EFSA mycotoxin occurrence, data request & exposure assessment

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EFSA mycotoxin occurrence, data request & exposure assessment

EFSA – European Food Safety Authority

"Europeans enjoy one of the highest levels of food safety in the world."

"ensures safe, healthy food for consumers → field to fork"

efsa
European Food Safety Authority

http://www.efsa.europa.eu/

EFSA

- The European Parliament and the Council adopted **Regulation (EC) 178/2002** which sets general principles and requirements of the **General Food Law**
- EFSA is an agency legally established by the EU under the **Regulation 178/2002**
  - Operates independently of the EU Member States
  - Responsible for scientific advice (**risk assessment**) and support (**to communicate on risk to the public**)

„Food is essential to life.
EFSA is working to keep food safe.“

efsa
European Food Safety Authority

http://www.efsa.europa.eu/

EFSA

- The reason to establish agency like EFSA?
- Why do we need risk assessment in food industry?

  - Series of food scandals during the 90's
  - Production and consumption of food is constantly changing
    - Advances in food technology
    - Climate change
    - New eating habits
    - Globalization of trade

efsa
European Food Safety Authority

http://www.efsa.europa.eu/

EFSA

- EFSA → risk assessor
  - Collects and analyzes data, together with EU Member States → European risk assessment is substantiated by the latest, clear scientific information
- Only then the EU legislators (European Commission – EC) will authorize a certain claim

- EFSA's task is also **risk communication**
  - To establish the bridge between science and consumers
  - To provide accurate information on food safety in time!

efsa
European Food Safety Authority

http://www.efsa.europa.eu/

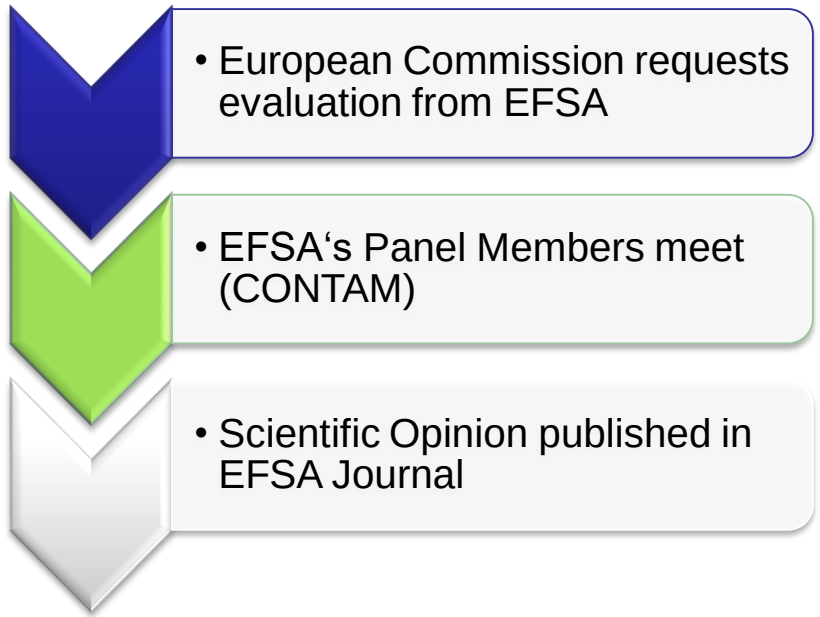
EFSA

- Different Scientific Commitees and Panels
  - Independent scientific experts with a three-year mandate
  - Carry out scientific assessments
  - Some of them AHAW, ANS, BIOHAZ, CONTAM....
    - AHAW – Panel on Animal Health and Walfare
    - ANS – Panel on Food Additives and Nutrient Sources Added to Food
    - BIOHAZ – Panel on Biological Hazards
    - ...

http://www.efsa.europa.eu/

CONTAM

- Panel on Contaminants in the Food Chain (**CONTAM**)
  - Panels engage scientists (chemists, toxicologists, epidemiologists, statisticians, etc. → Panel Members) from all over Europe
  - Gives scientific advices and risk assessment on chemical contaminants like mycotoxins, other natural toxicants, or residues of unauthorized compounds to **EU risk managers**



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CONTAM

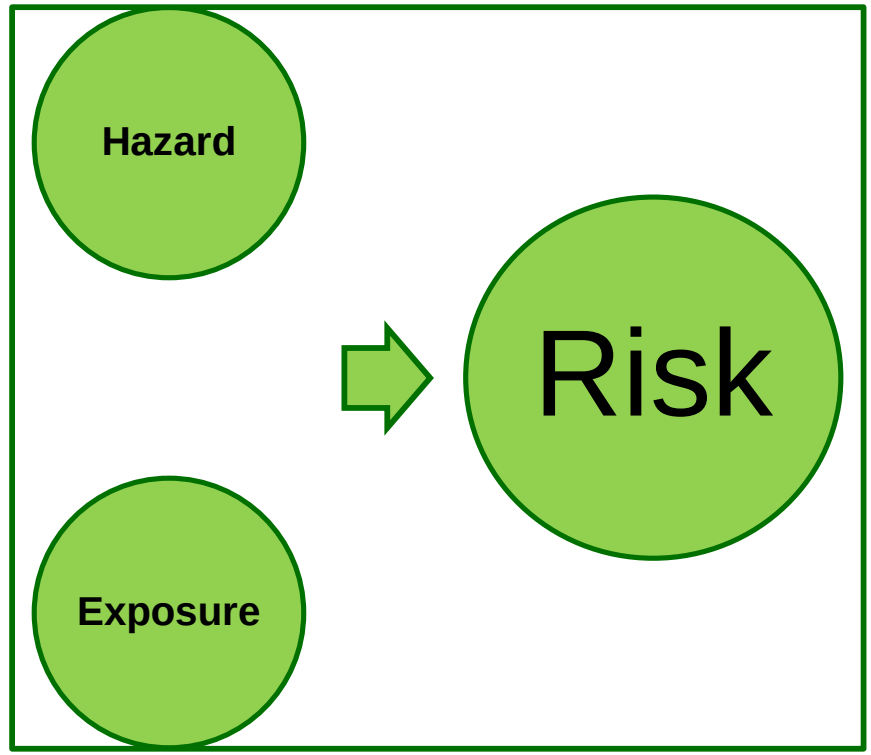
- CONTAM on mycotoxin-contaminated food and feed
  - Assess human and animal exposure (occurrence data)
  - Exposure for specific population groups
  - Exposure of different animal species
  - Evaluate the toxicity of mycotoxins for humans and animals
  - Recommendations for the collection of further data on mycotoxins that enable better risk assessments

- EU legislation
  - EC Regulation → maximum levels for mycotoxins in food and feed
  - EC Recommendations → agricultural, storage and processing procedures

http://www.efsa.europa.eu/

Risk assessment

- 3 pillars of risk analysis:
  - **Risk assessment**
    - Hazard identification
    - Hazard characterization
    - Exposure assessment
    - Risk characterization
  - **Risk management**
  - **Risk communication**



Hazard assessment + exposure assessment

What is the **potential** damage?

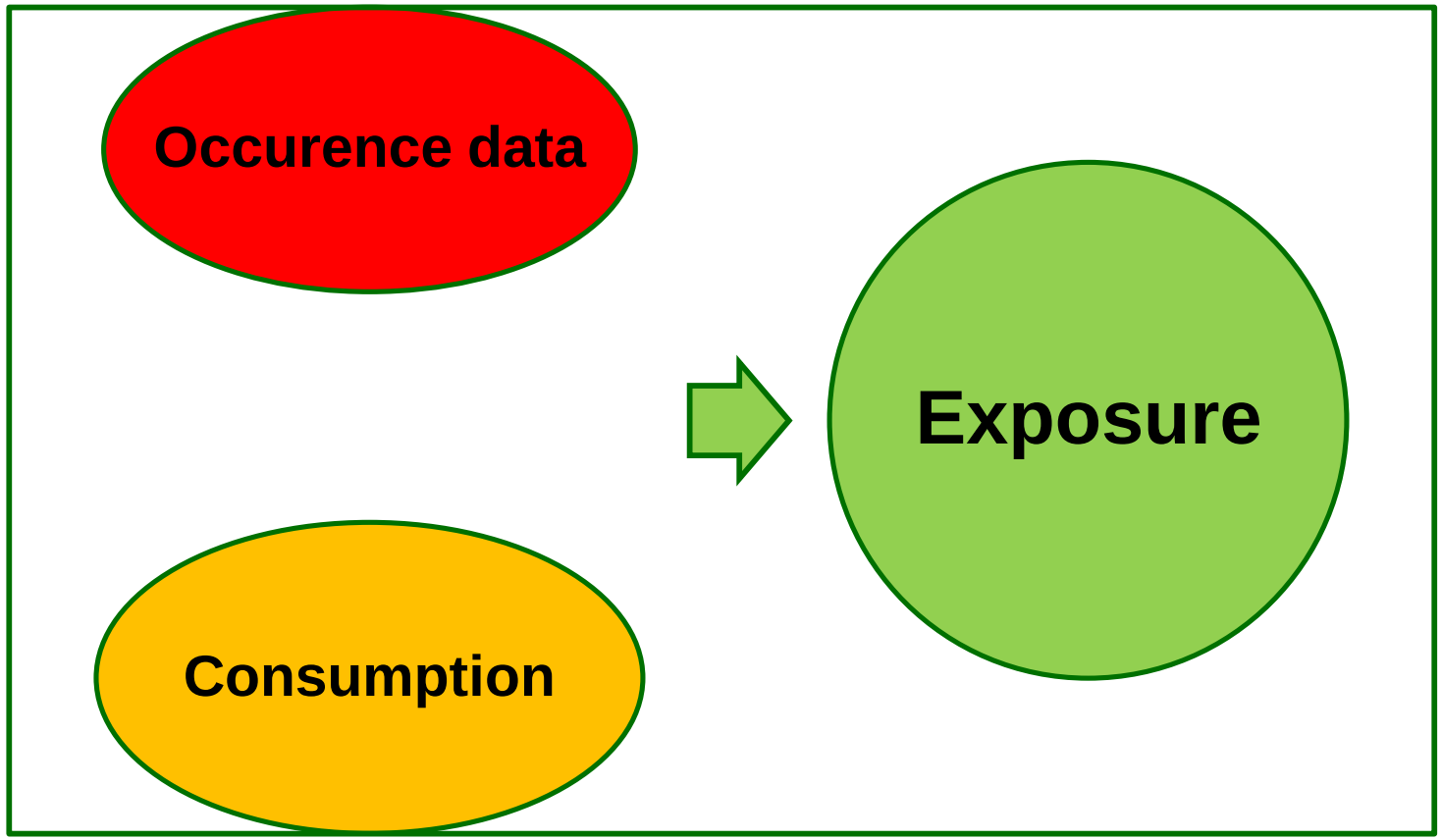
What is the **extent** of damage?

What is the **probability** of damage?

Prof. Dr. S. Godefroy; lecture at IFA-Tulln, 2016

http://www.who.int/en/

Risk assessment



Prof. Dr. S. Godefroy; lecture at IFA-Tulln, 2016
http://www.who.int/en/

Call for data

- Upon receiving request from the EC to deliver scientific opinions on risk related to certain mycotoxins calls for data are issued by EFSA

**“Share your data with EFSA.
Contribute to food safety in Europe.”**

- Collected data are extracted by the EFSA data management system and then used for writing future EFSA scientific opinions

http://www.efsa.europa.eu/

Closed calls for data

- *EU Member States*, *research institutions*, *academia*, *national food authorities*, *industry*, *trade* and any *other stakeholders* **were** invited to submit scientific data on occurrence of any of the following substances:

  - Deoxynivalenol (DON), 3-acetyl-deoxynivalenol (3-Ac-DON), 15-acetyl-deoxynivalenol (15-Ac-DON), DON-3-glucoside (DON-3-Glc) → closed in 2012
  - Nivalenol → closed in November 2010
  - Ergot alkaloids, citrinin, sterigmatocystine, beauvericin, enniatines, phomopsins, moniliformin, diacetoxyscirpenol → closed in January 2011
    - *Deadline extensions for moniliformin and diacetoxyscirpenol*

http://www.efsa.europa.eu/

Open calls for data

- **“Call for continuous collection of chemical contaminants occurrence data in food and feed” → 1. October each year**
  - Among them also for the following mycotoxins
    - Aflatoxins (B_1 in feed and B_1 and total in food, M_1 in dairy)
    - Ochratoxin A
    - Deoxynivalenol (and acetylated derivatives)
    - Zearalenone
    - Fumonisins
    - Patulin
    - T-2 and HT-2
    - Nivalenol
    - Ergot alkaloids
  - This continuous call includes mycotoxins, for which Commission Recommendations for occurence surveillance already exist

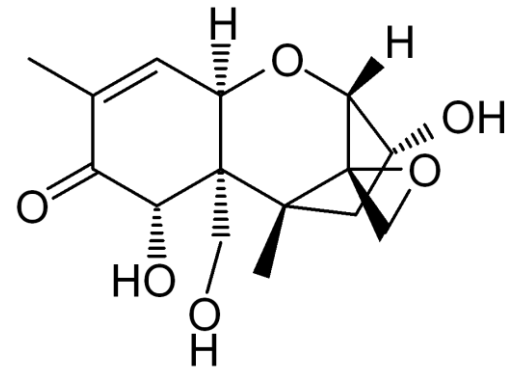
http://www.efsa.europa.eu/

Open calls for data

- **“Main work in progress” → deadline extensions for scientific opinions**
  - Deoxynivalenol, its metabolites and masked deoxynivalenol → 31. January 2017
  - Moniliformin → 31. December 2017
  - Diacetoxyscirpenol → 31. December 2017
    - Deadline extensions for moniliformin and diacetoxyscirpenol → January 2011 → September 2014 → December 2017

https://www.efsa.europa.eu/en/topics/topic/mycotoxins

Deoxynivalenol and its derivatives

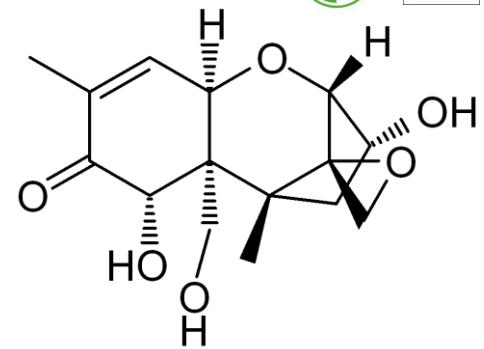


- Trichothecene mycotoxin
- Produced by *Fusarium* fungi
- Contaminate grain and cereal-based food and feed

- In 2002, the Scientific Committee on Food (SCF)
  - TDI → 1 µg/kg BW/day
- In 2010, Joint FAO/WHO Expert Committee on Food Aditives (JECFA) converted TDI for DON into *DON and its derivatives*
  - Provisional maximum tolerable daily intake (PMTDI) → 1 µg/kg BW
  - Acute reference dose (ARfD) → 8 µg/kg BW
- Maximum limits and guidance values were set to decrease the presence of DON in food and feed
  - Maximum level for DON up to 1750 µg/kg

http://www.efsa.europa.eu/
EFSA Journal 2013; 11(10):3379

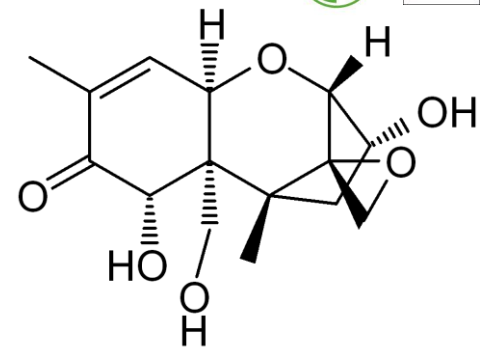
Deoxynivalenol and its derivatives



- Data on the presence of DON should to be reported regularly at the European level
- 26 613 analytical results submitted for DON and its derivatives (3-Ac-DON, 15-Ac-DON, DON-3-Glc)
  - By 21 Member State and Norway
  - *Croatia did not submit the results*
  - Samples collected between 2007 and 2012
- At the highest levels, also most frequently DON was found in corn, wheat and oat grains and their food and feed products

http://www.efsa.europa.eu/
EFSA Journal 2013; 11(10):3379

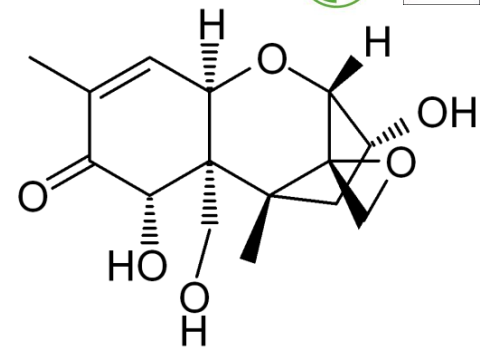
Deoxynivalenol and its derivatives



- Acetylated DON derivatives were not found frequently, also in lower concentrations
  - DON was also present in most of the samples where 3-Ac-DON and 15-Ac-DON were quantified
- Occurrence data for DON-3-Glc submitted by 1 Member State
  - Found in around 5% of samples, almost always with DON
  - Not taken for the exposure assessment
- Main contributors to chronic exposure were bread and rolls
  - 30.9% to 72.3% of total exposure

http://www.efsa.europa.eu/
EFSA Journal 2013; 11(10):3379

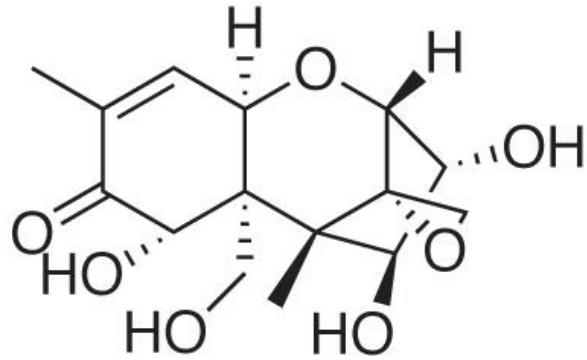
Deoxynivalenol and its derivatives



- Main contributors to acute exposure grain milling products, bread and rolls, fine bakery ware and raw pasta
- CONTAM recommendations
  - Harmonize the sampling
  - Further data on 3-Ac-DON, 15-Ac-DON, and DON-3-Glc to characterize their contribution to the total exposure
  - Precise food description when submitting to EFSA
  - Report only one result which is considered most accurate when one sample analyzed using different analytical methods

http://www.efsa.europa.eu/
EFSA Journal 2013; 11(10):3379

Nivalenol (NIV)

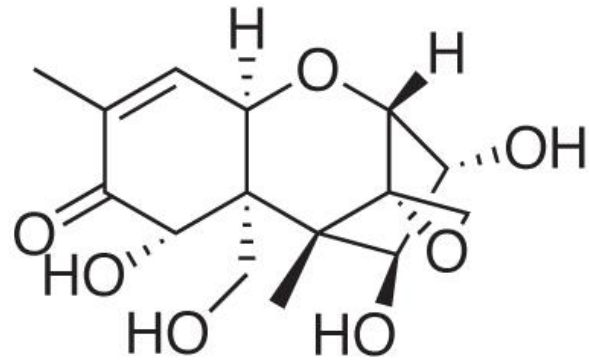


- Trichothecene mycotoxin
- Produced by *Fusarium* genus fungi
- Causes general toxicity, haematotoxicity and immunotoxicity

- In 2000, the Scientific Committee on Food
  - Temporary tolerable daily intake (t-TDI) → 0.7 µg/kg BW/day
- Almost 15 000 results were submitted
  - by 18 European countries
- CONTAM Panel evaluated 13 164 data on food, feed, and unprocessed grains for the Scientific Opinion

http://www.efsa.europa.eu/
EFSA Journal 2013; 13(6):3262

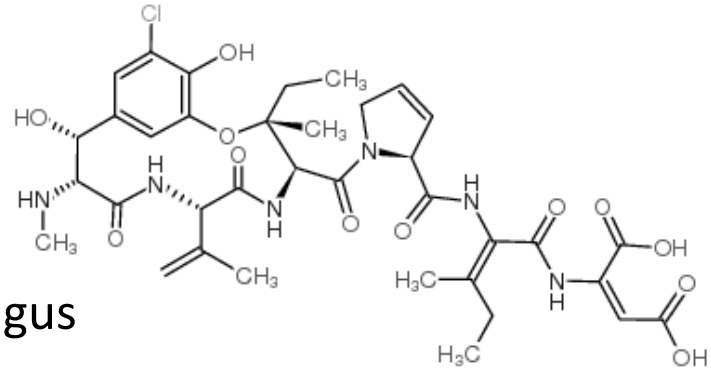
Nivalenol (NIV)



- Based on available occurrence data and estimation of chronic dietary exposures → NIV is not of health concern in 17 European countries
  - Highest mean concentrations observed in oats, maize, barley, wheat and their products
- NIV is unlikely genotoxic, therefore TDI was set
  - TDI → 1.2 µg/kg BW/day

http://www.efsa.europa.eu/
EFSA Journal 2013; 13(6):3262

Phomopsins

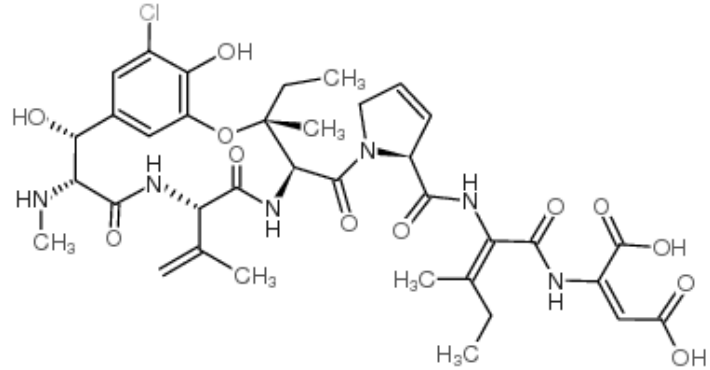


- Produced by *Diaporthe toxica* fungus
- Main host for fungus are lupins
  - Mainly animal consumption, but also for human consumption
- Phomopsin toxicosis (lupinosis) → "disease of sheep"
- Lupinosis reported also in cattle, goats, donkeys, horses and pigs

- No data submitted to EFSA
  - Exposure assessment was not possible
- No data from animal trials → no conclusions on the toxicokinetics
- **So far → the oral LD_{50}**
  - Sheep: 1.0 – 1.3 mg/kg BW
  - Nursling rats: 35 mg/kg BW

http://www.efsa.europa.eu/
EFSA Journal 2012; 10(2):2567

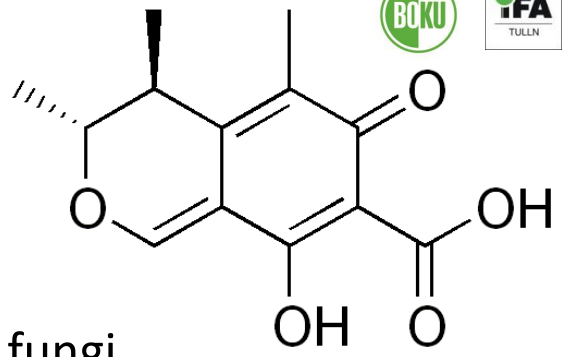
Phomopsins



- No risk assessment for either humans or livestock
  - Dose-response information on toxicities missing
  - Exposure/occurence data missing
- CONTAM recommendations
  - Validate analytical methods for identification and quantification of phomopsins in food, feed, biological animal samples (from animal trials)
  - Collect data on the contamination in lupin-based food and feed with phomopsins
  - Estimate the consumption by human population and animals

http://www.efsa.europa.eu/
EFSA Journal 2012; 10(2):2567

Citrinin (CIT)

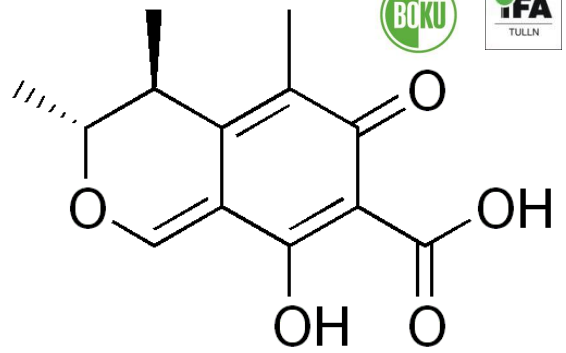


- Produced by *Aspergillus*, *Penicillium* and *Monascus* fungi
- Nephorotoxic mycotoxin
- Instabile in various organic solvents and heat sensitive

- Only results for 30 samples submitted to EFSA
  - By 1 Member State
  - Samples collected in period from 2006 to 2008
  - EFSA investigated CIT occurrence reported in the literature
- CONTAM Panel concluded no-observed-adverse-effect level (NOAEL) of 20 µg/kg BW/day
  - A 90-day toxicity study in rats

http://www.efsa.europa.eu/
EFSA Journal 2012; 10(3):2605

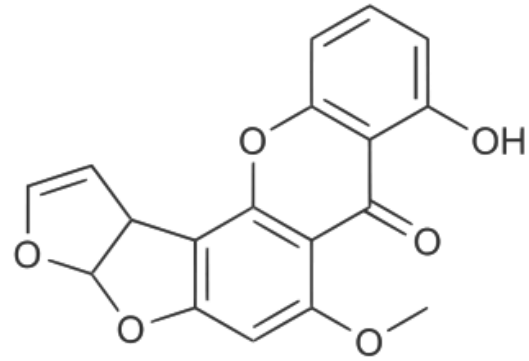
Citrinin (CIT)



- Risk assessment not possible
  - Not only grain and grain-based products are source of CIT
  - No conclusion on chronic exposure for nephrotoxicity → not enough data
- CONTAM recommendations
  - Collect more occurrence data
  - Characterize dose-response relationship
  - Have certified reference materials
  - Collect data on carryover of CIT from the feed to animal products for human consumption
  - Validate analytical method in an inter-laboratory study

http://www.efsa.europa.eu/
EFSA Journal 2012; 10(3):2605

Sterigmatocystin (STC)

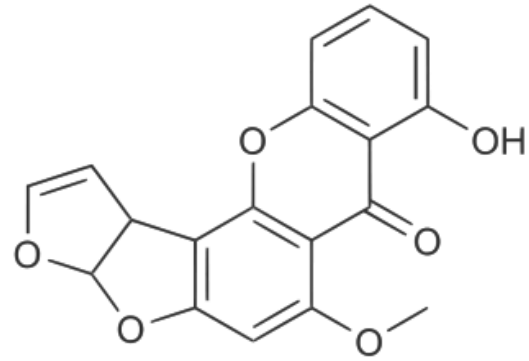


- Produced by *Aspergillus* fungi
- Shares biosynthetic pathway with aflatoxins

- Analytical results from 247 food and 334 feed samples submitted
  - By 2 Member States
- Adsorption of STC is limited after oral exposure
  - Insufficient data to assess the rate of carryover into milk
  - No information about carryover into meat or eggs
- Toxicity
  - Oral LD_{50} between 120 and 166 mg/kg BW
  - Target organs liver and kidneys
  - Genotoxic and carcinogenic

http://www.efsa.europa.eu/
EFSA Journal 2013; 11(6):3254

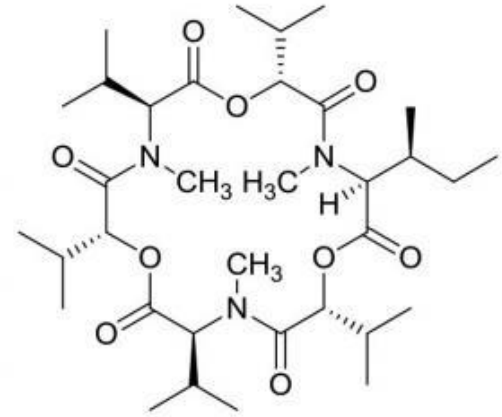
Sterigmatocystin (STC)



- Risk characterization not possible
  - Absence of exposure data
  - An exposure to grains and their products of low health concern **would** range from 1.5 to 8 µg/kg
  - Bench Mark Dose Low ($BMDL_{10}$) of 0.16 mg/kg BW/day were calculated
- CONTAM recommendations
  - Occurrence data necessary for risk characterization
  - Methods with an LOQ lower than 1.5 µg/kg
  - Certified reference material needed
  - Proficiency tests to support analytical methodology

http://www.efsa.europa.eu/
EFSA Journal 2013; 11(6):3254

Beauvericin and enniatins (ENNs)



- Produced by *Fusarium* fungi species
- Predominantly contaminate cereal grains
- Cyclic hexadepsipeptides
  - 29 naturally occurring analogue enniatins identified

- 2147 analytical results for beauvericin and 10 538 for ENNs in food, feed, and unprocessed grain submitted
  - By 12 European countries
  - Sum of four enniatins (A, A1, B, B1) taken for the assessment
  - Samples collected in period between 2000 and 2013

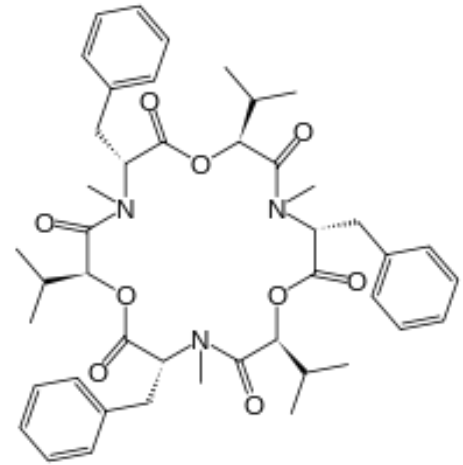
http://www.efsa.europa.eu/
EFSA Journal 2014; 12(8):3802

Beauvericin and enniatins (ENNs)

- The highest mean concentrations of beauvericin found in dried fruits, oilseeds, cereal based food for infants and young children and of ENNs in coffee beans and raw pasta
  - Stable during commercial cereal processing
- Chronic exposure for beauvericin
  - Mean exposure range from 0.003 µg/kg BW/day to 0.050 µg/kg BW/day
- Chronic exposure to sum of ENNs
  - Mean exposure range from 0.42 µg/kg BW/day to 1.82 µg/kg BW/day

http://www.efsa.europa.eu/
EFSA Journal 2014; 12(8):3802

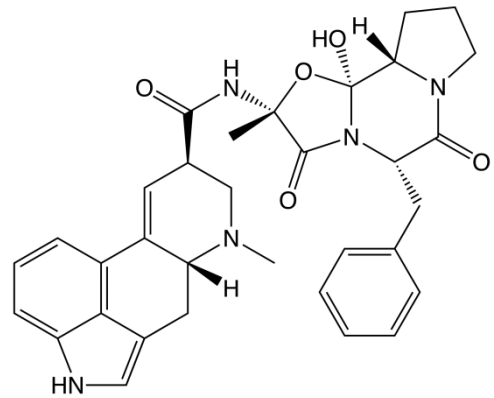
Beauvericin and enniatins (ENNs)



- Insufficient data for TDI or ARfD
- Risk assessment not possible
  - lack of toxicity data
- CONTAM recommendations
  - Inter-laboratory validation studies
  - Development of certified reference materials
  - *In vivo* toxicity data needed
  - Co-occurrence of beauvericin with enniatins confirmed → but further data needed, as well as possible combined effects

http://www.efsa.europa.eu/
EFSA Journal 2014; 12(8):3802

Ergot alkaloids (EAs)

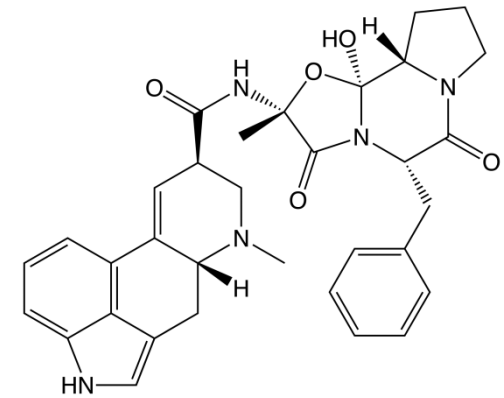


- Produced by sclerotia of *Claviceps* species
- In Europa most common *Claviceps purpurea*
- St. Antony's fire, ergotism
- More than 50 EAs identified

- 25 840 analytical data submitted
  - By 14 European countries
  - All samples collected between 2004 and 2011
  - Selected data based on the presence of 4 most abundant EAs (ergotamine, ergocristine, ergocornine, ergosine)
- The highest concentrations reported in rye grains and rye-based products

http://www.efsa.europa.eu/
EFSA Journal 2012; 10(7):2798

Ergot alkaloids (EAs)



- Chronic exposure
  - Mean exposure range from 0.007 µg/kg BW/day to 0.080 µg/kg BW/day
- EAs can cause acute as well as chronic effects → appropriate to establish both ARfD and TDI
  - ARfD → 1 µg/kg BW
  - TDI → 0.6 µg/kg BW/day
- Available data do not indicate a health concern
- CONTAM recommendations
  - Continuance of collecting analytical data
  - Need for commercially reference standards

http://www.efsa.europa.eu/
EFSA Journal 2012; 10(7):2798

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- **Take home message:**
  1. EC, which is responsible for legislation, **requests Scientific Opinion** from EFSA on certain contaminants (among them mycotoxins)
  2. EFSA opens **call for data** collection → institutions from EU Member States and other European countries are welcome to submit analytical results
     - *Croatia did not submit data for the most prevalent mycotoxin before last Scientific Opinion*
  3. CONTAM Panel members **write Scientific Opinions** on risks regarding mycotoxins in food and feed
  4. New **Directives and Regulations** are **passed** if Scientific Opinions proclaim upcoming risks
  5. With new **Directives and Regulations** **in force** consumers eat safer food

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