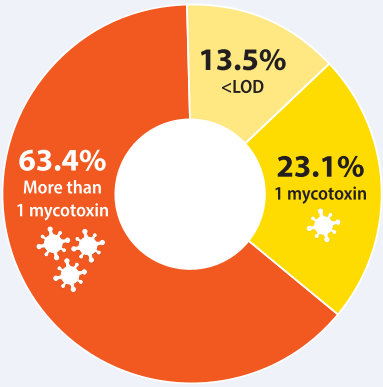
Innovad® Mycotoxin Feed Survey 2021

Highlights

- Feed and feed ingredients are **normally co-contaminated with two or more mycotoxins (63.4%)**
- **Deoxynivalenol (74%) was the most frequent mycotoxin** followed by fumonisins (49%) and zearalenone (41%)
- **Mycotoxin risk changes depending on the geographical areas.** Higher concentrations of deoxynivalenol in cold/temperate areas and larger presence of aflatoxins in tropical ones.
- **Some samples (14.8%) reached extremely high mycotoxin concentrations** and they could cause acute toxicity symptoms.
- **Innovad offers a unique platform** to manage mycotoxin risk from raw materials to the farm **combining rapid test + LC-MS/MS analysis + biomarker analysis**.



The majority of the samples had 2 or more mycotoxins

Introduction

Mycotoxins produced by fungi contaminate a wide variety of feed ingredients and cause a significant economically negative impact by affecting health status and reducing performance, welfare and profitability of livestock.

As part of our stress control platform, Innovad offers our customers the possibility to monitor the mycotoxin risk in raw materials and feed. Through this program during 2021 we received samples from twenty-four different countries (46% America; 38% Europe; 15% Asia; 1% MEA) that were analysed using rapid test or LC-MS/MS, both at high sensitivity level.

The results of these analyses help us to extract important conclusions about mycotoxins threat levels for the six main mycotoxins (deoxynivalenol, aflatoxins, fumonisins, zearalenone, ochratoxin A and T-2) in feed and feed ingredients from the different geographical regions across the globe.

Co-exposure is the highly prevalent

Results confirm that animals are continuously exposed to mycotoxins as most of the analysed samples (86.5%) were contaminated with one or more mycotoxins. Not unexpectedly, deoxynivalenol was the most frequent mycotoxin detected in feed ingredients (73.6%), followed by fumonisins (49.2%) and zearalenone (41.1%) ***(Table 1)***.

To a significantly lesser extent, T-2 (9.5%), aflatoxins (4.0%) and ochratoxin A (3.7%) were identified. It is important to note that, most of the samples were co-contaminated with two or more mycotoxins (63.4%).

Combinations of two, three, four and five different mycotoxins were detected in 26.5, 21.9, 13.2 and 1.8% respectively.

Combinations of deoxynivalenol with fumonisins and zearalenone was most commonly found which is unsurprising considering all three produced by the same fungi, *Fusarium*. The large co-presence detected in the feed ingredients is of concern as their combined toxic effect is often synergistic or additive causing a greater impact than the individual mycotoxin effects.

Mycotoxins	Prevalence (%)	Average ± standard deviation (ppb)	Median (ppb)	Maximum concentration (ppb)
Deoxynivalenol	73.6	939.3 ± 1,266.8	440	8,990
Fumonisins	49.2	690.7 ± 1,090.0	300	12,600
Zearalenone	41.1	160.4 ± 286.9	70	2,630
T-2 toxin	9.5	290.1 ± 1,196.4	90	11,610
Aflatoxins	4.0	5.9 ± 7.7	3.2	36.9
Ochratoxin A	3.7	3.5 ± 3.3	2	13

Table 1. Prevalence (%), average concentration ± standard deviation (ppb), median (ppb) and maximum concentration (ppb) of the six analysed mycotoxins (deoxynivalenol, fumonisins, zearalenone, T-2 toxin, aflatoxins and ochratoxin A).

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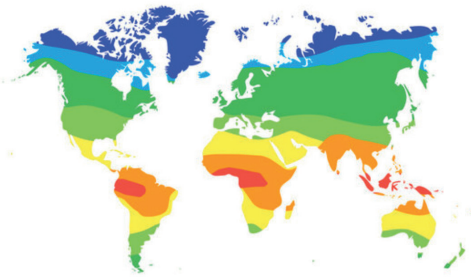
Innovad Mycotoxin Feed Survey 2021

Strong geographical differences in prevalence

Interestingly, strong geographical differences were detected among the studied mycotoxins.



For example, samples from Europe and North America had a large presence of deoxynivalenol (71 and 86%, respectively), but deoxynivalenol was only detected in 51% of the samples from Asia.

Besides, while the highest deoxynivalenol concentrations were found in the samples from North-America and Europe ***(Table 2)***, 90% of the samples with aflatoxins presence were from south-east Asia and Latin America ***(Table 3)***.

This is in line with our expectations as aflatoxins are typically produced by *Aspergillus* and this fungus is common in warmer climate. However, climate change is changing that picture and causing huge shifts in the mycotoxin distribution as aflatoxins become more prevalent in non-tropical regions like South Europe.

	Deoxynivalenol			
	Prevalence (%)	Average ± standard deviation (ppb)	Median (ppb)	Maximum (ppb)
Total	**73.6**	**939.3 ± 1,266.8**	**440**	**8,990**
Europe	**70.6**	**482.2 ± 739.4**	**220**	**5,220**
South	80.7	295.9 ± 571.9	167	5,200
Center/North	72.2	732.7 ± 921.9	415	4,610
East	57.8	356.6 ± 483.2	220	3,230
Americas	**83.3**	**1,414.1 ± 1,482.4**	**970**	**8,990**
US + Canada	85.9	1,522.9 ± 1,497.5	1,065	8,990
LATAM	62	171.8 ± 90.6	158	490
Asia	**50.7**	**215.7 ± 172.6**	**158**	**630**
South-East	47.9	196.9 ± 164.6	148	630
MEA	**77.8**	**186.6 ± 106.7**	**140**	**406**

Table 2. Summary of deoxynivalenol results depending on the geographical area with the prevalence (%), average concentration ± standard deviation (ppb), median (ppb) and maximum concentration (ppb).

	Aflatoxins			
	Prevalence (%)	Average ± standard deviation (ppb)	Median (ppb)	Maximum (ppb)
Total	4.0	5.9 ± 7.7	3.2	36.9
Europe	**0.5**	**2.4 ± 1.7**	**2.4**	**3.6**
South	1.7	2.4 ± 1.7	2.4	3.6
Center/North	0	-	-	-
East	0	-	-	-
Americas	**1.5**	**3.5 ± 2.7**	**2.4**	**9.1**
US + Canada	0.2	5.0 ± 1.5	4.3	7.9
LATAM	12.0	3.3 ± 2.9	2.2	9.1
Asia	**20.7**	**6.6 ± 8.5**	**4.0**	**36.9**
South-East	21.8	6.6 ± 8.5	4.0	36.9
MEA	**0**	**-**	**-**	**-**

Table 3. Summary of aflatoxins results depending on the geographical area with the prevalence (%), average concentration ± standard deviation (ppb), median (ppb) and maximum concentration (ppb).

Innovad Mycotoxin Feed Survey 2021

High concentrations across all feeds

Many scientific studies demonstrate that chronic exposure (even at low levels) has an enormous impact on animal health status and performance.

Low concentrations predispose animals to other infections, reduce growth and increase the FCR, whilst high mycotoxin levels cause acute toxicity in the animals with many severe clinical symptoms.

This highlights the need to have programs in place that efficiently detect high mycotoxin concentration as a crucial as a first step to protect animals' welfare.

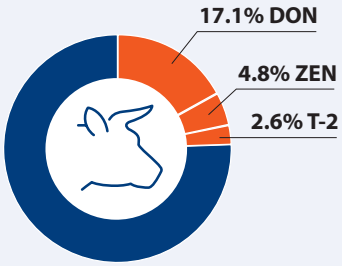
As part of the Innovad mycotoxin management plan established by Innovad we can rapidly identify samples that pose a high risk. This top level of detection gives producers the possibility to anticipate the problems and plan for the consequences. In this way we were able to detect that 14.8% of the samples (24.5% from ruminants, 10.8% from swine and 2.3% from poultry) had higher levels than the limits established by European Commission (EC)* with samples exceeding limits across mycotoxins and species.

In poultry this was mainly caused by T-2 (1.9%) and aflatoxins (0.4%), whilst deoxynivalenol (5.6%), zearalenone (4.5%) and aflatoxins (0.7%) were common in swine, and deoxynivalenol (17.1%), zearalenone (4.8%) and T-2 (2.6%) in ruminants ***(Table 4)***.

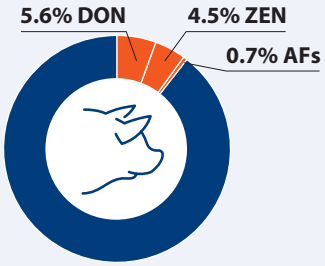
**(2002/32/EC – aflatoxins; 2006/576/EC – deoxynivalenol, fumonisins, ochratoxin A, T-2 toxin and zearalenone; 2013/165/EC – T-2 toxin)*

14.8% of the samples exceeded the European limits

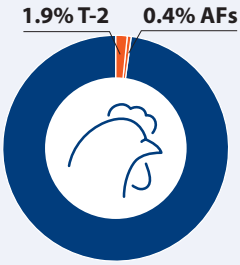
24.5% > EU limits



10.8% > EU limits



2.3% > EU limits



	Poultry		Swine		Ruminants	
	EC limits (ppb)	Max. concentration (ppb)	EC limits (ppb)	Max. concentration (ppb)	EC limits (ppb)	Max. concentration (ppb)
Deoxynivalenol	5,000	3,750	900	**5,200**	2,000	**8,990**
Fumonisins	20,000	8,970	5,000	2,810	20,000	12,600
Zearalenone	2,000	1,330	100	**1,070**	500	**2,630**
T-2 toxin	250	**11,610**	250	161	250	**980**
Aflatoxins	20	**26.7**	20	**36.9**	5	5
Ochratoxin A	100	4	50	13	250	1.7

Table 4. Maximum mycotoxin concentration (ppb) detected for each studied mycotoxin (deoxynivalenol, fumonisins, zearalenone, T-2 toxin, aflatoxins and ochratoxin A) depending on the specie (poultry, swine and ruminants). Remarked in red if the detected concentration exceeded the limits established by European Commission (EC).

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Innovad Mycotoxin Feed Survey 2021

All round mycotoxin control management system

Innovad offers a unique mycotoxin control strategy to manage mycotoxin risk from raw materials to the farm applying a 3-tier strategy:

1. Rapid test

Results provided in few minutes: ideal for control of raw materials at reception points. The test offered by Innovad reduces time-to-results, in one single extraction (15 minutes) concentrations of 4 of the most detected mycotoxins (deoxynivalenol + aflatoxins + fumonisins + zearalenone) are obtained.

Six mycotoxins with high sensitivity: Sensitivity offered in the rapid test allows to achieve outstanding low limits of detection (ppb level) for the targeted mycotoxins. The limits of detection offered in the rapid test are lower than the limits established by the European Union in the feed products.

Limits of detection		
Mycotoxins	Rapid test	EU Commission max. permited limits (Swine)
Deoxynivalenol	100	900
Aflatoxins	2.7	20
Zearalenone	50	100
Fumonisins	100	20,000
T-2	50	100
Ochratoxin A	1.5	50

2. Complete test:

High sensitivity: analysis for feed and raw materials using liquid chromatography with double mass spectrometry (LC-MS/MS)

Sixteen different key mycotoxins: other mycotoxins can be more common than the 6 main mycotoxins (aflatoxins, deoxynivalenol, fumonisins, ochratoxin A, T-2 and zearalenone). For this reason, the LC-MS/MS method includes 16 key different mycotoxins.

Results provided in few days: get your results in 5 days or less.

3. Myco-Marker® (patented by Innovad®):

Specific for your farm: blood analysis permits to elucidate real impact of mycotoxin exposure for each farm

Thirty-six different mycotoxin biomarkers: wide panel to discover the real exposure including common and emerging mycotoxins

Easy sampling collection: only 1 drop of blood per animal in a FTA card (without transport or temperature limitation) is needed to discover the real exposure to 36 mycotoxin biomarkers.

From harvest to farm

1 Rapid test

- Quick analysis (15 min.) with high sensitivity

2 Complete analysis

- Analysis for feed and raw materials with LC-MS/MS (16 mycotoxins)

3 Myco-Marker®

- Feed (16 mycotoxins) + Blood (36 mycotoxin biomarkers)

Optimize mitigation strategy

1. Reduce (chronic and acute) toxicity
2. Improve performance

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