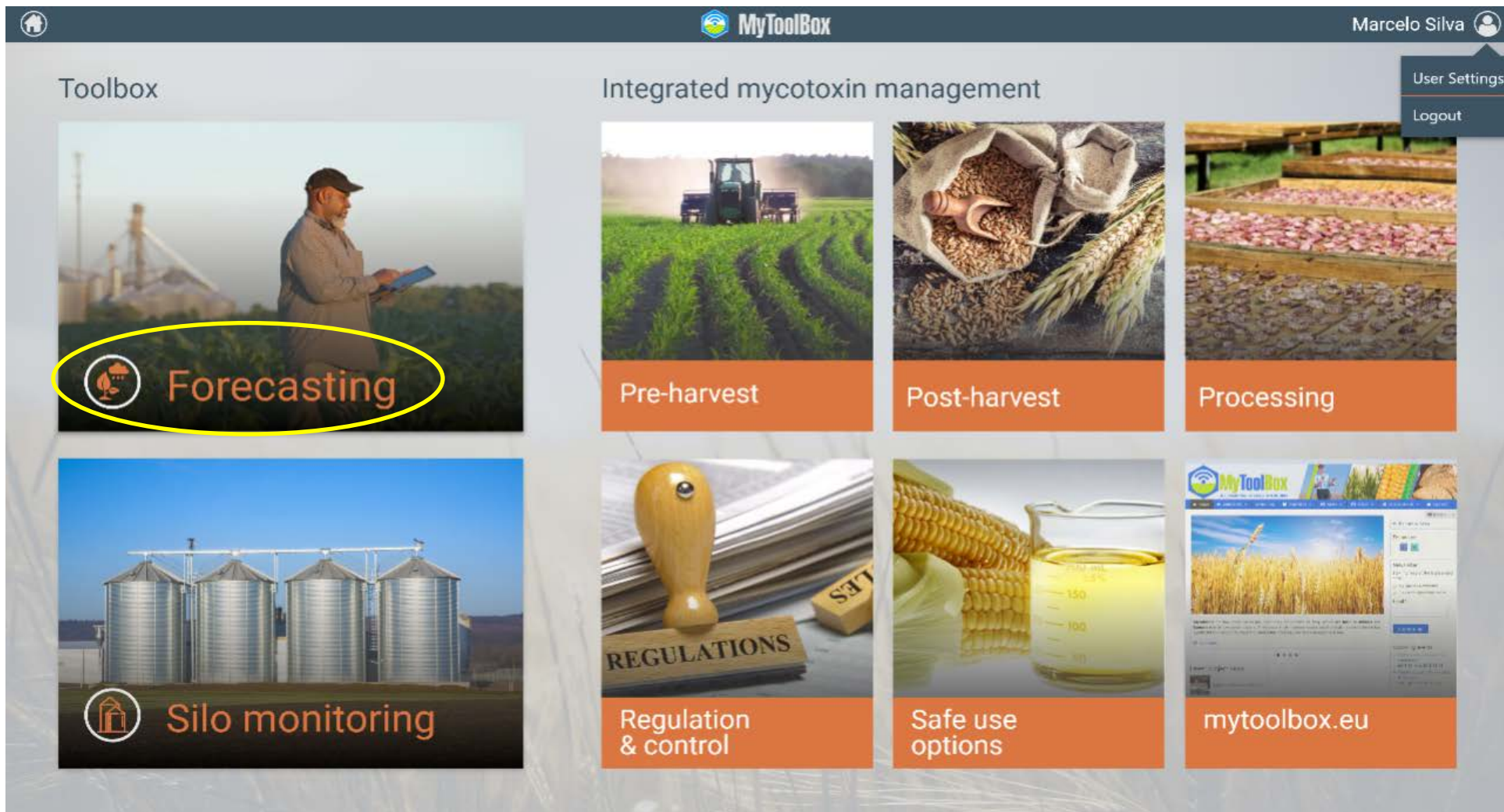
Show more

<https://doi.org/10.1016/j.biortech.2018.05.077>

[Get rights and content](#)

Highlights

- AFB₁ contaminated maize can be used in biogas reactors with no impact on methane.
- Aflatoxins are greatly reduced by anaerobic digestion in mesophilic conditions.
- Efficiency in AFB₁ reduction is inversely proportional to initial aflatoxins content.
- FBs content obtained important reduction during biogas production.



The screenshot displays the MyToolBox e-platform interface. At the top, a dark blue header bar contains a home icon, the MyToolBox logo, and the user name 'Marcelo Silva' with a profile icon. Below the header, the main content area is divided into several sections. On the left, a 'Toolbox' section features a large image of a man in a field holding a tablet, with a yellow oval highlighting a 'Forecasting' icon and label. Below this is a 'Silo monitoring' section with an image of four large metal silos. To the right, the 'Integrated mycotoxin management' section is organized into a grid of six tool cards: 'Pre-harvest' (tractor in field), 'Post-harvest' (grain in bag), 'Processing' (grain in wooden trays), 'Regulation & control' (wooden gavel on 'REGULATIONS' sign), 'Safe use options' (corn cobs and a beaker of yellow liquid), and 'mytoolbox.eu' (screenshot of the website). A dark blue sidebar on the right side of the interface contains 'User Settings' and 'Logout' links.

MyToolBox

Marcelo Silva

Toolbox

Forecasting

Silo monitoring

Integrated mycotoxin management

Pre-harvest

Post-harvest

Processing

Regulation & control

Safe use options

mytoolbox.eu

User Settings

Logout

Dynamic Pre-harvest Decision Tool for Farmer: **Forecasting**



Field location
agronomic
data



model system

Closest/most
relevant
weather station



Prediction tool:-

- Traffic light system
- Probability of different DON levels in grain
- Several days warning
- Advice on action to take

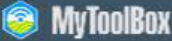





The MyToolBox Approach:



THE SMART WAY TO TACKLE MYCOTOXINS

MyToolBox-e-platform tool:




Marcelo Silva 

 Add Field


Field1 


Field2

Field3





Sowing

06/06/2018 





Heading






Flowering







Harvesting




Fungicide spray against Fusarium head blight only. No entries for early sprays.





Spray 1







Spray 2







Spray 3













Spray 4






Weather Station

Shropshire, GB

| | | | |
|---|---|---|---|
|  <div>0%</div> |  <div>0%</div> |  <div>0%</div> |  <div>0%</div> |
|  <div>22.42C</div> |  <div>22.42C</div> |  <div>22.42C</div> |  <div>22.42C</div> |



Mycotoxin

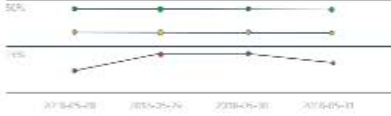
Fusarium / DON


90%


70%


50%


30%



 1200 ppp

 500-1200 ppp

 1200 ppp



ID: Z, Name: Rome, Crop: Common wheat X

Name: Field1

Country: Ireland

Crop: Durum Wheat

Previous Crop: Cereals

Variety: Medium Susceptible

Soil Tillage: Non Turning tillage

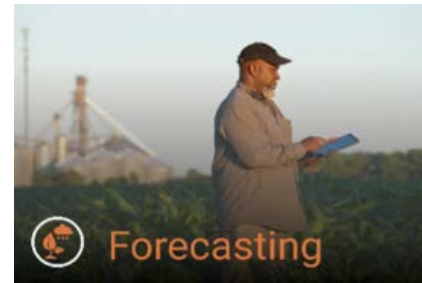
Growing Area: Low Pressure




Weather Provider: Shropshire, United Kingdom


The MyToolBox Approach:




THE SMART WAY TO TACKLE MYCOTOXINS


MyToolBox-e-platform tool:




 MyToolBox Marcelo Silva 

 Add Field

 Field1  

 Field2

 Field3

New Field

Name

Crop

Previous Crop

Variety


Soil Tillage

Growing Area

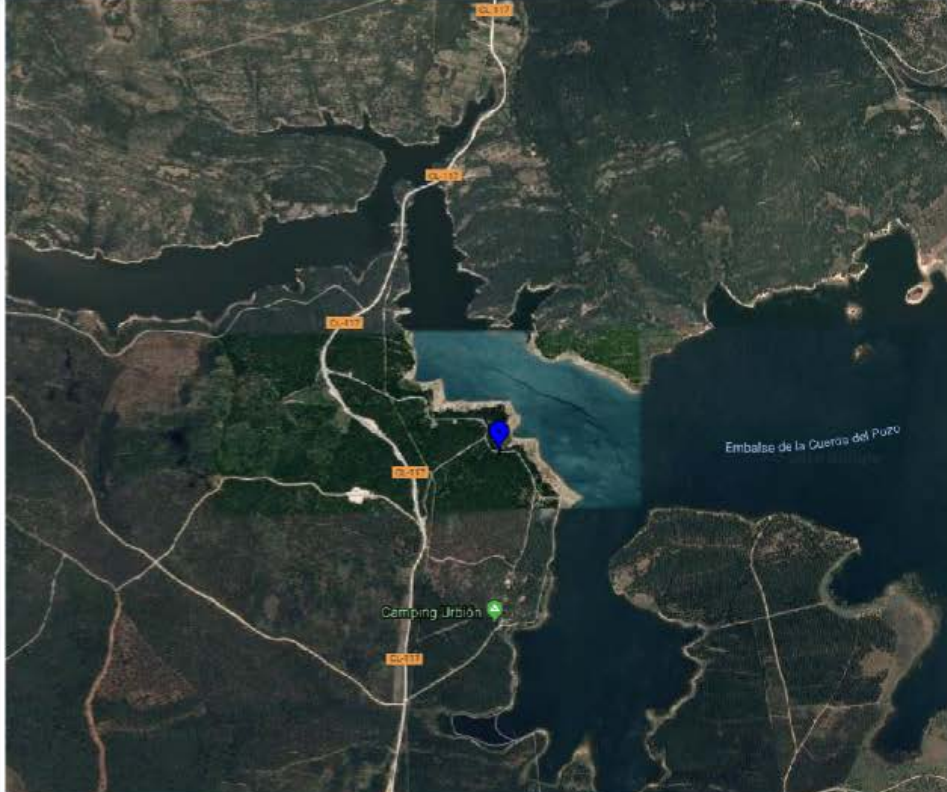
Country

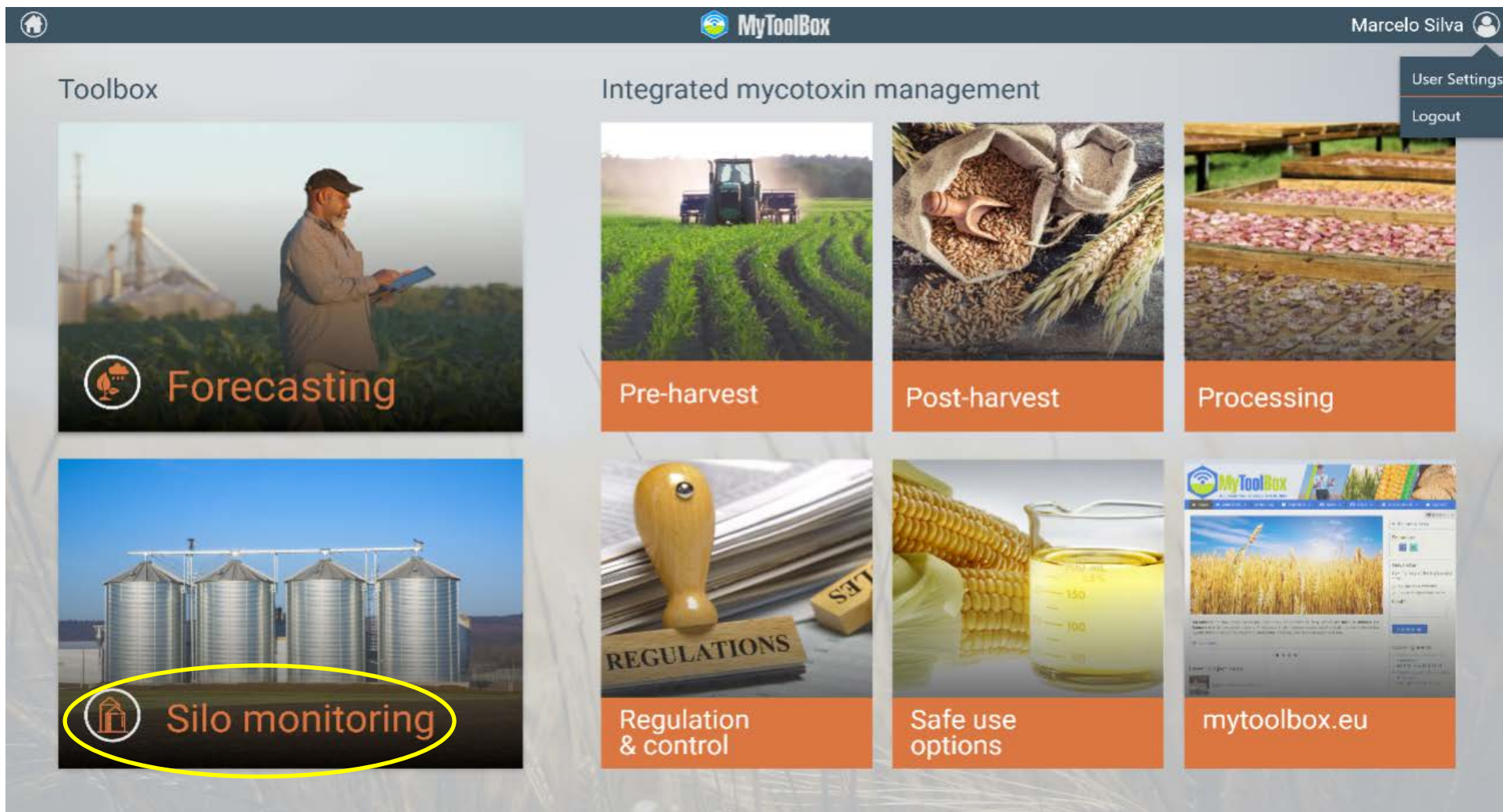
Latitude

Longitude

 Locate Field on Map

Geo Location





The screenshot displays the MyToolBox e-platform interface. At the top, a dark blue header bar contains the MyToolBox logo, the user name "Marcelo Silva" with a profile icon, and a dropdown menu with "User Settings" and "Logout" options. The main content area is divided into two sections: "Toolbox" on the left and "Integrated mycotoxin management" on the right. The "Toolbox" section features two tool cards: "Forecasting" (showing a man in a field with a tablet) and "Silo monitoring" (showing four large metal silos, with the card title and icon circled in yellow). The "Integrated mycotoxin management" section features six tool cards arranged in a 2x3 grid: "Pre-harvest" (tractor in a field), "Post-harvest" (wheat in a sack), "Processing" (wheat in a wooden tray), "Regulation & control" (a wooden gavel on a stack of papers labeled "REGULATIONS"), "Safe use options" (corn cobs and a beaker of yellow liquid), and "mytoolbox.eu" (a screenshot of the website). Each card has an orange base with white text.

MyToolBox

Marcelo Silva

User Settings

Logout

Toolbox

Integrated mycotoxin management

Forecasting

Pre-harvest

Post-harvest

Processing

Regulation & control

Safe use options

mytoolbox.eu

Silo monitoring

Dynamic Post-harvest Decision Tool for Farmer: **Silo Monitoring**



Sensors

- Moisture
- Temperature
- Carbon dioxide



Prediction sent
to silo manager



MyToolBox-e-platform tools:



MyToolBox

Marcelo Silva


⊕ Add Facility

- MyFacility1
- Silo1**
- Silo2
- MyFacility2
- MyFacility3

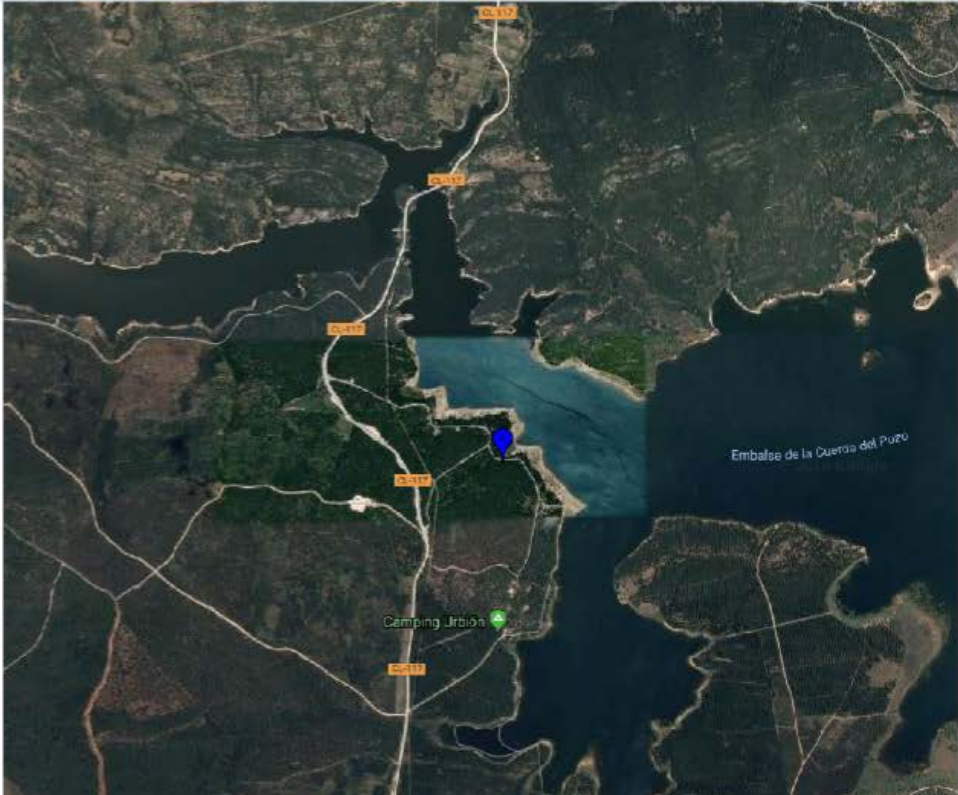
New Facility

Name:

Latitude: Longitude:

 Locate Facility on Map

Geo Location



Embalse de la Cuenca del Pozo

Camping Urbión



MyToolBox将有助于在欧盟和中国创造公开透明的食品饲料供应链。我们将在多方面交换信息并分享经验，包括生物防治的生成与应用（合作方：农科院农产品加工所刘阳教授）、预测模型以及在谷物和花生存储过程中对环境因素的在线检测（合作方：国家粮食局科学研究院王松雪博士）。

作为MyToolBox与中国长期战略合作的一部分，我们将建立一个欧盟-中国-真菌毒素论坛。该论坛视为中国和欧盟之间的对话平台，同时为欧盟和中国间进一步在食品安全上的合作打下基础。欧盟-中国-真菌毒素论坛将由刘阳教授和MyToolBox项目协调员Rudolf Krska教授共同主持，国际谷物科学与技术协会现任会长Wang Fengcheng教授协同主持。

我们的合作伙伴关系，也将有助于授权中国饲料添加剂中真菌毒素解毒的标准设定。现行的欧盟饲料添加剂解毒的指导方针，将作为中国在该方面立法的范例。该立法具有重要性，因为中国目前人工养殖近4.75亿头猪，占世界人工养殖猪数目的60%，由此估计中国需要超过54,000吨的解毒剂。

通过MyToolBox项目成立的欧盟-中国合作伙伴关系，将有助于为进口到欧盟出口到中国的食品饲料，建立公开透明的供应链，从而对食品安全和消费者的信心带来深远的影响。

通过MyToolBox项目成立的欧盟-中国合作伙伴关系，将有助于为进口到欧盟出口到中国的食品饲料，建立公开透明的供应链，从而对食品安全和消费者的信心带来深远的影响。

[Partners Area](#)

Latest project news



Pre-harvest
mycotoxin reduction
strategies in Serbia



Partners:



This project has received funding from the European Union's [Horizon 2020 research and innovation programme](#) under grant agreement No 678012.

[Legal notes](#)

48 months (Mar. 2016 - Feb. 2020)

5 Mio. € funding



23 partners

11 countries

Developed by [ICC](#)

Visual identity by [IRIS](#)



Follow us:  

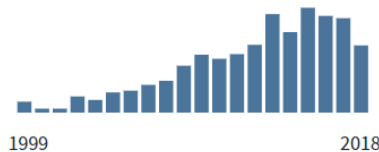
Backbone: Multi-toxin determination 2005-2018



- LC-ESI-MS/MS
- > 600 fungal, plant and bacterial metabolites
- no clean-up
- LOD deoxynivalenol: 0.3 pg

Total Publications

1.818 Analyze



h-index

84

Average citations per item

24,54

Sum of Times Cited

44.611

Without self citations

30.359

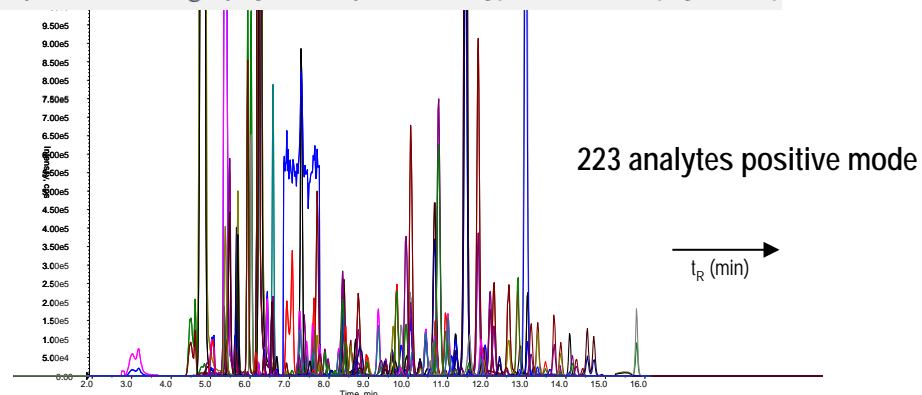
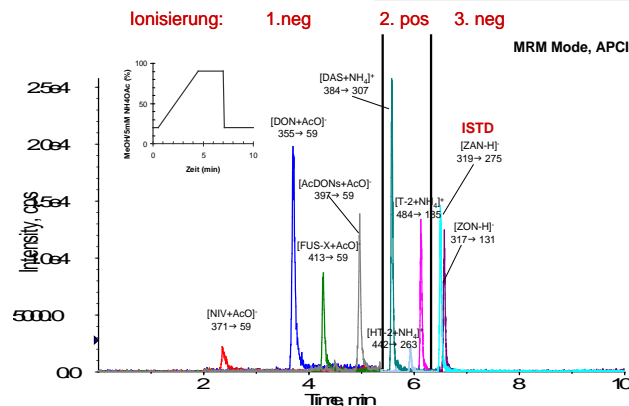
Citing articles

16.701 Analyze

Without self citations

15.032 Analyze

You searched for: TOPIC: (liquid chromatography mass spectrometry) AND TOPIC: (mycotoxin*)



The chemical structures of 87 mycotoxins

Anal Bioanal Chem (2007) 389:1505–1523
DOI 10.1007/s00216-007-1542-2

ORIGINAL PAPER

A liquid chromatography/tandem mass spectrometric multi-mycotoxin method for the quantification of 87 analytes and its application to semi-quantitative screening of moldy food samples

Michael Sulyok · Rudolf Krska · Rainer Schuhmacher

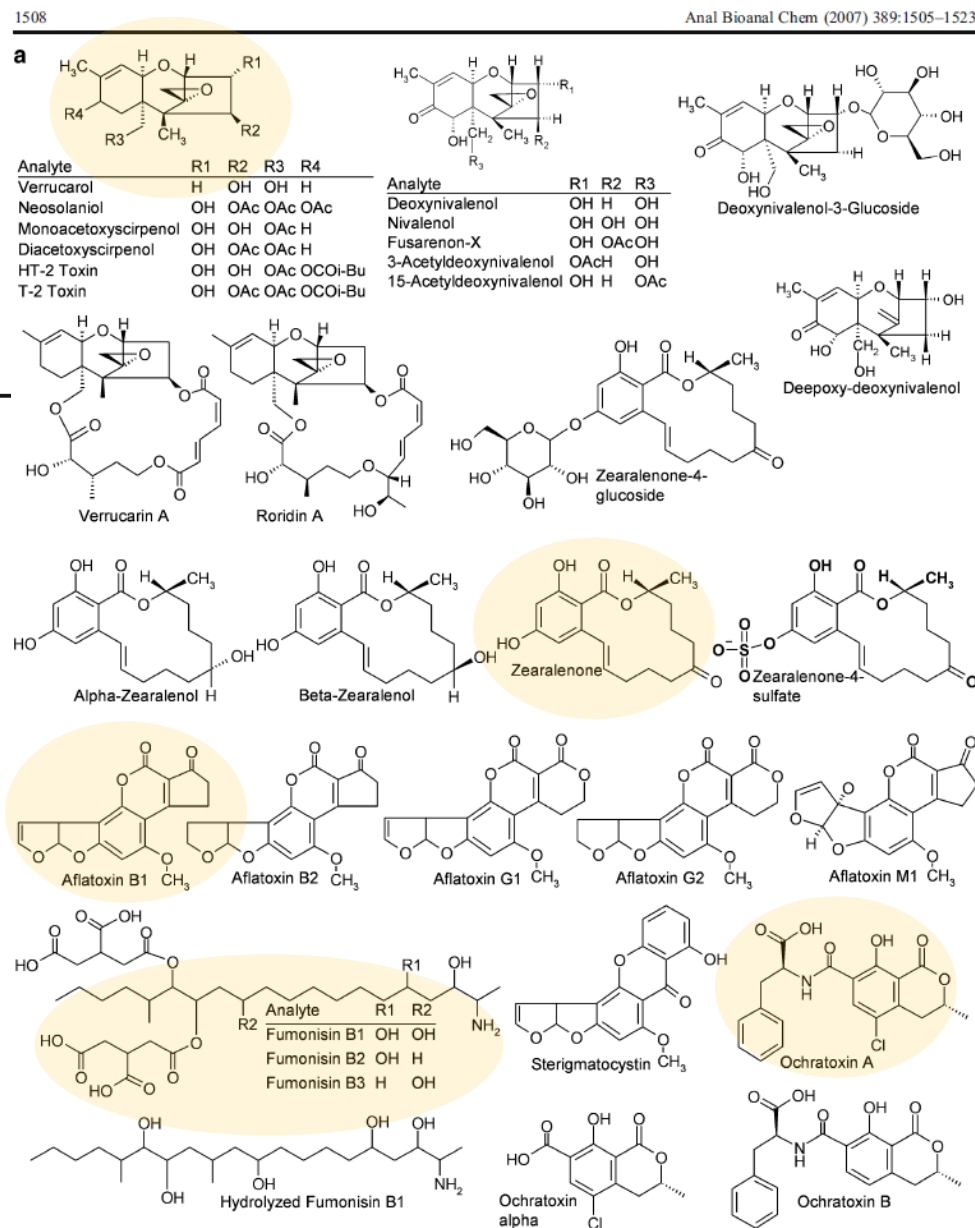
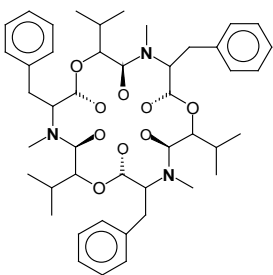
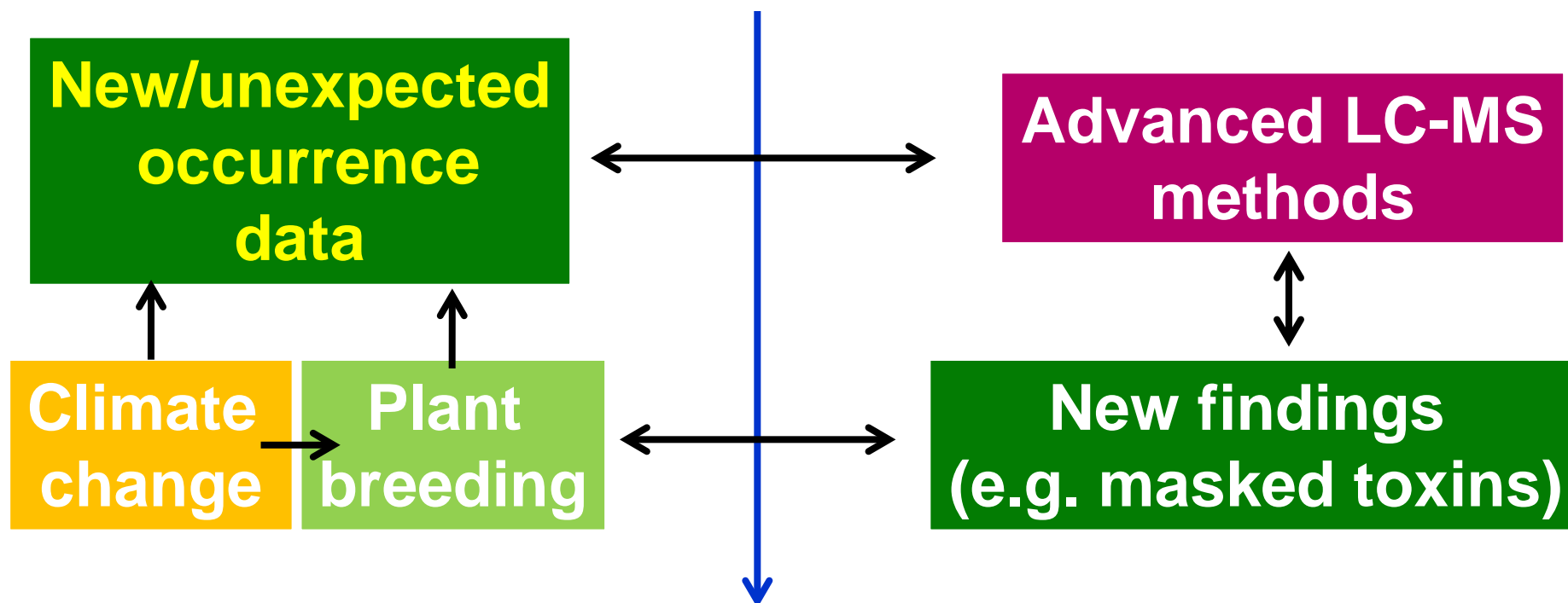


Fig. 1 a–c Chemical structures of the investigated compounds



Emerging Mycotoxins



What is Overlooked in Routine Analysis?

Masked Mycotoxins, Emerging Mycotoxins, Other Fungal Metabolites

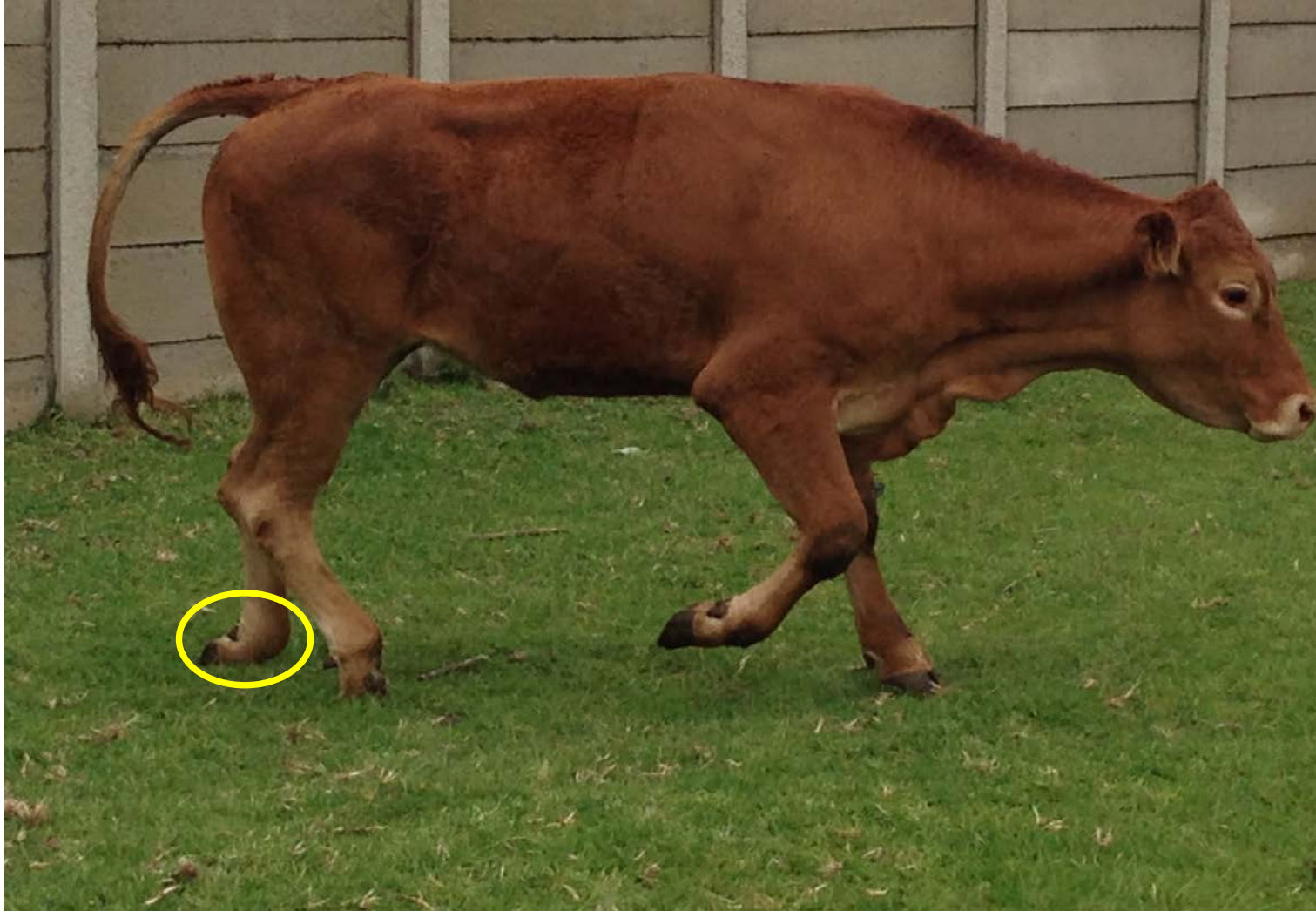
Article

Co-Occurrence of Regulated, Masked and Emerging Mycotoxins and Secondary Metabolites in Finished Feed and Maize—An Extensive Survey

Paula Kovalsky ^{1,†}, Gregor Kos ^{2,†}, Karin Nährer ¹, Christina Schwab ¹, Timothy Jenkins ¹, Gerd Schatzmayr ¹, Michael Sulyok ^{3,*} and Rudolf Krska ³

- 1926 samples from 52 countries
- Results indicate that **considerably more than 25%** (FAO figure)
- of agricultural commodities **could be contaminated with mycotoxins**
- ...also due to lower LOQs
- Observed contamination percentages:
 - **88% for Zearalenone**
 - **7-79% for B-trichothecenes**

Multi-Toxin-Case Study: Semi-automated production of sprouted barley in Pretoria as feed for cattle



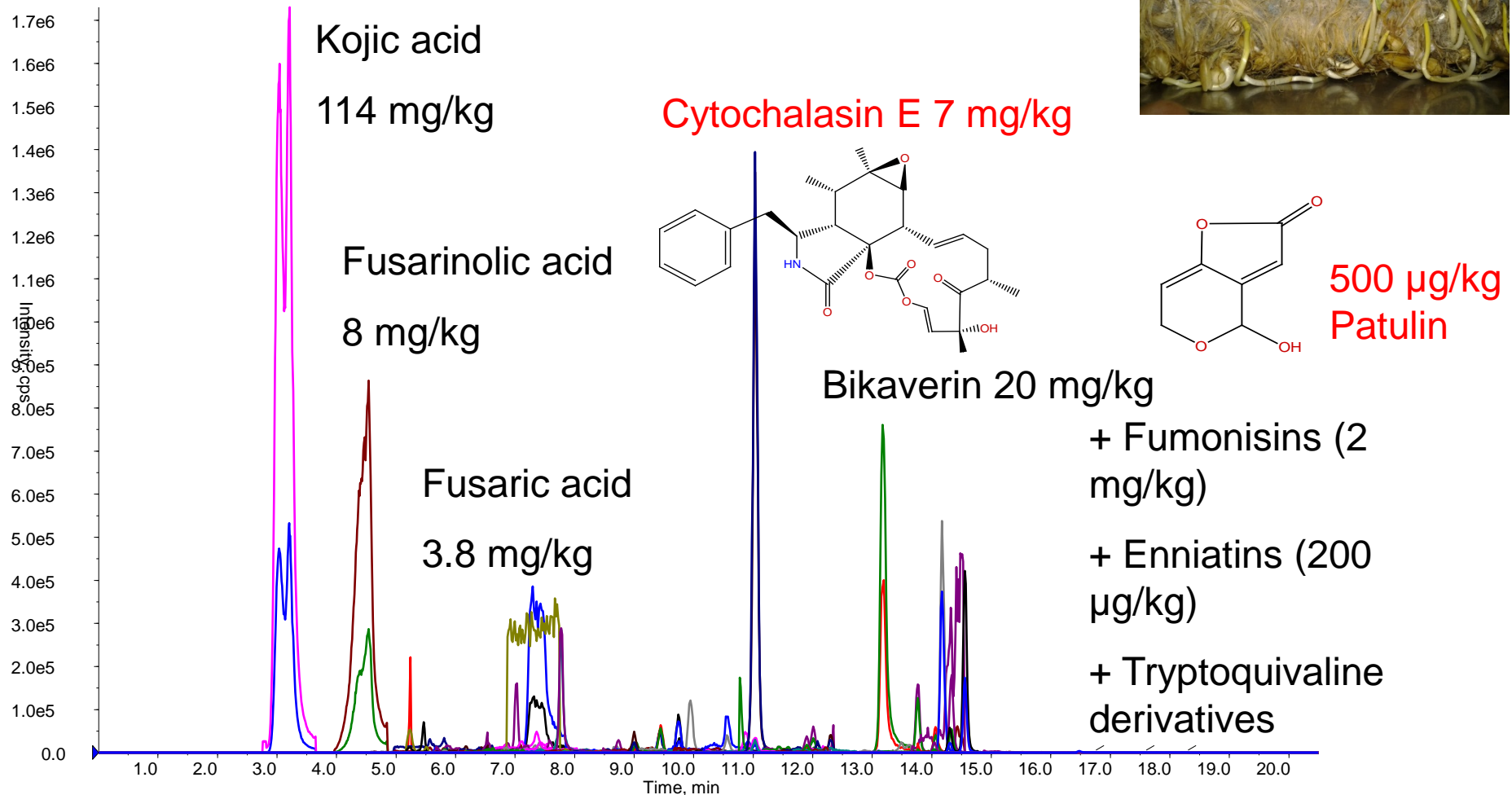
Diagnosis: **Tremor**

Case study: Semi-automated production of sprouted barley in Pretoria



Case study: Sprouted barley in Pretoria as feed

LC-MS/MS (+/-) analysis of barley seed grass



NFSCCLN



Health
Canada

Santé
Canada

Rudolf Krska, Ph. D.

Chief Food Research Division
Bureau of Chemical Safety
Food Directorate
Health Products and Food Branch

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Tel: (613) 946-9680 Fax: (613) 941-4775
Email: rudolf_krska@hc-sc.gc.ca

Canada





The Canadian Total Diet Study

- Since 1969 the **TDS** provides estimates of levels of exposure to contaminants (and nutrients) that Canadians are exposed to through the food supply
- **Procedure:**
 - Some 900 food items are purchased at 4 different stores in one Canadian city/year within 5 weeks
 - Preparing the specific food as they 'would be consumed' in the average household kitchen following common recipes
 - Processed foods are finally combined and homogenized to make **~160 food composite samples**
 - **=> very low detection limits required**





The Canadian Total Diet Study

- E.g. composite “**Bread, whole wheat**”: 450 g loaf purchased in 4 stores. Toasted and non-toasted bread combined and well homogenized
- Then analysed for the presence of toxic and nutritionally important chemicals
- Analysed levels are used with food consumption data to provide **estimates of dietary intakes** of these chemicals by Canadians



Retail Sampling for surveys

- **Determination of market share acc. to available ACNielsen data**
- where sample members report all retail purchases through scanning the barcodes on all their purchases
- Then **Random Sampling** weighted by market share
- If list of brands is short (e.g. corn flakes), a **targeted survey** for these products or a combination of “AC Nielsen” sampling and survey can be done



Retail sampling plan based on number of categories (e.g. 40 different breakfast cereals) and the total number of analyses that can be managed



R-TDS institutional framework (international)

CPC was designated by FAO and WHO to coordinate the WTO funded Regional Total Diet Study in Benin, Cameroon, Mali and Nigeria 2014-2018



Food and Agriculture Organization
of the United Nations



World Health
Organization





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Contents lists available at ScienceDirect

Food and Chemical Toxicology

journal homepage: www.elsevier.com/locate/foodchemtox



Methodology design of the regional Sub-Saharan Africa Total Diet Study in Benin, Cameroon, Mali and Nigeria



Luc Ingenbleek^{a, b}, Eric Jazet^c, Anaclet D. Dzossa^c, Samson B. Adebayo^d, Julius Ogungbangbe^e, Sylvestre Dansou^f, Zima J. Diallo^g, Christiant Kouebou^h, Abimbola Adegboye^d, Epiphane Hossouⁱ, Salimata Coulibaly^j, Sara Eyangoh^a, Bruno Le Bizet^b, Philippe Verger^k, Jean Kamanzi^l, Caroline Merten^l, Jean-Charles Leblanc^{l, *}

^a Centre Pasteur du Cameroun (CPC), Yaounde, Cameroon

^b IUNAM Université, Oniris, LABERCA, Nantes, France

^c National Institute for Statistics (NIS), Yaounde, Cameroon

^d National Agency for Food and Drug Administration and Control (NAFDAC), Abuja, Nigeria

^e National Bureau of Statistics (NBS), Abuja, Nigeria

^f Institut National de la Statistique et de l'Analyse Economique (INSAE), Cotonou, Benin

^g Institut National de la Statistique (INSTAT), Bamako, Mali

^h Institut de Recherche Agronomique pour le Développement (IRAD), Yaounde, Cameroon

ⁱ Agence Béninoise de Sécurité Sanitaire des Aliments (ABSSA), Cotonou, Benin

^j Agence Nationale pour la Sécurité Sanitaire des Aliments (ANSSA), Bamako, Mali

^k World Health Organization (WHO), Geneva, Switzerland

^l Food and Agriculture Organization of the United Nations (FAO), Rome, Italy

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Core food

Total diet study

Sampling plan

ABSTRACT

The core food model was described more than three decades ago, and has been used ever since to identify main food contributors to dietary intakes for both nutrients and other food chemicals. The Sub-Saharan Africa Total Diet Study (SSA-TDS) uses this model to describe the food consumption habits of some selected populations of Benin, Cameroon, Mali, and Nigeria, prior to use in the completion of quantitative risk assessments with regard to food chemicals. Food consumption data were derived from food expenditure data contained in national household budget surveys that were provided by the national institutes of statistics in each country. A classification of African foods was established for the purpose of the study and core foods were selected, so as to reflect $96 \pm 1\%$ of the average national total diet expressed in weight. Populations from eight study centers were selected by national stakeholders. This approach involves the purchase of 4020 individual foods, prepared as consumed and pooled into 335 food composite samples, for analysis of mycotoxins, PAHs, PCBs and dioxins, pesticides, metals and trace elements, PFAs, and BFRs. This sampling plan aims to provide a representative, cost effective, and replicable approach for deterministic dietary exposure assessments in developing countries.

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Kitchen laboratory in Yaoundé



FOR MORE INFORMATION

For more information, please contact the Scientific Committee Secretariat

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Dr Jean-Charles Leblanc (FAO)

Email : JeanCharles.Leblanc@fao.org

Dr Philippe Verger (WHO)

Email : vergerp@who.int



The biomarker approach



Contaminated food commodities



Contaminated food



Intake – Dietary Exposure



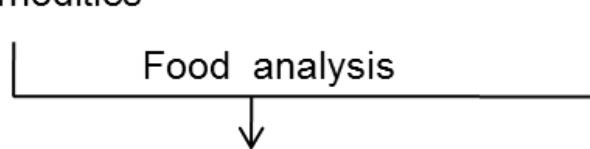
Urine collection



Urinary biomarker analysis



Determination by LC-MS/MS multi-analyte method



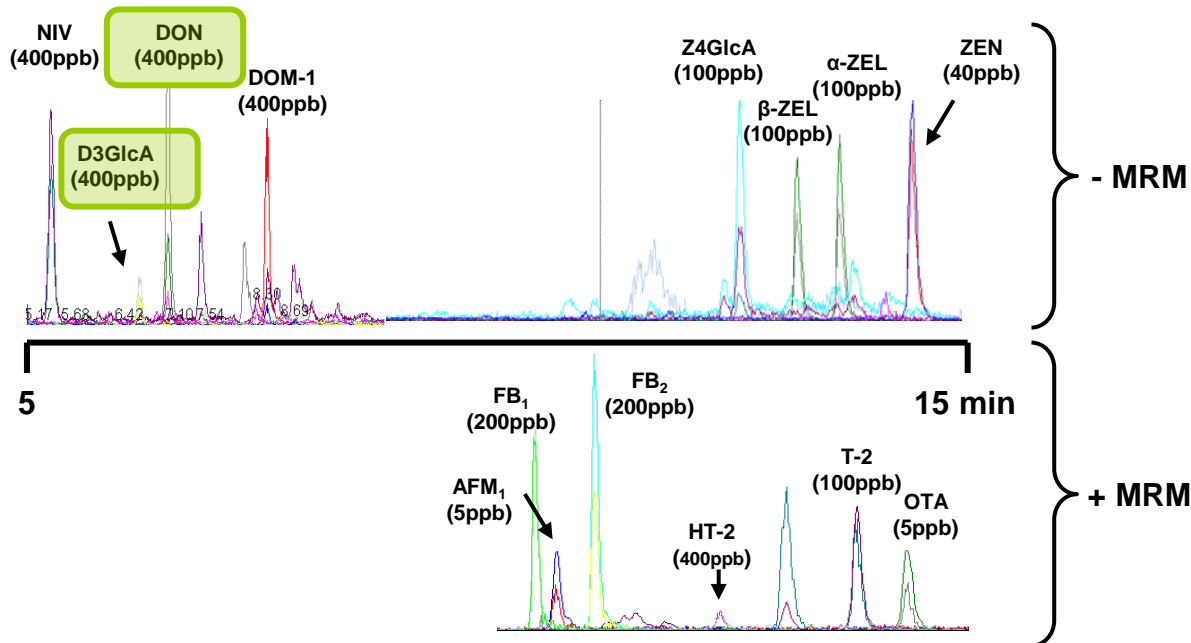
Assessing mycotoxin co-exposure through urine analysis

LC-MS/MS Dilute & Shoot Approach:

- 1 ml urine centrifuged and diluted 1:10 with ACN/H₂O (10/90)
- ¹³C-DON as Internal Standard

LOD values

- DON: 4 ng ml⁻¹ (**0.05 ng ml⁻¹** after PRiME HLB® SPE column)



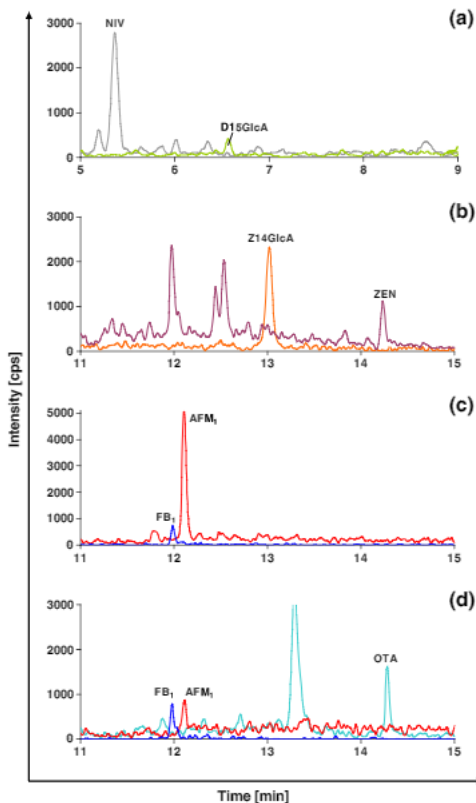
LC: Agilent 1290
MS: AB Sciex QTrap® 5500
Column: Atlantis T3, 3 μ m
Flow: 0.6 ml min⁻¹
Eluents: H₂O/ACN + 0.1% HAc

Chromatograms of a urine sample spiked with **15 mycotoxins** and key metabolites.

Biomarker study in Cameroon



- **175 volunteers** tested on mycotoxin biomarkers
- **Urine collected** from healthy persons (n=30) and persons living with HIV (n=145) from Yaounde and Bamenda

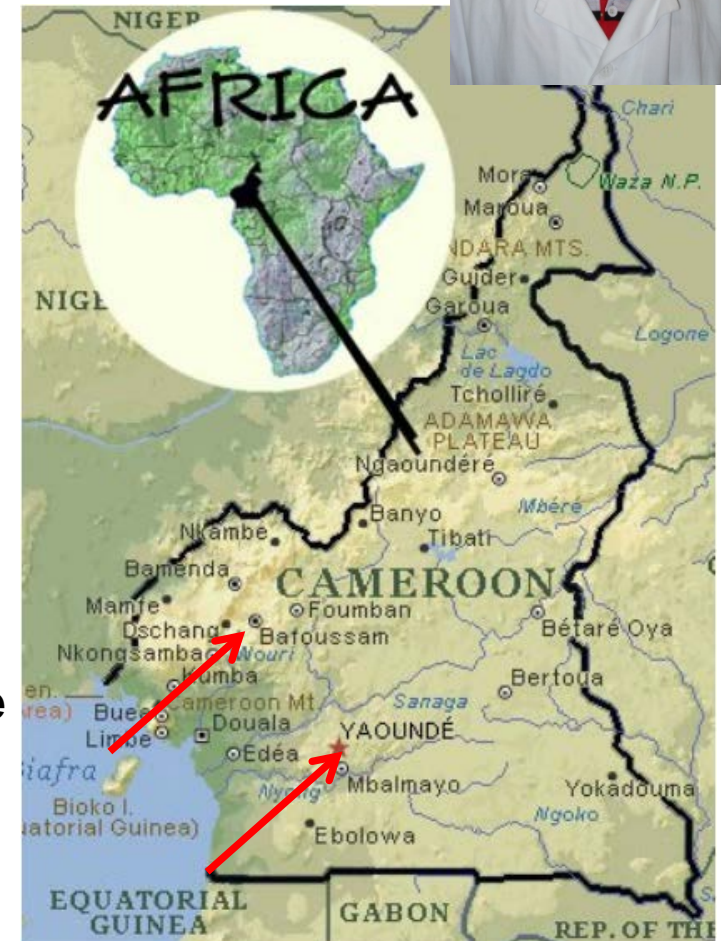


→ **Six mycotoxins and metabolites** determined in one urine sample simultaneously

→ **In total, 11 biomarkers were detected**



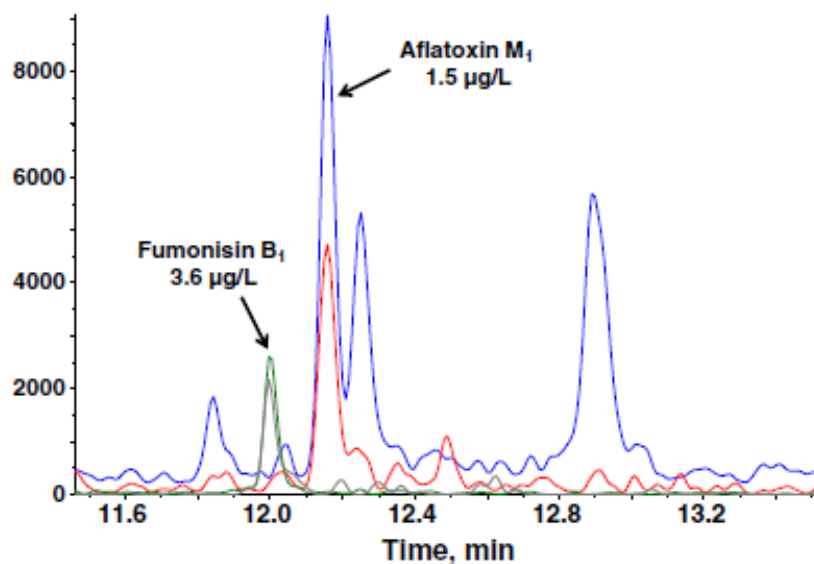
B. Warth, R. Krska et al.



Mycotoxin exposure in rural residents in northern Nigeria: A pilot study using multi-urinary biomarkers



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SRM of biomarkers found in the
urine sample breastfeeding mother

Ultra-sensitive, stable isotope assisted quantification of multiple urinary mycotoxin exposure biomarkers

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- = multi-mycotoxin exposure assessment in human bio-fluids based on UPLC-MS/MS and labelled IS
- using de-glucuronidation of mycotoxin metabolites, Oasis PRiME HLB® SPE columns (Waters)
- => stable isotopes provided superior compensation for matrix effects
- => significantly higher sensitivity

Entering the ppq levels in mycotoxin biomarker analysis

Babcock University, Ilishan, Ogun States

Comparison of the results

| Mycotoxins | Number (%) positive | Concentration (ng/mL) | | | |
|---------------|---------------------|-----------------------|------|----------|--------|
| | | Maximum | Mean | Std Dev. | Median |
| AFM1 2012 | 17 (14.2) | 1.54 | 0.34 | 0.45 | 0.08 |
| AFM1 2015 | 87 (72.5) | 0.62 | 0.04 | 0.08 | 0.01 |
| AOH | 8 (6.7) | 0.20 | 0.06 | 0.06 | 0.03 |
| CIT | 79 (65.8) | 241.5 | 5.96 | 27.43 | 0.84 |
| DHC | 69 (57.5) | 16.89 | 2.39 | 3.56 | 1.00 |
| DON 2012 | 6 (5) | 6.84 | 2.56 | 2.31 | 1.67 |
| DON 2015 | 23 (19.2) | 6.22 | 2.37 | 1.88 | 1.79 |
| FB1 2012 | 16 (13.3) | 12.77 | 4.56 | 2.82 | 3.84 |
| FB1 2015 | 85 (70.8) | 14.88 | 1.09 | 2.04 | 0.48 |
| NIV | 40 (33.3) | 3.02 | 0.95 | 0.60 | 0.75 |
| OTA 2012 | 34 (28.3) | 0.56 | 0.15 | 0.11 | 0.08 |
| OTA 2015 | 94 (78.3) | 0.31 | 0.05 | 0.06 | 0.04 |
| ZEN 2012 | 13 (10.8) | 6.84 | 3.13 | 2.28 | 2.40 |
| ZEN 2015 | 98 (81.7) | 19.99 | 0.75 | 2.59 | 0.20 |
| α -ZEL | 5 (4.2) | 2.52 | 1.27 | 0.87 | 0.87 |
| β -ZEL | 7 (5.8) | 2.74 | 0.88 | 1.08 | 0.33 |



Summary and Outlook



- **International cooperation** is crucial to control and mitigate the mycotoxin issue world wide
- **Entire food and feed chains shall be considered involving end users**
- Safe use options of mycotoxin contaminated batches include the production of **biofuels**
- **New ultrasensitive biomarker LC-MS/MS method** enables improved mycotoxin exposure assessment quantifiable results increase from 50% to 100%
- More **funding** for EU-Africa- and EU-China cooperations in the area food safety is needed
- Management programs that optimise both the mitigation-method's (e.g. biocontrol) long-term revenue and the area-wide benefit

[www.ifa-tulln.boku.ac.at/
mycotoxin-summer-academy/](http://www.ifa-tulln.boku.ac.at/mycotoxin-summer-academy/)



MYCOTOXIN SUMMER ACADEMY



2018



University of Natural Resources and
Life Sciences, Vienna - Austria
Department for Agrobiotechnology (IFA-Tulln)



Thanks for listening!

Biomim



incl. 1 week LC-MS-training

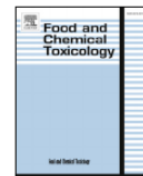
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Assessing the mycotoxicological risk from consumption of complementary foods by infants and young children in Nigeria



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REVIEW



Advanced LC–MS-based methods to study the co-occurrence and metabolism of multiple mycotoxins in cereals and cereal-based food

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Open Post Doc Position



University of Natural Resources and Life
Sciences, Vienna
Department of Agrobiotechnology,
IFA-Tulln

- Project Aquascreen (see BOKU FIS) biostability of water in storage and supply
- 8 months, 30 h/week (~2720 € monthly)
- Detm. of volatile substances in water
- Training in high-resolution ICP-MS



Requirements:

- Experience in CG-MS, ideally Agilent Mass Hunter Software
- Knowledge in QA/QM
- Scientific publications



Contact



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www.multicoop.eu



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