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World Mycotoxin Survey

The Global Threat
January – June 2024

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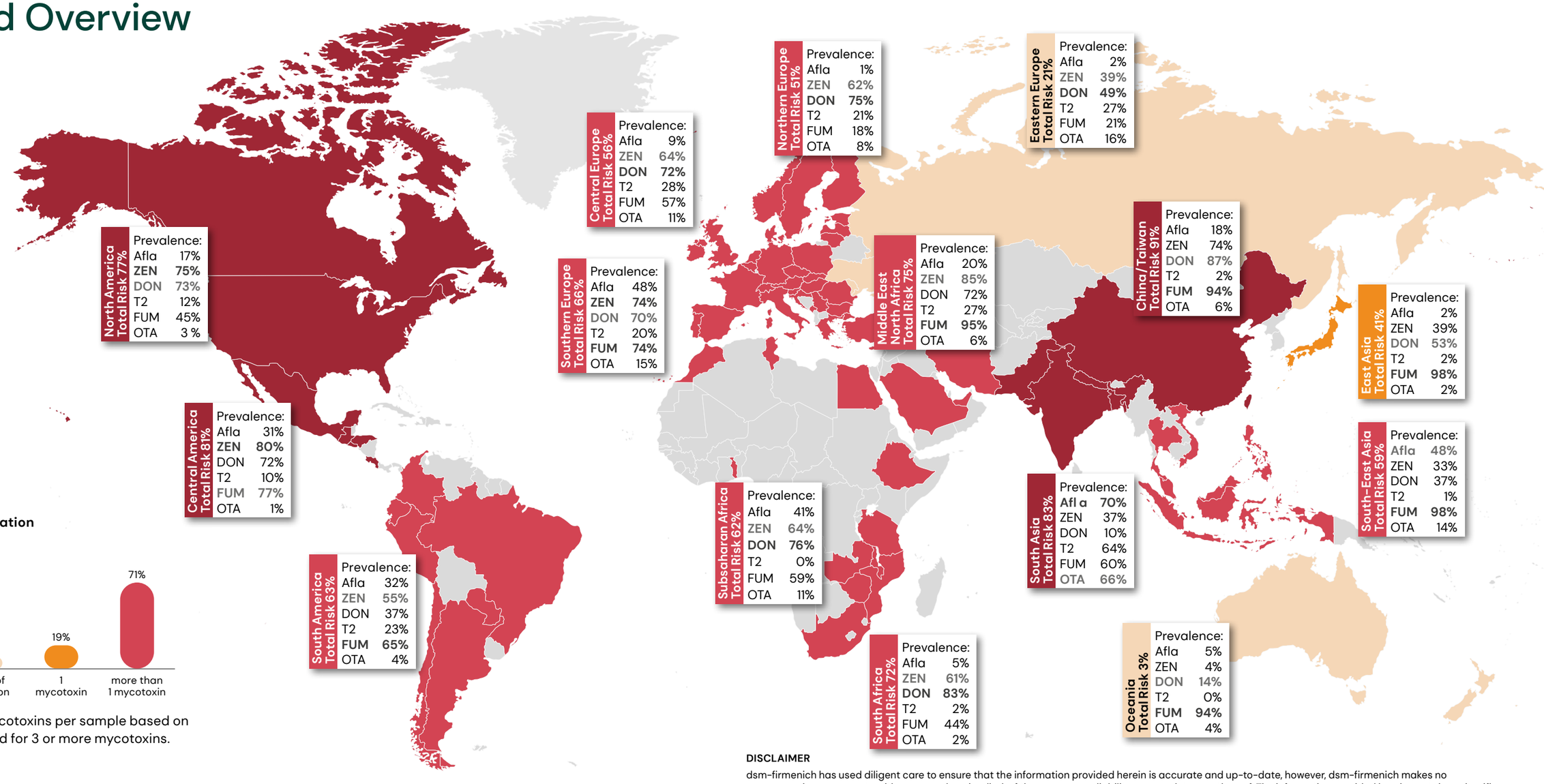
World Mycotoxin Survey

World Overview

11 520
Samples

58 277
Analyses

77
Countries



Co-contamination

Number of mycotoxins per sample based on samples tested for 3 or more mycotoxins.

Risk Level

The risk level expresses the percentage of samples testing positive for at least one mycotoxin above the threshold level in parts per billion (ppb).

Recommended risk threshold of major mycotoxins in ppb

Afla	ZEN	DON	T2	FUM	OTA
2	50	150	50	500	10

Figure 1. Global map of mycotoxin prevalence and risk in different regions.

0 – 25% | 26 – 50% | 51 – 75% | 76 – 100% | No samples tested

of samples above risk threshold

Moderate risk — **Extreme risk**

DISCLAIMER

ACKNOWLEDGEMENTS

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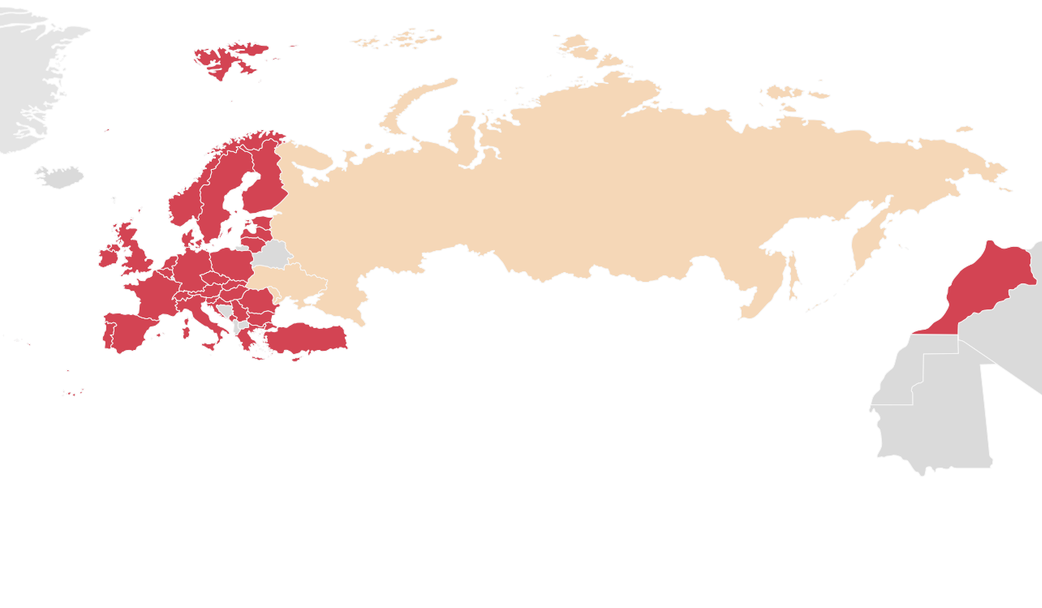
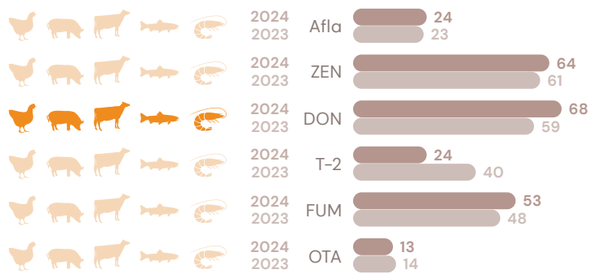
Europe



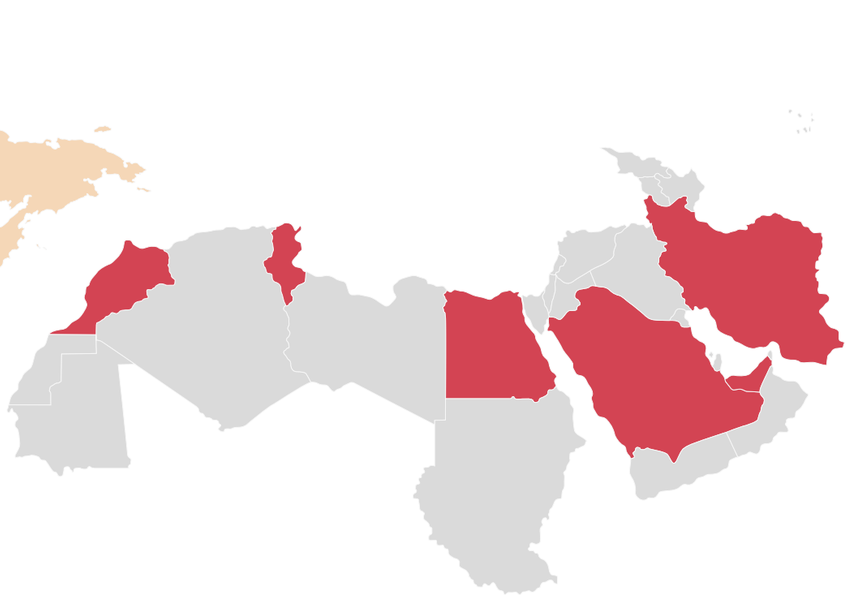


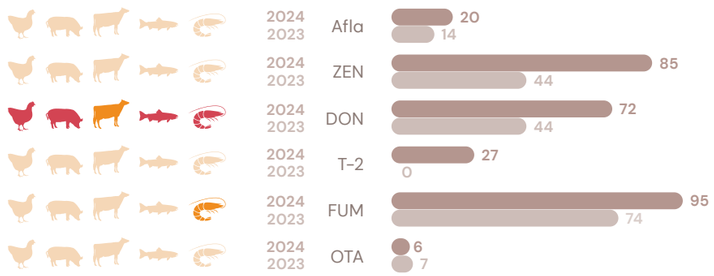
Animal colours indicate the risk posed to this species by the prevalence and concentration of each mycotoxin in all samples from this region (light orange=moderate to red=extreme see color code page 2)

% Contaminated samples January – June 2024 ■ and January – June 2023 ■

Total samples: 4 680	Afla	ZEN	DON	T-2	FUM	OTA
Number of samples tested	3 852	4 457	4 489	3 454	3 505	3 435
% Contaminated samples	24%	64%	68%	24%	53%	13%
Average of positive (ppb)	8	83	578	33	278	8
Median of positive (ppb)	4	20	212	14	93	3
Maximum (ppb)	741	5 000	43 891	1 731	12 368	331

Middle East & North Africa



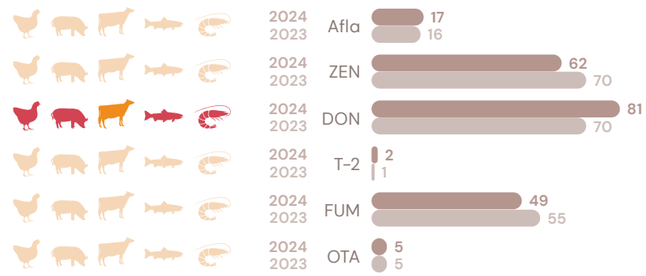


Animal colours indicate the risk posed to this species by the prevalence and concentration of each mycotoxin in all samples from this region (light orange=moderate to red=extreme see color code page 2)

% Contaminated samples January – June 2024 ■ and January – June 2023 ■

Total samples: 102	Afla	ZEN	DON	T-2	FUM	OTA
Number of samples tested	102	102	102	102	102	102
% Contaminated samples	20%	85%	72%	27%	95%	6%
Average of positive (ppb)	3	38	360	14	596	3
Median of positive (ppb)	1	14	295	11	282	2
Maximum (ppb)	12	263	1 152	55	22 030	7

Sub-saharan Africa



Animal colours indicate the risk posed to this species by the prevalence and concentration of each mycotoxin in all samples from this region (light orange=moderate to red=extreme see color code page 2)

% Contaminated samples January – June 2024 ■ and January – June 2023 ■

Total samples: 380	Afla	ZEN	DON	T-2	FUM	OTA
Number of samples tested	380	380	380	380	380	380
% Contaminated samples	17%	62%	81%	2%	49%	5%
Average of positive (ppb)	58	25	654	45	216	10
Median of positive (ppb)	4	10	295	51	71	4
Maximum (ppb)	708	491	18 341	89	3 224	85

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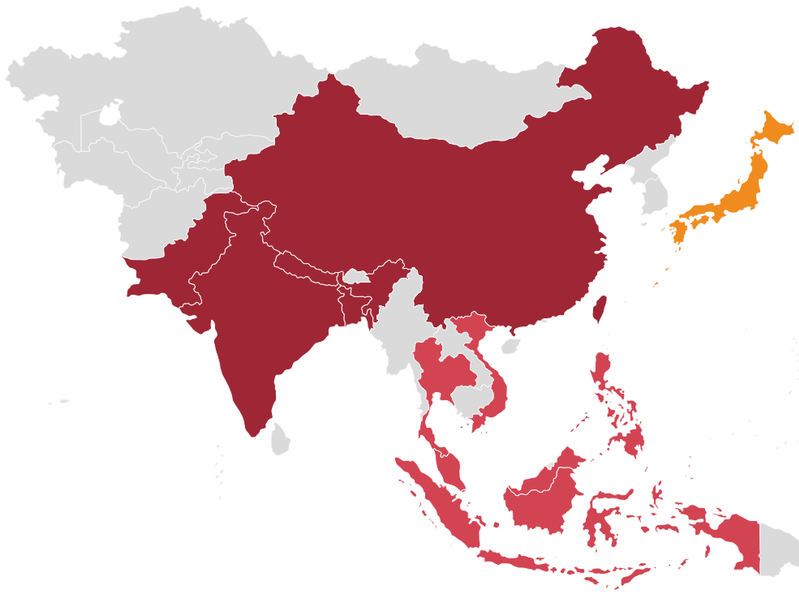
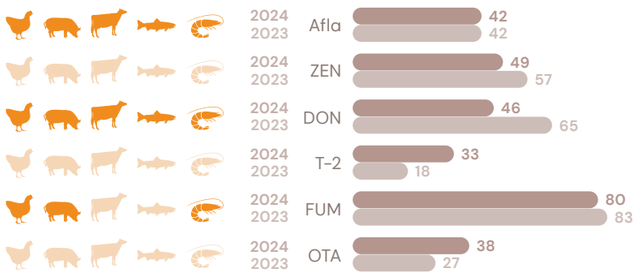
Asia



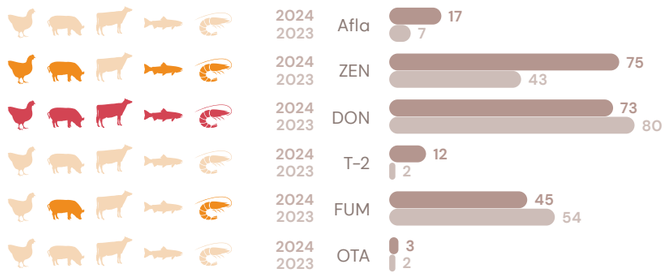


Animal colours indicate the risk posed to this species by the prevalence and concentration of each mycotoxin in all samples from this region (light orange=moderate to red=extreme see color code page 2)

% Contaminated samples January – June 2024 ■ and January – June 2023 ■

Total samples: 1 801	Afla	ZEN	DON	T-2	FUM	OTA
Number of samples tested	1 677	1 734	1 791	1 435	1 669	1 368
% Contaminated samples	42%	49%	46%	33%	80%	38%
Average of positive (ppb)	29	99	2 021	28	1 725	17
Median of positive (ppb)	13	44	400	24	726	6
Maximum (ppb)	517	3 437	476 954	113	489 698	579

North America

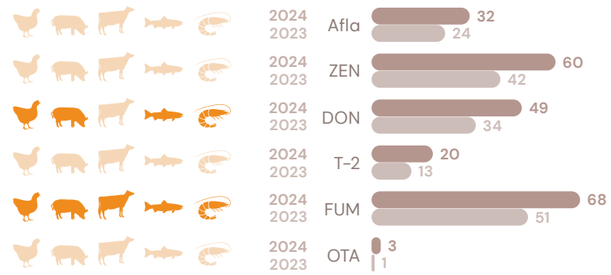


Animal colours indicate the risk posed to this species by the prevalence and concentration of each mycotoxin in all samples from this region (light orange=moderate to red=extreme see color code page 2)

% Contaminated samples January – June 2024 ■ and January – June 2023 ■

Total samples: 1 135	Afla	ZEN	DON	T-2	FUM	OTA
Number of samples tested	1 098	1 108	1 064	1 064	1 064	1 061
% Contaminated samples	17%	75%	73%	12%	45%	3%
Average of positive (ppb)	42	149	1 713	29	2 990	5
Median of positive (ppb)	2	43	720	13	1 139	3
Maximum (ppb)	1 767	6 513	32 220	360	96 316	62

Latin America



Animal colours indicate the risk posed to this species by the prevalence and concentration of each mycotoxin in all samples from this region (light orange=moderate to red=extreme see color code page 2)

% Contaminated samples January – June 2024 ■ and January – June 2023 ■

Total samples: 3 422	Afla	ZEN	DON	T-2	FUM	OTA
Number of samples tested	3 300	3 267	2 177	2 811	2 501	2 004
% Contaminated samples	32%	60%	49%	20%	68%	3%
Average of positive (ppb)	4	79	535	35	2 496	3
Median of positive (ppb)	2	40	299	31	1 463	2
Maximum (ppb)	306	2 599	9 856	200	244 701	15

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Spectrum 380® and Spectrum Top®50

Only analyzing for single mycotoxins can lead to underestimation of the detrimental effects of mycotoxins on animal health and performance. Our long-term monitoring of mycotoxins in different commodities shows that co-occurrence of mycotoxins is the rule and not the exception. Here we need support of state-of the art analytical methods based on LC-MS/MS. These allow to detect multiple mycotoxins in one run. The high sensitivity of the method is important, as already moderate levels of mycotoxins can have a detrimental effect. This is especially true in case of co-contamination.

Romer Labs®

Spectrum 380®:

The most advanced and comprehensive mycotoxin analysis available

It detects > 800 different mycotoxins (including masked and modified forms and emerging mycotoxins), fungal metabolites as well as plant and bacterial toxins and metabolites.

This is not a routine analysis but it is done in special cases and/or also of course as part of research of future objectives.

Spectrum 380® is developed and conducted by the world's leading independent mycotoxin research lab at the Department of Agrobiotechnology (IFA-Tulln) at the University of Natural Resources and Life Sciences Vienna and offered through cooperation with Performance Solutions plus Biomin.

Spectrum Top®50:

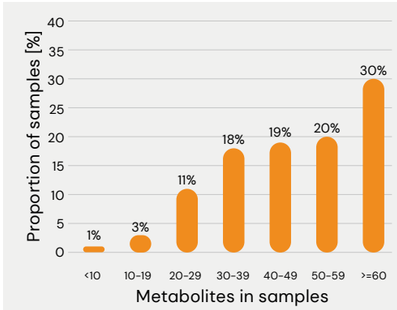
The most comprehensive mycotoxin analysis commercially available

It detects > 50 different mycotoxins (including masked and modified forms), emerging mycotoxins and fungal metabolites.

The Spectrum Top® 50 method was developed by scientists of Romer Labs, a leading global supplier of diagnostic solutions for food and feed safety.

Multiple mycotoxin occurrence

Spectrum 380® results January to June 2024: the most comprehensive mycotoxin analysis available



51
average number of Mycotoxins and Metabolites per sample

10 out of **10** samples contaminated with *Fusarium* toxins

99 %
Contained **10** or more mycotoxins and metabolites

Total 501 samples from 27 countries; 400 800 points of analysis

Mycotoxins & metabolites

Metabolite	Prevalence	Average	Maximum
Tryptophol	88%	534	78200
Aurofusarin	82%	437	17329
Moniliformin	77%	86	1233
Enniatin B	74%	64	2651
Equisetin	73%	55	2808
Flavoglaucin	73%	522	95136
Siccanol	72%	275	7152
Asperglaucide	72%	182	25781
Brevianamid F	71%	62	1663
Culmorin	70%	132	2379
Abscisic acid	68%	280	7685
Infectopyron	67%	13493	631680
Emodin	67%	40	2197
Asperphenamate	67%	211	12475
Beauvericin	66%	19	568
Enniatin B1	66%	42	1283
Bikaverin	65%	28	605
Fellutanine A	64%	54	1288
Daidzin	62%	33444	237100
Daidzein	62%	3698	26110
Neoechinulin A	60%	365	79008
Zearalenone	60%	69	4961
Tenuazonic acid	60%	388	9188

Positive Samples [%] for metabolites present in >=60% of samples (orange bars indicate regulated or guideline mycotoxins; red bar indicates a masked mycotoxin). Cut off for all metabolites 1 ppb (except for aflatoxins 0.5 ppb). Average of positives and Maximum are presented in ppb.

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Overview of the most frequently found mycotoxins, their masked and modified forms as well as emerging mycotoxins in all samples and finished feed

ALL samples (n=3 014)

Metabolite	Prevalence	Average	Maximum
Deoxynivalenol	76%	588	43 891
Enniatin B	72%	68	8 355
Beauvericin	69%	48	2 056
Enniatin B1	68%	26	3 262
Fumonisin B1	63%	536	335 053
Fumonisin B2	61%	190	114 907
Zearalenone	61%	76	6 513
Moniliformin	53%	99	3 440
Alternariol	45%	23	3 672
Enniatin A1	43%	16	1 307
Fumonisin B3	40%	104	39 738
Deoxynivalenol-3-Glucoside	29%	113	2 709
Enniatin A	27%	8	377
Aflatoxin B1	20%	9	204
Ochratoxin A	16%	7	579
15-Acetyl-Deoxynivalenol	14%	208	3 813
HT-2 Toxin	13%	92	3 081
Sterigmatocystin	13%	8	119
T-2 Toxin	12%	35	1 255
Mycophenolic Acid	10%	287	24 078
Nivalenol	8%	298	6 359
Ergometrine	6%	22	144
3-Acetyl-Deoxynivalenol	5%	993	11 465
Ergosine	4%	13	141
Aflatoxin B2	4%	3	21

Top25 metabolites are presented according to their prevalence (orange bars indicate regulated or guideline mycotoxins; red bar indicates a masked mycotoxin). Cut off for all metabolites 1 ppb (except for aflatoxins 0.5 ppb). Average of positive samples and maximum levels found are reported in ppb.

Ergot alkaloids

Regulated or guideline mycotoxins

Masked and modified myoctoxins

3-Acetyldeoxynivalenol and **15-Acetyldeoxynivalenol** are metabolites of the mycotoxin Deoxynivalenol. They can be converted to Deoxynivalenol in the intestinal tract.

DON-3-glucoside: plant metabolite of DON (masked DON); less toxic than DON, but it converted back to DON in the gastrointestinal tract of mammals.

Aflatoxin B2 and G1: Aflatoxins, less toxic than Aflatoxin B1, not regulated

Nivalenol: Type B trichothecene, more cytotoxic than DON in intestinal cells of pigs and ruminants (*in vitro*)

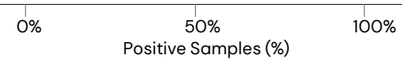
3 014 Samples

159 742 Analysis points

105 Countries

FINISHED FEED (n=1 351)

Metabolite	Prevalence	Average	Maximum
Deoxynivalenol	81%	344	14 532
Enniatin B	77%	36	2654
Fumonisin B1	76%	198	7 853
Enniatin B1	75%	14	499
Fumonisin B2	71%	73	2 862
Beauvericin	68%	21	224
Zearalenone	67%	27	1 207
Moniliformin	64%	66	744
Alternariol	56%	16	805
Enniatin A1	47%	8	152
Fumonisin B3	46%	46	1 204
Aflatoxin B1	30%	6	150
Enniatin A	28%	4	69
Deoxynivalenol-3-Glucoside	26%	74	2 379
Ochratoxin A	23%	5	579
Sterigmatocystin	14%	6	43
Ergometrine	9%	27	144
15-Acetyl-Deoxynivalenol	9%	105	2 061
T-2 Toxin	8%	28	892
Mycophenolic Acid	8%	135	9 083
HT-2 Toxin	5%	64	973
Nivalenol	4%	125	2 436
Aflatoxin B2	4%	3	16
Aflatoxin G1	4%	23	234
3-Acetyl-Deoxynivalenol	4%	1 624	11 465



Top25 metabolites are presented according to their prevalence (orange bars indicate regulated or guideline mycotoxins; red bar indicates a masked mycotoxin). Cut off for all metabolites 1 ppb (except for aflatoxins 0.5 ppb). Average of positive samples and maximum levels found are reported in ppb.

Emerging myotoxins: frequently found on agricultural commodities, not regulated; toxicity is under investigation, but toxic effects suggested in some scientific literature; EFSA started to publish reports to do a risk assessment for these toxins.

Moniliformin: broiler very susceptible, genotoxic, immunosuppressive; causes heart damage, muscular weakness, respiratory distress

Mycophenolic acid: Mycophenolic Acid shows a low acute toxicity in animals but may cause immunosuppression.

Alternariol: no acute toxicity, cytotoxic and mutagenic *in vitro*, effects on reproductive & immune system *in vitro*.

Beauvericin and Enniatins: effects on immune system: accumulation in fat-rich tissue.

Sterigmatocystin: precursor of aflatoxins; causes similar effects as aflatoxin B_1 in animals, but lower acute toxicity; negative effects incl. bloody diarrhea, less milk production, less feed intake, hepatotoxicity, nephrotoxicity

We bring progress to life

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