



Federal Ministry
of Food
and Agriculture

Feed Safety Risk Management Strategies

German experiences on control of mycotoxins

Reunión sobre Contaminantes y Análisis de Riesgo

Reunión Comité Técnico Mixto – Regulatório y Estrategía 2018-2019

LANAGRO/MAPA – Pedro Leopoldo – MG – Brasil 11 a 16 de diciembre de 2017

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Objectives

- **European safety concept on undesirable substances**
- **Development of risk management strategy**
- **From risk assessment to management strategies for Aflatoxin and other mycotoxins**
- **Recommendations of the European Commission**
- **Decontamination of mycotoxins using detoxification processes or feed additives**
- **Obligations of feed business operators**
- **Official feed control**



European Regulations on Feed Safety

General Food Law - Regulation (EC) 178/2002

Feed additives

Reg. EC 1831/2003

- incl. trace-elements, vitamins,
cocciostats, enzymes

Undesirable
substances in feed
Directive 2002/32/EC

Pesticide residues

Reg. EC 396/2005

-incl. residues of identical
substances used as biocides or
medicines

Feed hygiene

Reg. EC 1831/2005

- registration/approval
- HACCP-principle

Feed marketing

Reg. EC 767/2009

- contaminated materials
- residues of processing aids

Sampling and
analysis of feed

Reg. EC 152/2009

Official Control - Regulation EU 625/2017



Safety Concept of Directive 2002/32/EC



- The provisions apply for **all types of feed**, including additives, premixtures.
- The **maximum level (ML)** applies for the relevant feed type calculated on a **moisture content of 12% (= 88% dry matter)**.
- **Feed exceeding the maximum limits** established in Annex I shall **not be placed on the market or diluted** with the same or other feed.



Safety Concept of Directive 2002/32/EC



- The **ML for complete feed** applies for the **daily ration**.



- The content of undesirable substances in **feed materials and complementary feed** shall not exceed the **maximum limit for the daily ration**, taking into account the intended use of the feed material and complementary feed.



- Feed exceeding a maximum limit may be **decontaminated by cleaning or detoxification**, but not be 'blended down' or diluted.



Safety Concept of Directive 2002/32/EC



- Feed that exceed a limit should be notified *via* the **Rapid Alert System for Food and Feed (RASFF)**, if the feed, when correctly used, represents any danger to human health, animal health or to the environment or could adversely affect livestock production.



- In case of exceeding the maximum limits the feed business operator and the competent authority are obligated to **detect the source** of undesirable substances and measures should be taken to **reduce the level or to eliminate** the undesirable substances.



Development of Risk Management Strategies

Advisory working group „Carry over of undesirable substances in feed“ by the Federal Ministry of Food and Agriculture



Experts of different scientific fields

- deal with all questions regarding hazards in the feed and food chain including soil, air and water,
- assist the Ministry in all questions regarding the management of hazards in feed,
- initiate and coordinate research projects,
- publish the opinions on the web page of the Ministry.

https://www.bmel.de/DE/Tier/Tierernaehrung/_texte/AG-CarryOver.html



Development of Risk Management Strategies

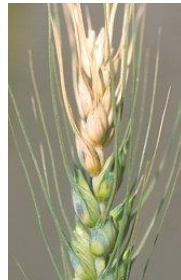
Advisory working group „Carry over of undesirable substances in feed“ by the federal Ministry of Food and Agriculture **publishes opinions, studies and organized workshops**



Risk Assessment of Mycotoxins

Mycotoxins are toxic secondary metabolites produced by fungi that readily colonize feed crops and which may have an **adverse effect on human or animals health or decrease the productivity of livestock.**

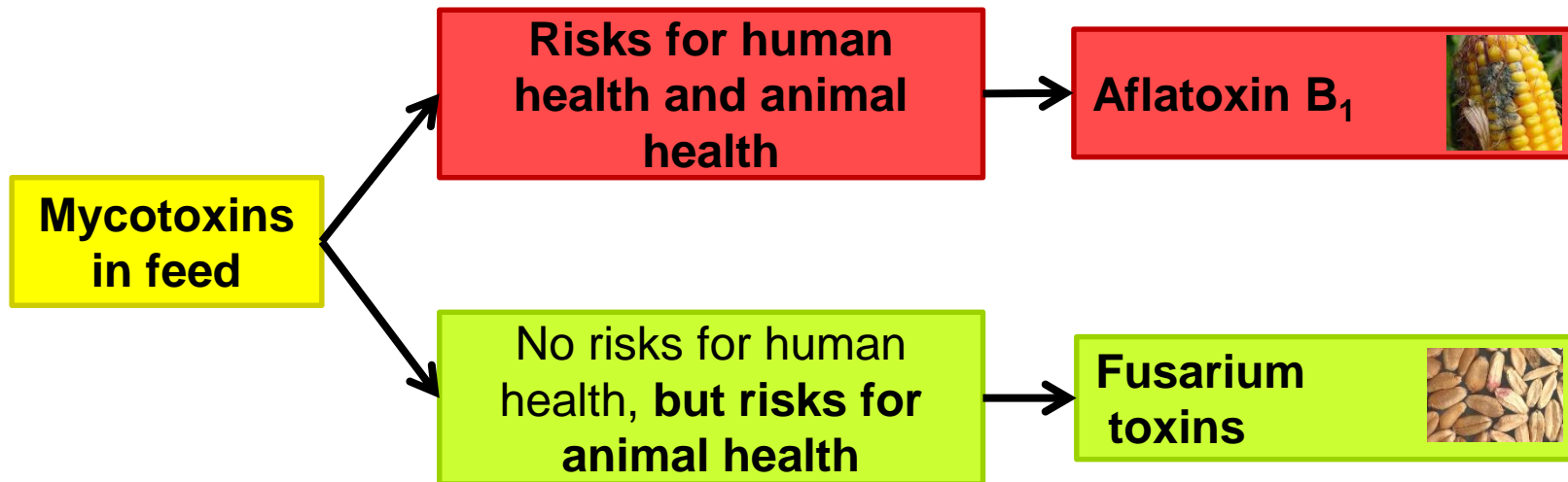
One species may produce many different mycotoxins, and the same mycotoxin may be produced by several species.



- **Aflatoxins** are produced by *Aspergillus* species.
- **Ochratoxin A, B, and C** are produced by *Penicillium* and *Aspergillus* species.
- **Fumonisin (B1-B2), Trichothecenes (DON, T2, HT2), Zearalenone** toxins are produced by over 50 species of *Fusarium*.



Risk Assessment of Mycotoxins



Legal Provisions for Aflatoxin B₁

Before 2002
Directive
74/63/ECC

Feed containing levels of Aflatoxin B₁ that exceed the maximum levels fixed in Annex I **could be mixed** with other feed **under the specific condition.**

Conditional dilution or mixing



After 2002
Directive
2002/32/EC

Feed containing levels of Aflatoxin B₁ that exceed the maximum levels fixed in Annex I **can not be mixed for dilution purposes** with the same, or other, products intended for animal feed.

General dilution ban

Decontamination is possible



Maximum Levels for Aflatoxin B₁

ML for Aflatoxin B₁ laid down in Annex I of Directive 2002/32/EC



Feed materials	0.02 mg/kg ¹⁾
Compound feed <u>except</u> dairy cattle and calves dairy sheep and lambs dairy goats and kids piglets and young poultry	0.01 mg/kg ¹⁾
Compound feed for other cattle, sheep, goats, pigs and poultry	0.005 mg/kg ¹⁾
	0.02 mg/kg ¹⁾

¹⁾ Relative to feedingstuffs with moisture content of 12%



Guidance values for other Mycotoxins



Opinion of the „Carry over” working group regarding the minimisation of the mycotoxin content in the feed (July 2000)

- ↪ Establishment of **Guidance values** for mycotoxins which are only relevant to animal health and productivity and without relevant carry over into products from animal origin

Purpose of Guidance values

- = Assessment of feed containing mycotoxins
- = Support of identification of animal health problems as result of high mycotoxin contents in feed
- = Support of uniform enforcement by the competent authorities
- = Concentration on prevention measurements by farmers and the industry

https://www.bmel.de/DE/Tier/Tierernaehrung/texte/Werte/DeoxynivalenolZearalenon.html;jsessionid=88CDEECCBD64CEC86217C7FFB0D25F04.1_cid367



Management Concept for other Mycotoxins



Opinion of the „Carry over” working group regarding the minimisation of the mycotoxin content in the feed (March 2002)

- ↳ **Prevention** = Minimisation of toxin formation
- ↳ **Detoxification** = Destruction, inactivation or binding of toxins
- ↳ **Chemisorption** = Binding or deactivation of toxins in the digestive tract
- ↳ **Limitation** = Feeding to less sensitive animals



Risk Assessment of Mycotoxins



- Opinion of the Scientific Panel on contaminants in the food chain related to **Aflatoxin B1** as undesirable substance in animal feed (2004)
<https://www.efsa.europa.eu/en/efsajournal/pub/39>
- Opinion of the Scientific Panel on contaminants in the food chain related to **Deoxynivalenol (DON)** as undesirable substance in animal feed (2004)
<https://www.efsa.europa.eu/de/efsajournal/pub/73>
- Opinion of the Scientific Panel on contaminants in the food chain related to **Zearalenone** as undesirable substance in animal feed (2004)
<https://www.efsa.europa.eu/de/efsajournal/pub/89>
- Opinion of the Scientific Panel on contaminants in the food chain related to **Ochratoxin A (OTA)** as undesirable substance in animal feed (2004)
<https://www.efsa.europa.eu/de/efsajournal/pub/101>
- Opinion of the Scientific Panel on contaminants in the food chain related to **fumonisin**s as undesirable substances in animal feed (2005)
<http://www.efsa.europa.eu/en/efsajournal/pub/235>
- **T-2 and HT-2** toxins in food and feed (2011)
<https://www.efsa.europa.eu/de/efsajournal/pub/2481>



Recommendation of European Commission



Recommendation 2006/576/EC on the presence of DON, ZEA, OTA, T-2, HT-2 and fumonisins

Mycotoxin	Products intended for animal feed	Guidance value mg/kg (12 % MC)
Deoxynivalenol	Feed materials - cereals and cereal products Complementary and complete feedingstuffs with the exception of - complementary and complete feedingstuffs for pigs - complementary and complete feedingstuffs for calves, lambs and kids	8 5 0,9 2
Zearalenon	Feed materials - cereals and cereal products Complementary and complete feedingstuffs - piglets and gilts (young sows) - sows and fattening pigs - calves, dairy cattle, sheep, goats	2 0,1 0,25 0,5
Ochatoxin A	Feed materials - cereals and cereal products- Complementary and complete feedingstuffs - pigs - poultry	0,25 0,05 0.1
Fumonisin B1 and B2	Feed materials - maize and maize products Complementary and complete feedingstuffs - pigs horses, rabbits and pets - fish - Poultry, calves, lambs and kids - adult ruminants and mink	60 5 10 20 50
T-2 and HT-2	Compound feed for cats	0.05



Recommendation of European Commission



Recommendation 2006/576/EC on the presence of DON, ZEA, OTA, T-2, HT-2 and fumonisins

- **Monitoring** on the presence of deoxynivalenol, zearalenon, ochratoxin A and fumonisin B1 +B2, T-2 and HT-2 in cereals and cereal products.
- **Analysis of samples simultaneously** for the presence of that mycotoxins in order to enable an assessment of the extent of co-occurrence.
- The **guidance value for cereals and cereal products** is determined with regard to the most tolerant animal species.
- For the **feeding of and the production of feedingstuffs** for more sensitive animals lower guidance value have to be applied.
- Feed business operators should use in their **HACCP system** the guidance values for the monitoring and for the prevention, elimination or reduction of identified hazards.

<http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006H0576&qid=1511080290262&from=DE>



Recommendation of European Commission



Recommendation 2013/165/EU on the presence of T-2 and HT-2 toxin in cereals and cereal products

- Member States should **collect more data** (occurrence, reasons for year to year variation, effect of food processing, agricultural practices).
- On the basis of those data the human and **animal exposure** should be assessed.
- Recommendation of **indicative levels** for the sum of T-2 and HT-2 $\mu\text{g}/\text{kg}$:

Cereal products for feed and compound feed (*****)	
oat milling products (husks)	2000
other cereal products	500
compound feed, with the exception of feed for cats	250

*****) The indicative levels for cereals and cereal products intended for feed and compound feed are relative to a feed with a moisture content of 12 %.



Recommendation of European Commission



Recommendation 2006/583/EC on the prevention and reduction of Fusarium toxins in cereals and cereal products

Principles of prevention to minimize the occurrence using good agricultural practices:



- ✓ **Crop rotation**
- ✓ **Choice of variety/hybrid**
- ✓ **Crop planning**
- ✓ **Soil and crop management**
- ✓ **Harvesting**
- ✓ **Drying**
- ✓ **Storage**
- ✓ **Transport from storage**



International Standards



- Prevention and Reduction of Mycotoxin Contamination in Cereals, including Annexes on **Ochratoxin A, Zearalenone, Fumonisin and Tricothecenes** (CAC/RCP 51-2003)
- Reduction of **Aflatoxin B₁** in Raw Materials and Supplemental Feedingstuffs for Milk-Producing Animals (CAC/RCP 45-1997)



Decontamination

If feed exceed maximum limits established in Annex I of Directive 2002/32/EC **processes for decontamination** (cleaning and detoxification) of feed can be used under specific conditions:



Feed with excessive level of Aflatoxin B₁, only to be used as feed after detoxification in authorised establishments



- ✓ **EFSA** performs a **scientific assessment** of the detoxification process and evaluate the compliance with criteria of acceptability.
- ✓ Feed for decontamination must be **labelled** for this purpose.
- ✓ Feed business operators, which carry out the **detoxification must be approved** by the competent authority. The competent authority shall ensure the correct application of the detoxification processes and that the detoxified products are safe.



Regulation (EU) 2015/786 on decontamination

Regulation (EU) 2015/786 defined **criteria for the acceptability of detoxification processes**, such as

- Physical detoxification: e.g. heat
- Chemical detoxification: e.g. organic acids, ammonia
- Biological detoxification: e.g. micro-organisms

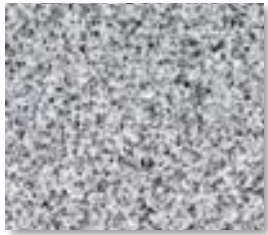
The feed business operator must provide data, such as

- Data on efficiency and effectivity of the process
- Evidence that decontaminated feed has no adverse effect on feed, animal or human health and environment or mode of action, nor toxic residues or metabolites



Additives for Reduction of Mycotoxins

Substances that **reduce the contamination of feed by mycotoxins** shall be authorised under the feed additive Regulation (EC) 1831/2003 under the functional group:



“(m) substances for reduction of the contamination of feed by mycotoxins: Substances that can suppress or reduce the absorption, promote the excretion of mycotoxins or modify their mode of action”



The use of this additives is **only allowed in feed complying** with the European Union legislation on undesirable substances in animal feed.



Additives for Reduction of Mycotoxins



Recommendation of the German Society for Mycotoxin Research (2008)

Guidelines for assessment of the efficacy of substances for detoxification of feed contaminated with mycotoxins

- ✓ Clear definition of the mycotoxins
- ✓ Characterisation of the substance used for detoxification
- ✓ Verification of the specific efficacy via feeding trials (*in vivo*)
- ✓ Characterisation of the mycotoxins and analysis in the feeding trial
- ✓ Verification of non-specific effects in the feeding trial
- ✓ Publication of all results



Additives for Reduction of Mycotoxins



Statement on guidelines for ‘substances for reduction of the contamination of feed by mycotoxins’ (2010)

Substances for the reduction of contamination of feed by mycotoxins

- ✓ The mode of action shall be declared and demonstrated.
- ✓ Evidence of the mode of action can be provided by *in vitro* studies.
- ✓ Efficacy shall be demonstrated in *in vivo* studies and should be performed in the relevant target species.
- ✓ A minimum of three *in vivo* studies showing significant effects on the relevant end-points shall be provided to demonstrate efficacy.
- ✓ The mycotoxin content in feed used in studies shall not exceed the values given in the EU-legislation.



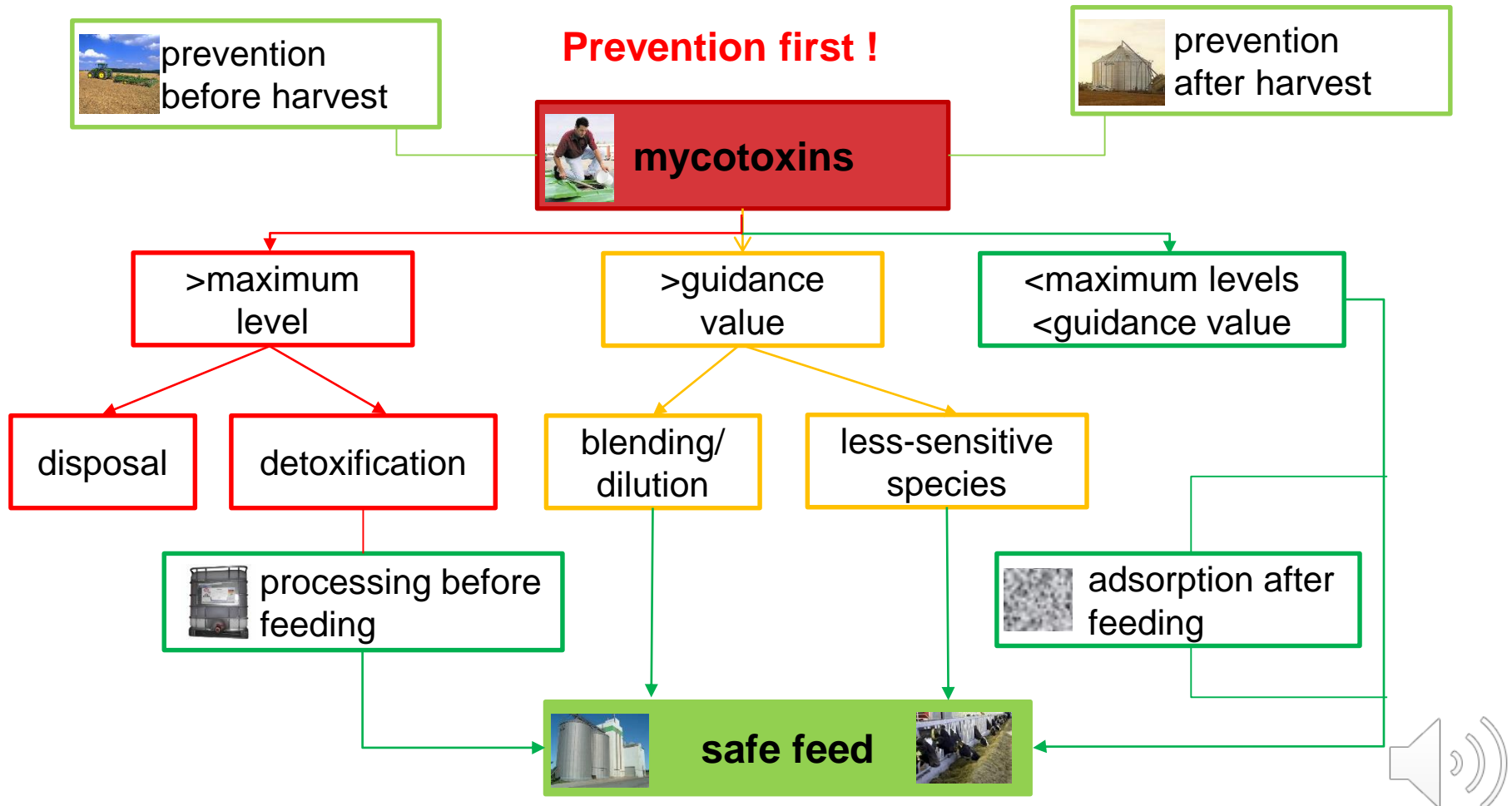
Additives for Reduction of Mycotoxins

The following feed additives are approved as mycotoxin-controller:

- ✓ 1m558 **Bentonite (> 70% smectite)** for binding of **afatoxin B₁** in feed for ruminants, pigs and poultry (CIR (EU) 1060/2013)
<http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R1060&qid=1511086825265&from=DE>
- ✓ 1m01 Preparation of a **micro-organism** *Coriobacteriaceae* family DSM 11798 for reduction of Trichothecenes in feed of pigs and poultry (CIR (EU) 1016/2013 and 2017/930)
<http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017R0930&qid=1511086742805&from=DE>
- ✓ 1m03 Preparation of **fumonisinesterase** from *Komagataella pastoris* (DSM 26643) for the detoxification of Fumonisin in feed for pigs and poultry (CIR (EU) 1115/2014)
<http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R1115&qid=1511086889949&from=DE>



EU- Mycotoxin Management Strategy



Regulation (EC) 178/2002 - General Food Law

“Food and feed business operators at all stages of production, processing and distribution within the businesses under their control shall ensure that foods or feeds satisfy the requirements of food law which are relevant to their activities and shall verify that such requirements are met.”



Special provisions are regulated in Regulation (EC) No 1831/2003 on Feed Additives and Feed Backstops and Regulation (EC) No 1831/2003 on Feed Hygiene

Regulation (EC) 1831/2003 on Feed Hygiene



- **Feed business operators** (with the exception of primary production) shall put in place, implement and maintain procedures based on the **HACCP principles**.

Specific requirements for production, storage, transport, quality control, record keeping etc. are described in the Annex II of the Regulation.



- **Feed business operators** at the level of primary production of feed shall comply with the provisions in Annex I and III of the Regulation.

“Guides to good practice shall include appropriate information on hazards ... and actions to control hazards ... such as:

a) the control of contamination such as mycotoxins ...”



Obligations of the Feed Business Operator



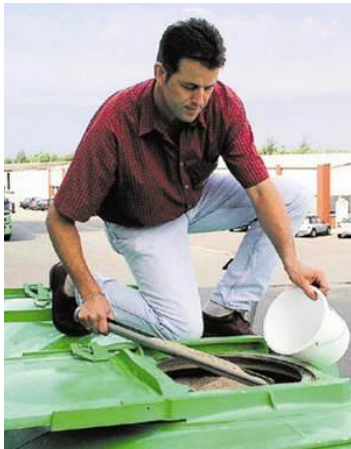
The feed business operator shall

- not place on the market unsafe feed.
- be able to identify rapidly any supplier or consignment,
- immediately inform the competent authorities if he has reason to believe that the feed is not safe,
- immediately withdraw unsafe feed from the market,
- co-operate with the competent authorities in actions taken to reduce risks,
- identify and regularly review the critical points in his processes and ensure that controls are applied at these points.

Feed business operators are responsible for the safety of the feed, which they produce, transport, store or sale.



Objectives of the official feed control



The authorities shall monitor and verify that the feed business operators fulfill the requirements of the feed law.

The competent authorities shall

- ensure that official controls are carried out regularly, on a risk basis and with appropriate frequency,
- ensure that official controls are effective and appropriate,
- ensure that staff carrying out official controls is qualified and free from conflict of interests,
- shall implement a control plan.



Feed Sector in Germany



Farms (> 2ha)

285 100

Feed input

17 800 million €

Feed import

12%

Compound feed

of total use of feed

26%

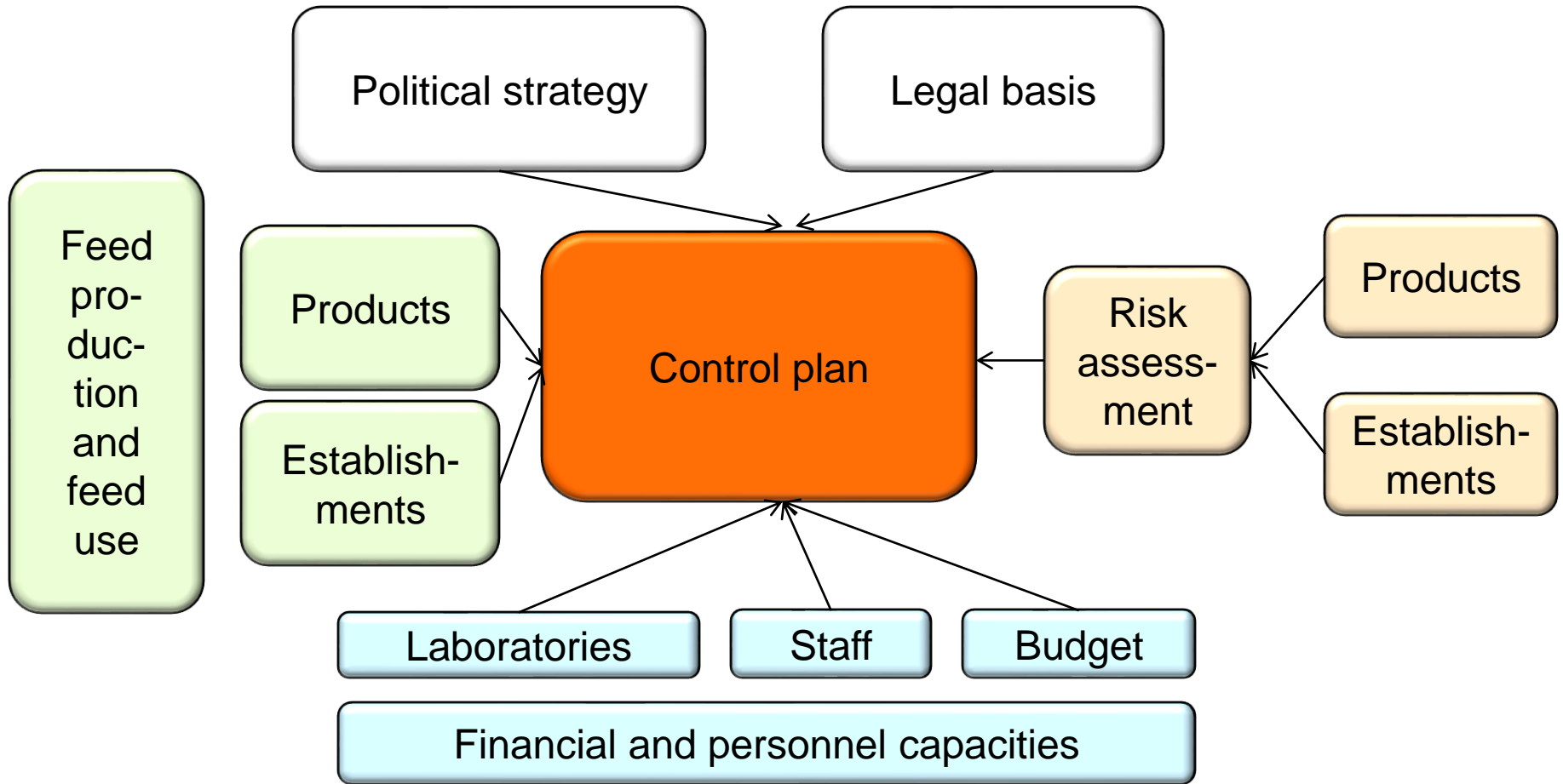
Compound feed

producers (> 500t/year)

314



German Feed Control Plan



Official Feed Control in Germany



Approx. 220 persons (on the basis of full-time jobs) work for the official feed control by the competent authorities and approx. 150 persons work for the 25 official laboratories in the feed sector.

The qualification of the staff are regulated in a **national Regulation for the qualification of feed inspectors.**

This includes

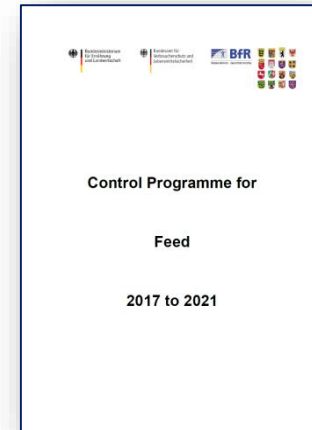
- ✓ standards of education
- ✓ obligatory training courses in the field of feed legislation, animal nutrition, feed safety, feed hygiene, feed manufacturing, analysis and others
- ✓ obligatory practical training
- ✓ control and test procedures



Control Systems for Mycotoxins



**Annual
Pre - harvest
data system**



**Control Programme for
Feed
2017 to 2021**

**Monitoring
(based on random
sampling)**

**Official control
program
(risk based)**

Kategorie	Mycotoxin	Erntedaten		Mycotoxin		Mycotoxin		Mycotoxin		Mycotoxin	
		Ernte	Ernte	Ernte	Ernte	Ernte	Ernte	Ernte	Ernte	Ernte	Ernte
Weizen	Deoxynivalenol	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.3	3.6	3.9
	Zearalenon	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4
Gerste	Deoxynivalenol	1.5	1.8	2.1	2.4	2.7	3.0	3.3	3.6	3.9	4.2
	Zearalenon	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5
Mais	Deoxynivalenol	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5
	Zearalenon	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6



Results of Annual Pre-Harvest Control

Vorläufige Ergebnisse der DON-Gehalte in Weizen der BEE 2017

Bundesland	n	Mittelwert	Median	90.Perzentil	Maximum
µg/kg Stand: 25.09.2017					
Bund	458	132	31	279	6.139
Baden-Württemberg	33	214	39	565	2.203
Bayern	38	147	11	192	2.735
Brandenburg	37	84	47	162	494
Hessen	40	192	57	383	2.313
Mecklenburg-Vorpommern	30	295	139	641	2.655
Niedersachsen	37	110	61	309	518
Nordrhein-Westfalen	38	105	37	308	762
Rheinland-Pfalz	38	69	18	184	751

Vorläufige Ergebnisse der DON-Gehalte in Roggen der BEE 2017

Bundesland	n	Mittelwert	Median	90.Perzentil	Maximum
µg/kg Stand: 25.09.2017					
Bund	247	122	29	319	2.929
Bayern	18	39	23	75	227
Brandenburg	34	95	22	275	953
Hessen	20	63	39	137	336
Mecklenburg-Vorpommern	14	353	142	366	2.929
Niedersachsen	36	251	104	431	1.998
Nordrhein-Westfalen	19	25	13	57	144
Rheinland-Pfalz	19	39	17	59	343
Saarland	8	33	20	60	132
Sachsen	20	47	15	58	452
Sachsen-Anhalt	20	102	21	147	1.096
Schleswig-Holstein	19	224	75	582	712
Thüringen	20	112	19	99	1.508

Regional data

Vergleich der vorläufigen DON-Gehalte in Weizen der BEE 2017 mit den Vorjahren

Getreide	Jahr	Anzahl	Mittelwert	Median	Min.-Max.	90. Perzentil	Positiv [%]	> 1.250µg/kg [%]
µg/kg								
Weizen	2007*	481	394	163	< 10 - 12.249	763	-	-
	2008*	468	70	16	< 5 - 2.506	185	56	< 1
	2009*	473	118	27	< 5 - 7.236	279	58	2
	2010*	458	127	27	< 3 - 5.005	269	66	2
	2011*	462	68	5	< 3 - 2.024	160	69	1
	2012*	473	367	120	< 3 - 29.266	710	100	6
	2013*	435	6	5				
	2014*	465	5	5				
2015*	490	2						
2016*	475	3						
2017	458	1						

Vergleich der vorläufigen DON-Gehalte in Roggen der BEE 2017 mit den Vorjahren

Getreide	Jahr	Anzahl	Mittelwert	Median	Min-Max	90. Perzentil	Positiv [%]	> 1.250µg/kg [%]
µg/kg								
Roggen	2007*	241	88	23	< 10 - 1.606	183	-	-
	2008*	276	29	17	< 7 - 467	63	91	0
	2009*	185	37	23	< 7 - 505	79	93	0
	2010*	236	68	11	< 4 - 17.005	86	70	2
	2011*	235	162	64	< 4 - 3.576	322	99	2
	2012*	239	84	38	< 4 - 2.085	140	99	1
	2013*	207	135	40	< 4 - 3.772	341	99	1
	2014*	259	75	33	< 4 - 1.369	133	85	< 1
	2015*	261	46	19	< 4 - 2.094	72	91	< 1
	2016*	257	123	64	< 4 - 12.540	267	99	2
	2017	247	122	29	< 4 - 2.929	319	100	1,6

Annual comparison



Results of Official Control

Analyses of undesirable substances	Number of analyses				Non-compliances %		
	2014	2015	2016	Plan 2017-2021*	2014	2015	2016
Total	55 238	56 124	58 033	30 375	0.2	0.2	0.2
Thereof:							
Aflatoxin B1	2 090	2 480	2 369	1 079	0.0	0.0	0.0
Organic chlorides	8 180	10 133	11 475	3 239	0.0	0.0	0.0
Heavy metals	12 882	14 153	16 965	6 500	0.0	0.0	0.1
Dioxins/dl PCBs	3 390	1 492	1 654	1 079	0.3	0.0	0.6
ndl PCBs	1 601	1 614	1 771	551	0.0	0.0	0.0
Other Mycotoxins	8 523	8 613	9 402	1 950	0.1	0.0	0.0

*http://www.bmel.de/SharedDocs/Downloads/Tier/Futtermittel/KontrollprogrammFuttermittel_2017_2021.pdf?__blob=publicationFile



Future Development



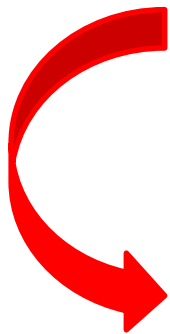
Modified mycotoxins in food and feed (2014)

<https://www.efsa.europa.eu/de/efsajournal/pub/3916>

Risks for animal health related to the presence of zearalenone and its modified forms in feed (2017)

<https://www.efsa.europa.eu/de/efsajournal/pub/4851>

*“**Modified** (often called “**masked**”) **mycotoxins** are metabolites of the parent mycotoxin formed in the plant or fungus, e.g. by conjugation with polar compounds. Fumonisin, which are difficult to extract from the plant matrix, are also termed modified mycotoxins.”*



New challenges for analysis and risk assessment of mycotoxin



Future Development

Joint FAO/WHO Expert Meeting on Hazards Associated with Animal Feed; 12-15 May 2015, Rome, Italy



Food and Agriculture Organization
of the United Nations



World Health
Organization

JOINT FAO/WHO EXPERT MEETING ON HAZARDS ASSOCIATED WITH ANIMAL FEED

12 – 15 May 2015
FAO Headquarters, Rome, Italy

EXECUTIVE SUMMARY OF THE REPORT

The expert meeting was jointly organized by the Food and Agriculture Organization (FAO) and the World Health Organization (WHO), in line with their over and food safety and ensuring fair practices in the trade of feed and food. The was to provide an updated overview of the current state of knowledge on hazards (including feed and feed production technologies of increasing relevance, such and food processing by-products and biofuel by-products). The meeting was guidance on the most appropriate use of this information for risk analyses, to edge gaps and to prioritize future work on the identification of potential hazard from the perspective of human and animal health.

The need for feed for terrestrial and aquatic animals continues to rise with the foods of animal origin; however, the challenge is not only to meet this growing to ensure its safety. Feed safety incorporates the impact on human as well as animal, in turn, can affect productivity. Hazards in feed may be inherent to be introduced during feed production, processing, handling, storage, transport, also result from accidental or deliberate human intervention.

This report considers hazards in animal feed which present a risk for human health from feed to foods of animal origin. It also addresses the impact of these hazards. While acknowledging the potential wider impacts of some of these hazards on and productivity, and in turn on food security, the meeting did not comprehensively but noted the need for further work in these areas. Hazards in water relevant in accordance with the Codex definition of animal feed¹. With regard to veterinary drugs intentionally added to feed were not considered within the scope of microbial resistance was not considered by the expert meeting as it is current comprehensively in other fora.

The expert meeting reviewed and discussed potential hazards in feed of chemical origin. While reviewing a wide range of hazards it did not prioritize a group of hazards, because of differences in their potential presence in feed at area, production system and kind of feed (e.g. compound feed vs. pasture or The chemical hazards considered included persistent organic pollutants (POPs) dioxin-like PCBs (PCDDs) and polychlorinated dibenzo-furans (PCDFs), dioxin phenyls (dl-PCBs) and non-dioxin-like polychlorinated biphenyls (ndl-PCBs); organochlorine and other pesticides; potentially toxic elements (PTEs) (e.g. mercury); mycotoxins; and plant toxins (e.g. genotoxic pyrrolizidine alkaloids as glucosinolates) as well as other potential and emerging chemical hazards; hazards considered primarily bacteria but also parasites, viruses and prions. In addition, radionuclides, residues of nanomaterials, micro- and nano-plastics and were addressed. For each of the above, the hazard as well as its occurrence in transfer from feed to food, relevance for food safety, impact on animal health, trends were reviewed. In addition, specific consideration was given to feed analogies of increasing relevance. Specific hazards and research requirements at insects, former food and food processing by-products, biofuels (bioethanol and biodiesel) by-products, aquatic plants and marine resources as feed were highlighted. Methods of analysis, including multi-an-

¹ Feed (Feedingstuff): Any single or multiple materials, whether processed, semi-processed or raw, which is intended to be fed directly to food producing animals. (CAC/RCP54-2004)

- **Climate change** may expand the occurrence of mycotoxins in plants.
- A range of mycotoxins are identified, but there are likely to be many as yet **unrecognized mycotoxins**.
- Because it is very difficult to remove mycotoxins from contaminated feed, **preventing them from accumulating in agricultural commodities** is the most effective strategy to combat the problem.
- **Continuous monitoring** is essential and efficient **detoxification strategies** are needed to deal with outbreaks and the risks posed by low level exposure.

<http://www.fao.org/documents/card/en/c/79ba7839-617e-468f-88ee-a0a72d87d63e/>





I thank you
for your
attention.

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