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World Mycotoxin Survey

The Global Threat
January – March 2024

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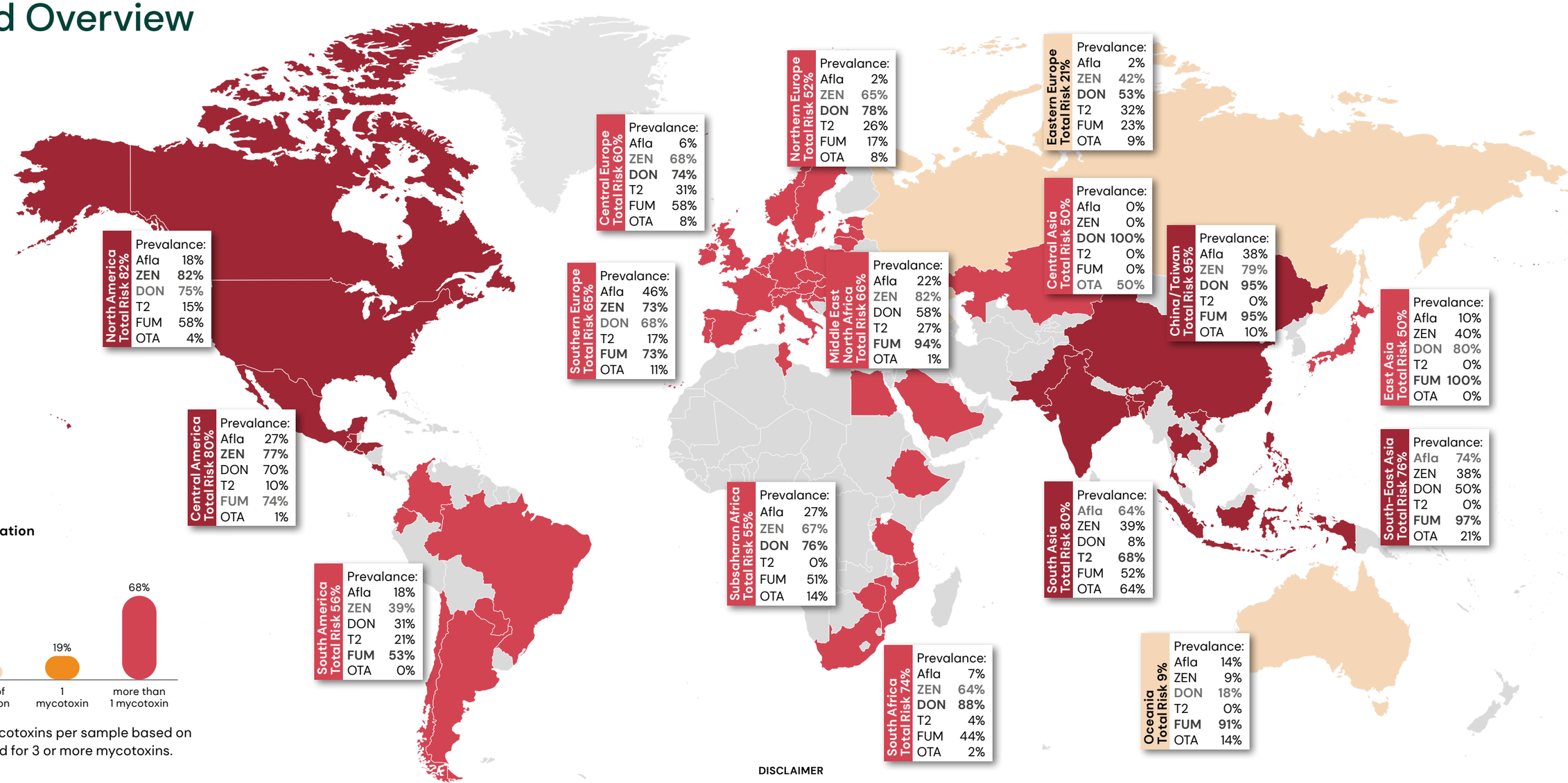
World Mycotoxin Survey

World Overview

5 383
Samples

28 538
Analyses

64
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**

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Mycofix® is not available in the US and Canada.

ACKNOWLEDGEMENTS

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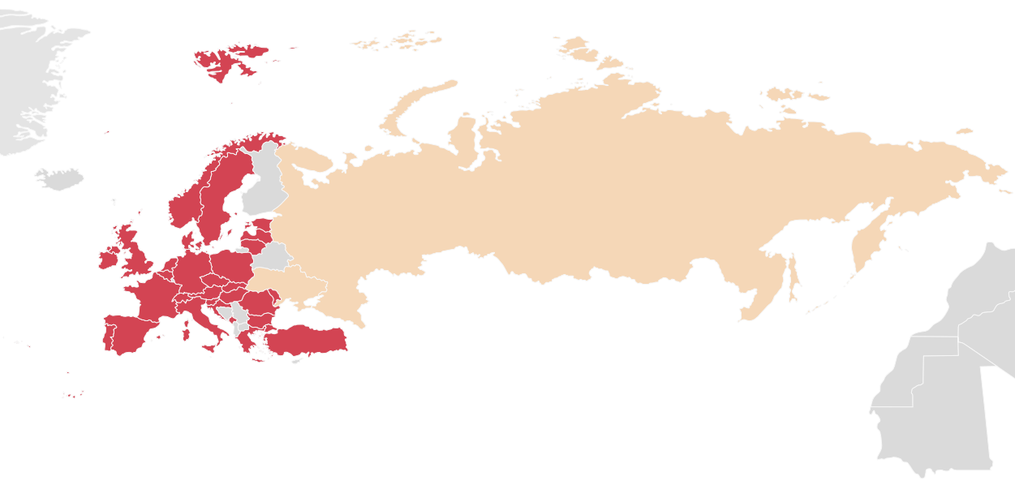
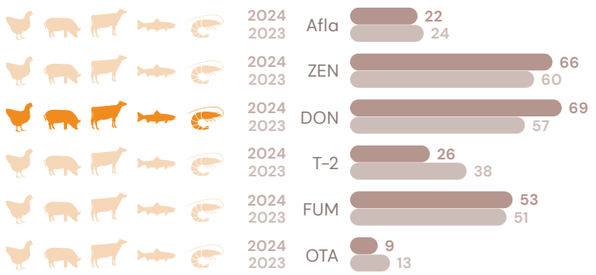
Europe



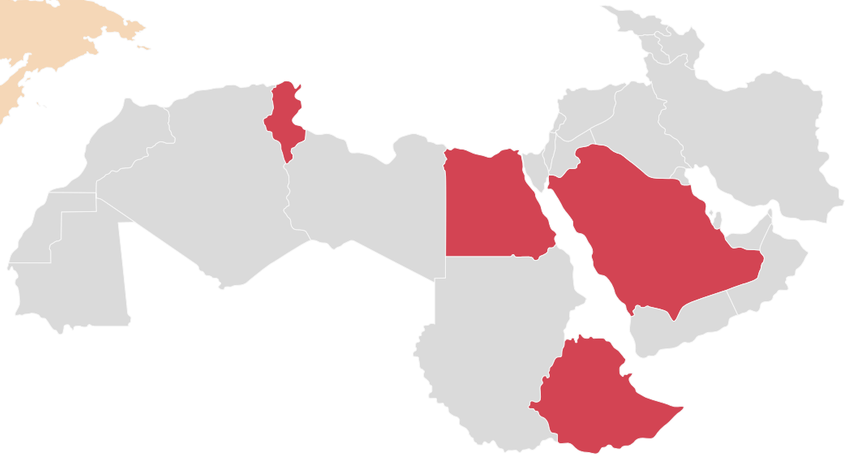


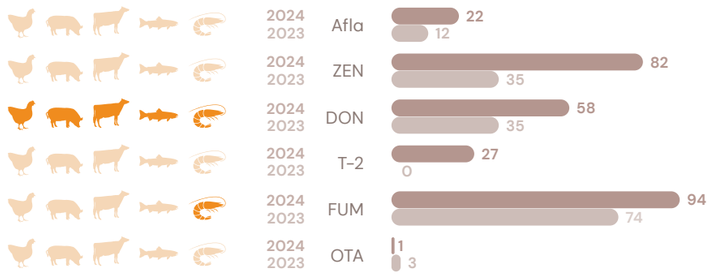
Animal colours indicate the risk posed to this species by the prevalence and concentration of each mycotoxin in all samples from this region (light orange=moderate to red=extreme see color code page 2)

% Contaminated samples January–March 20243 and January–March 2023

Total samples: 2 638	Afla	ZEN	DON	T-2	FUM	OTA
Number of samples tested	2 212	2 531	2 559	1 971	2 017	1 953
% Contaminated samples	22%	66%	69%	26%	53%	9%
Average of positive (ppb)	6	95	632	35	330	8
Median of positive (ppb)	3	23	221	14	104	3
Maximum (ppb)	132	4810	43891	1731	12368	331

Middle East & North Africa



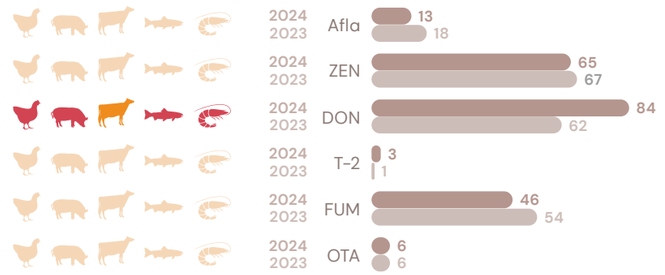


Animal colours indicate the risk posed to this species by the prevalence and concentration of each mycotoxin in all samples from this region (light orange=moderate to red=extreme see color code page 2)

% Contaminated samples January–March 20243 and January–March 2023

Total samples: 67	Afla	ZEN	DON	T-2	FUM	OTA
Number of samples tested	67	67	67	67	67	67
% Contaminated samples	22%	82%	58%	27%	94%	1%
Average of positive (ppb)	2	40	368	14	395	1
Median of positive (ppb)	1	7	297	11	305	1
Maximum (ppb)	6	263	1 152	55	1 509	1

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–March 20243 and January–March 2023

Total samples: 172	Afla	ZEN	DON	T-2	FUM	OTA
Number of samples tested	172	172	172	172	172	172
% Contaminated samples	13%	65%	84%	3%	46%	6%
Average of positive (ppb)	34	25	487	53	112	8
Median of positive (ppb)	4	9	241	56	58	6
Maximum (ppb)	214	433	5 091	89	738	24

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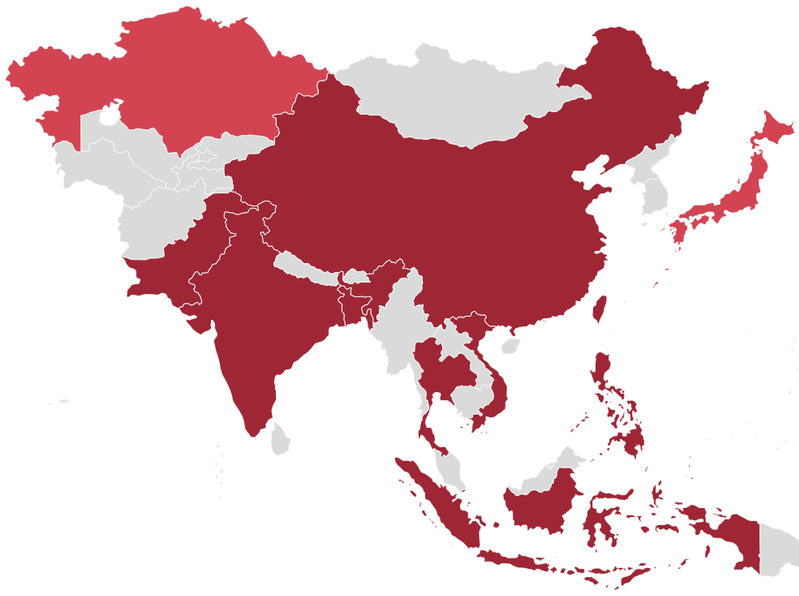
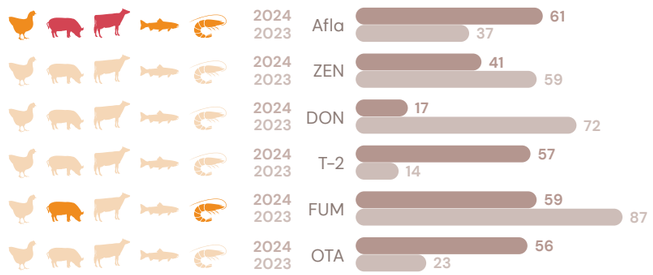
Asia



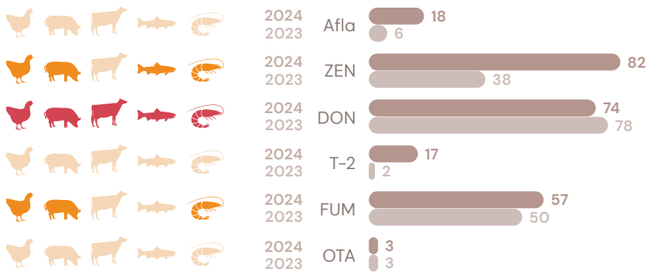


Animal colours indicate the risk posed to this species by the prevalence and concentration of each mycotoxin in all samples from this region (light orange=moderate to red=extreme see color code page 2)

% Contaminated samples January–March 20243 ■ and January–March 2023 ■

Total samples: 595	Afla	ZEN	DON	T-2	FUM	OTA
Number of samples tested	595	594	595	586	594	586
% Contaminated samples	61%	41%	17%	57%	59%	56%
Average of positive (ppb)	27	56	443	31	1 566	17
Median of positive (ppb)	15	34	217	26	635	5
Maximum (ppb)	253	1 122	9 700	113	489 698	441

North America

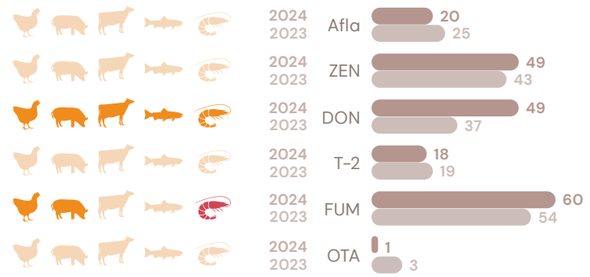


Animal colours indicate the risk posed to this species by the prevalence and concentration of each mycotoxin in all samples from this region (light orange=moderate to red=extreme see color code page 2)

% Contaminated samples January–March 20243 ■ and January–March 2023 ■

Total samples: 403	Afla	ZEN	DON	T-2	FUM	OTA
Number of samples tested	400	403	403	403	403	400
% Contaminated samples	18%	82%	74%	17%	57%	3%
Average of positive (ppb)	7	136	1 836	28	3 846	3
Median of positive (ppb)	2	40	726	15	1 534	3
Maximum (ppb)	111	2 310	20 963	276	96 316	8

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–March 20243 ■ and January–March 2023 ■

Total samples: 1 455	Afla	ZEN	DON	T-2	FUM	OTA
Number of samples tested	1 455	1 455	823	1 455	1 066	1 327
% Contaminated samples	20%	49%	49%	18%	60%	1%
Average of positive (ppb)	2	91	638	38	2 089	5
Median of positive (ppb)	2	45	324	36	1 460	3
Maximum (ppb)	28	946	9 856	113	17 820	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:

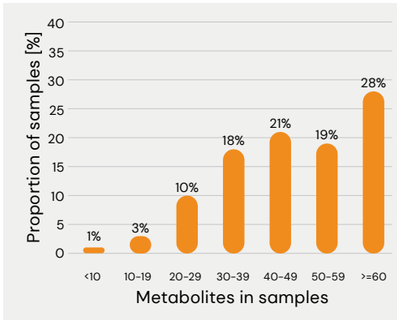
The most comprehensive mycotoxin analysis commercially available

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 March 2024: the most comprehensive mycotoxin analysis available



50
average number
of Mycotoxins and Metabolites per sample

9,9
out of
10
samples contaminated with *Fusarium* toxins

99 %
Contained
10
or more mycotoxins and metabolites

Total 330 samples from 23 countries; 264 000 points of analysis

Mycotoxins & metabolites

Metabolite	Prevalence		Average	Maximum
Tryptophol		84%	630	78 200
Aurofusarin		80%	409	14 744
Moniliformin		80%	95	1 233
Asperglaucide		73%	117	6 706
Equisetin		72%	60	2 808
Flavoglaucin		72%	509	95 136
Siccanol		72%	267	7 152
Infectopyron		70%	13 788	229 248
Enniatin B		70%	71	2 651
Culmorin		69%	136	2 310
Brevianamid F		68%	57	1 663
Emodin		67%	48	2 197
Abscisic acid		66%	323	7 685
Beauvericin		65%	15	193
Daidzin		65%	28 017	237 100
Asperphenamate		65%	197	8 693
Daidzein		65%	3 052	20 440
Enniatin B1		62%	44	1 037
Tenuazonic acid		62%	381	5 448
Bikaverin		62%	33	605
Neoechinulin A		61%	465	79 008
Fellutanine A		60%	52	1 288
Genistin		58%	44 393	317 400
Alternariolmethylether		58%	17	402
15-Hydroxyculomorin		56%	593	14 770
Zearalenone		55%	74	4 961
Alternariol		54%	68	4 627
Genistein		53%	2 972	17 332
Altersetin		52%	57	915
Deoxynivalenol		52%	522	8 120
Rugulusovin		52%	84	3 044
Chrysogin		51%	49	1 013

Positive Samples [%] for metabolites present in >50% 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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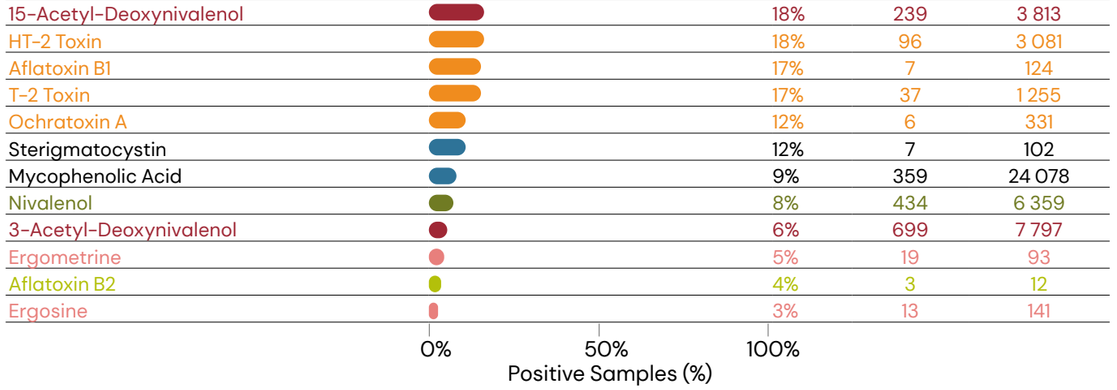
Overview of the most frequently found mycotoxins, their masked and modified forms as well as emerging mycotoxins in all samples and finished feed

ALL samples (n=1 618)

Metabolite	Prevalence	Average	Maximum
Enniatin B	81%	77	8 355
Deoxynivalenol	81%	621	43 891
Enniatin B1	81%	30	3 262
Beauvericin	76%	60	2 056
Zearalenone	68%	82	4 412
Fumonisin B1	63%	625	335 053
Enniatin A1	56%	17	1 307
Fumonisin B2	56%	245	114 907
Moniliformin	55%	102	1 271
Alternariol	50%	23	3 672
Fumonisin B3	38%	123	39 738
Enniatin A	35%	8	377
Deoxynivalenol-3-Glucoside	32%	134	2 379
15-Acetyl-Deoxynivalenol	18%	239	3 813
HT-2 Toxin	18%	96	3 081
Aflatoxin B1	17%	7	124
T-2 Toxin	17%	37	1 255
Ochratoxin A	12%	6	331
Sterigmatocystin	12%	7	102
Mycophenolic Acid	9%	359	24 078
Nivalenol	8%	434	6 359
3-Acetyl-Deoxynivalenol	6%	699	7 797
Ergometrine	5%	19	93
Aflatoxin B2	4%	3	12
Ergosine	3%	13	141



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.

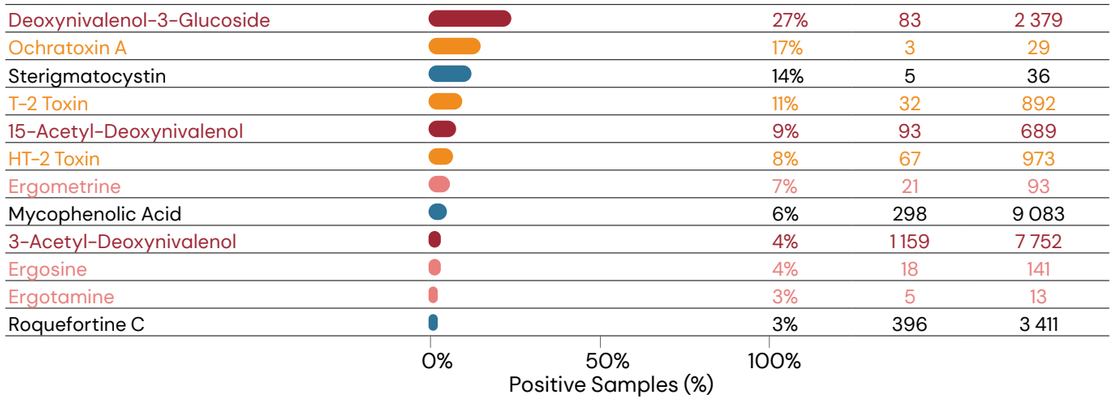
Aflatoxin B2 and G1: Aflatoxins, less toxic than Aflatoxin B1, not regulated

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

1 618	85 754	52
Samples	Analysis points	Countries

FINISHED FEED (n=633)

Metabolite	Prevalence	Average	Maximum
Enniatin B1	87%	16	499
Enniatin B	87%	37	2 654
Deoxynivalenol	86%	289	4 211
Fumonisin B1	77%	179	6 305
Beauvericin	76%	24	224
Zearalenone	74%	24	324
Moniliformin	69%	64	673
Fumonisin B2	67%	69	1 106
Enniatin A1	64%	8	123
Alternariol	63%	17	805
Fumonisin B3	51%	37	432
Enniatin A	43%	4	69
Aflatoxin B1	27%	4	98
Deoxynivalenol-3-Glucoside	27%	83	2 379
Ochratoxin A	17%	3	29
Sterigmatocystin	14%	5	36
T-2 Toxin	11%	32	892
15-Acetyl-Deoxynivalenol	9%	93	689
HT-2 Toxin	8%	67	973
Ergometrine	7%	21	93
Mycophenolic Acid	6%	298	9 083
3-Acetyl-Deoxynivalenol	4%	1 159	7 752
Ergosine	4%	18	141
Ergotamine	3%	5	13
Roquefortine C	3%	396	3 411



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

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

Roquefortine C effects: low acute toxicity, associated neurotoxicity observed in chickens, cows and dogs when co-contaminated with penitrems. Reduced lymphocyte proliferation *in vitro* at high concentrations.

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