UFAS Review of Mycotoxins in Feed 2023

By analysing for a broad range of mycotoxins it is hoped to demonstrate the level of compliance with legal and guidance limits within the UK feed supply chain. Every 3 years UFAS compound feed Participants are selected to submit feed samples for analysis of the following Mycotoxins:

- Aflatoxin B1
- Deoxynivalenol (DON)
- Zearalenone (ZON)
- Ochratoxin A (OTA)
- Fumonisin B1 and B2 (2023 only)
- T-2 and HT-2

The 2023 cohort of Participants submitted 55 feed samples in total. The results from this screening were evaluated alongside those obtained from feeds analysed between 2017 and 2020. Only 5 feeds were sampled in 2020 due to COVID, so these results should be considered with this knowledge in mind. The yearly results presented in the report are split to allow comparison with current legal or guidance levels for each animal category. The results are shown in a graphical form. Tables of results showing sample numbers and annual averages are presented in the appendices.

Aflatoxin B1

Current legal limits for Aflatoxin B1 in animal feeds are presented in table 1. The laboratory results summary is presented in figure 1 and appendix 1.

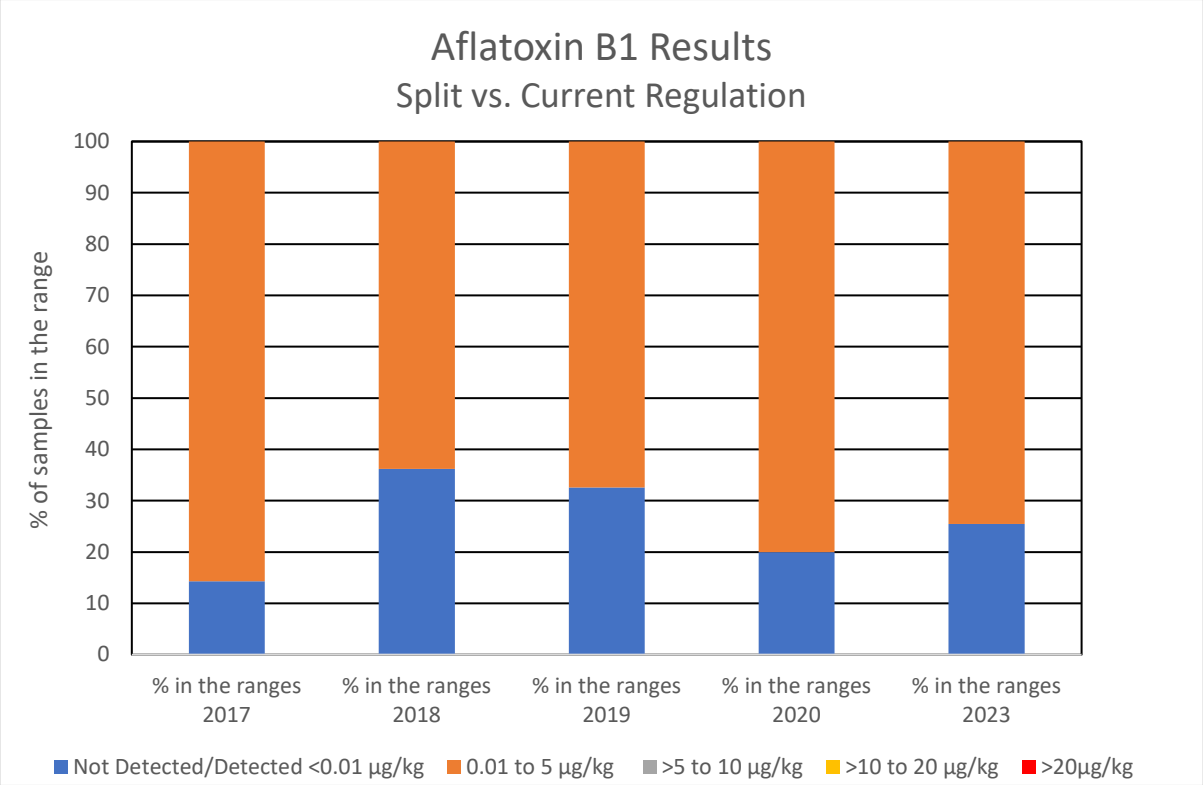
Table 1: Legal maximum limits for Aflatoxin B1 µg/kg (feed moisture 12%)

Level µg/kg	Limit
0.01	Limit of detection for analysis
5	Limit for compound feed for dairy cattle and calves, dairy sheep and lambs, dairy goats and kids, piglets and young poultry animals,
10	Limit for other complementary and complete feed

20	Limit for compound feed for cattle (except dairy cattle and calves), sheep (except dairy sheep and lambs), goats (except dairy goats and kids), pigs (except piglets) and poultry (except young animals).

In each year, the level of Aflatoxin B1 in feeds produced for animal feeding were below 5 µg/kg. Between 14% and 36% of samples over the years sampled were found to contain no detectable amounts of the mycotoxin. The highest recovery of aflatoxin B1 was 2.02 µg/kg in a 2018 sample. The feed type was however not identified. In 2023, the highest recovery was 1.88 µg/kg in a ruminant blend. This is below the lowest limit of 5 µg/kg for this animal category (dairy feed), indicating that there is a low risk of Aflatoxin B1 issue in the UK feed chain.

Figure 1: Yearly Aflatoxin results summary (split by legal limit)



Deoxynivalenol (DON)

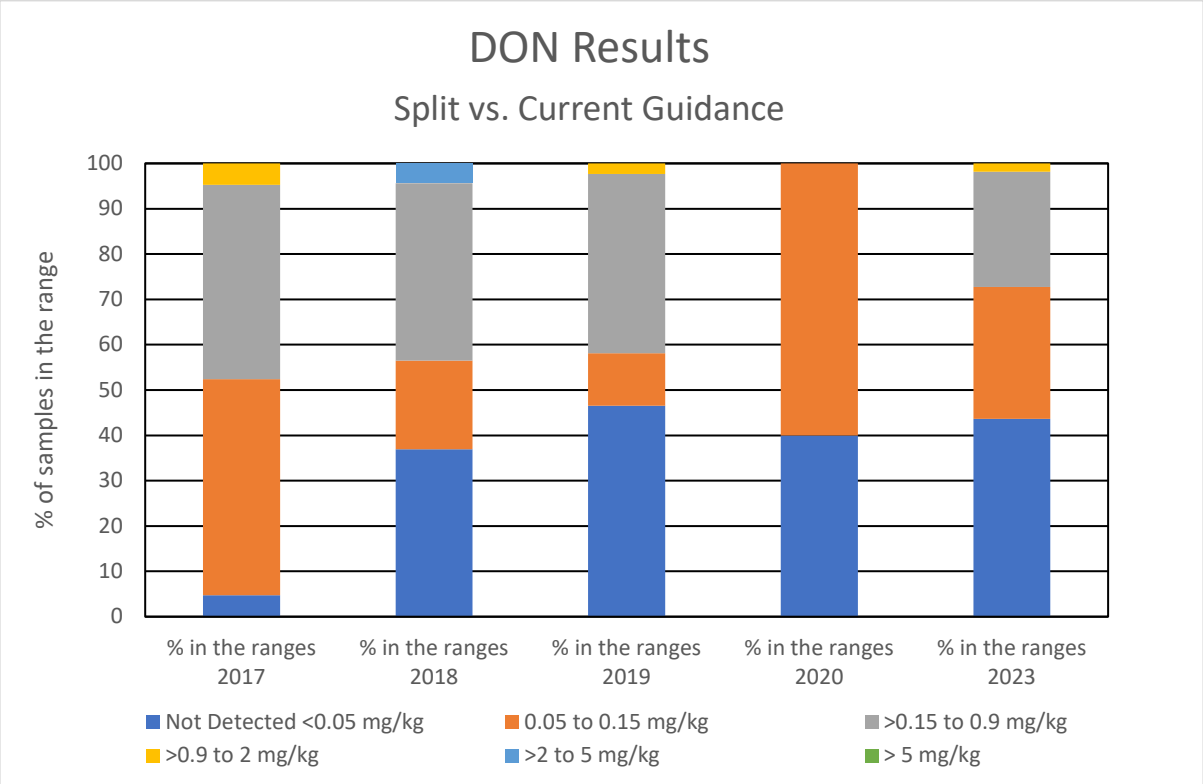
The current guidelines for maximum levels of DON in animal feeds are detailed in table 2. The laboratory results summary is presented in figure 2 and appendix 2.

Table 2: Maximum guidelines for DON in animal feeds (mg/kg)

Level mg/kg	Limit
0.05	Limit of detection for analysis
0.05 to 0.15	Limit of quantification
0.9	Guidance level for compound feed for pigs
2	Guidance level for compound feed for young animals, except piglets
5	Guidance level for other compound feeds

In the years tested, no samples were found to contain DON above the maximum guidance limit for compound feeds of 5mg/kg. Most feed samples were below 0.9 mg/kg. The exceptions to this were in 2017 where one sample was found to be between 0.9 and 2 mg/kg, in 2018 where two samples were found to contain between 2 and 5 mg/kg, and in 2023 one sample was found to contain 0.928 mg/kg of DON. This 2023 feed sample result is just above the feed guidance limit for pigs but was identified as a ruminant blend. This feed tested was therefore within the guidance limits for the species it was intended. Overall results indicate that DON is a low risk currently in UK feed.

Figure 2: Yearly DON results summary (split by guidance limit)



Zearalenone (ZON)

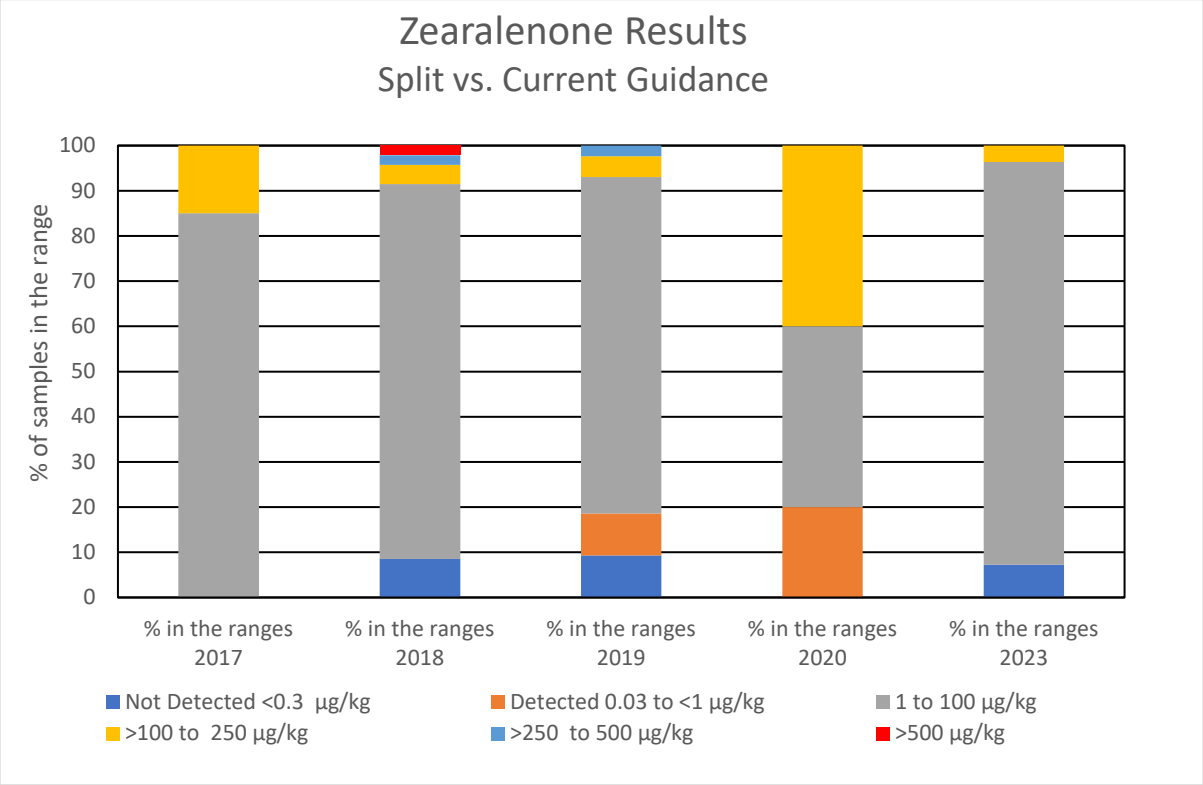
The current guidelines for maximum levels of ZON in animal feeds are detailed in table 3. The laboratory results summary is presented in figure 3 and appendix 3.

Table 3: Maximum guidelines for ZON in animal feeds (µg/kg)

Level µg/kg	Limit
0.3	Limit of detection
0.3 to1	Limit of quantification
100	Guidance level compound feed for piglets, gilts
250	Guidance level compound feed for sows and fattening pigs
500	Guidance level compound feed for calves, dairy cattle, sheep (including lamb) and goats (including kids)

ZON results were within limits for each year tested, except for one 2018 sample of feed which was found contain significantly more ZON than the compound feed guidance limit of 500 µg/kg. This sample contained 1471 µg/kg of ZON. It was described as feed/grain on the laboratory sheet. Assuming this sample was a straight feed grain, it is within the ZON limit of 2000 µg/kg for feed materials except maize. The recent 2023 sample results showed that none were above the maximum of guidance limit for feed of 500 µg/kg, with 96% of those samples below the maximum limit for piglets and gilts, or non-detectable. The highest ZON recovery in 2023 was 147 µg/kg in a beef finisher feed sample.

Figure 3: Yearly ZON results summary (split by guidance limit)



Ochratoxin A

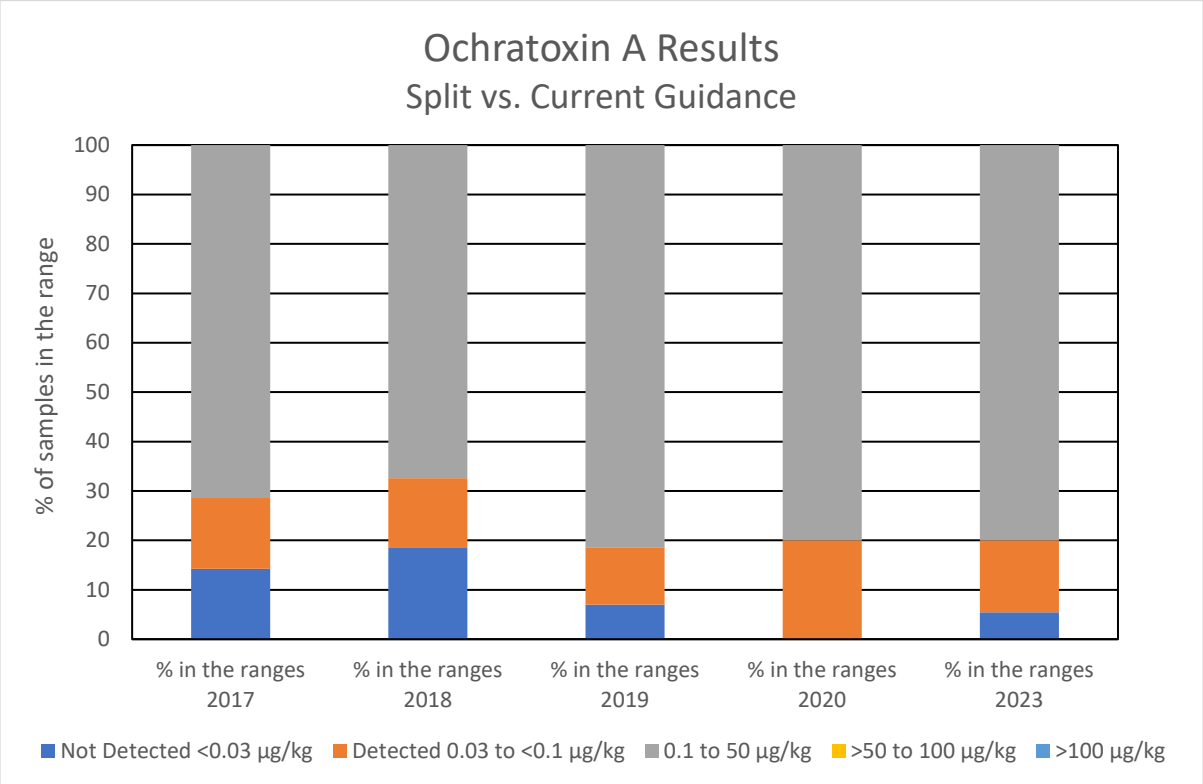
The current guidelines for maximum levels of OTA in animal feeds are detailed in table 4. The laboratory results summary is presented in figure 4 and appendix 4.

Table 4: Maximum guidelines for OTA in animal feeds (µg/kg).

Level µg/kg	Limit
0.03	Limit of detection
0.03 to 0.1	Limit of quantification
50	Guidance level compound feed for pigs
100	Guidance level compound feed for poultry

All OTA levels in the feeds analysed in all years were below 50 ug/kg, the guidance level of compound feed for pigs. The risk of OTA in UK feed would currently appear low. The highest recovery in the 2023 sampling cohort was 3.39 ug/kg in a pig finisher feed, and the highest recoery in 2019 18.3 ug/kg in a sample described as feed.

Figure 4: Yearly OTA results summary (split by guidance limit)



Fumonisin B1 and B2

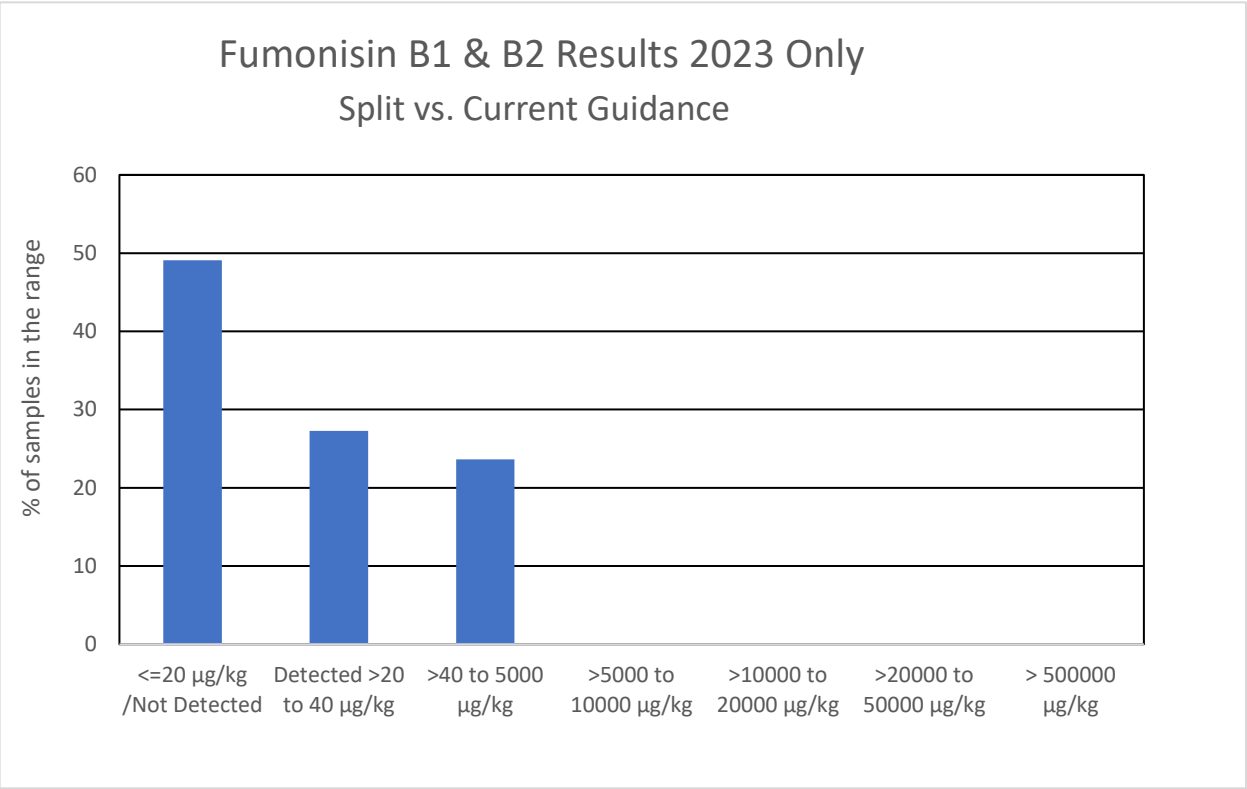
Fumonisin B1 and B2 were evaluated in 2023 only. The current guidelines for maximum levels of Fumonisin B1 and B2 in animal feeds are detailed in table 5. The laboratory results summary is presented in figure 5 and appendix 5.

Table 5: Maximum guidelines for Fumonisin B1 and B2 in animal feeds (µg/kg)

Level µg/kg	Limit
5000	Guidance level compound feed pigs, horses (Equidae), rabbits and pet animals
10000	Guidance level compound feed fish
20000	Guidance level compound feed for poultry, calves (< 4 months), lambs and kids
50000	Guidance level compound feed for adult ruminants (> 4 months)

The highest recovery of B1 and B2 in the feed samples evaluated was 1972 µg/kg. This individual sample was identified as a ruminant blend. In total, 76% of the samples were less than 40 µg/kg, or did not contain quantifiable amounts.

Figure 5: Fumonisin B1 and B2 2023 results summary (split by guidance limit)



T-2 and HT-2

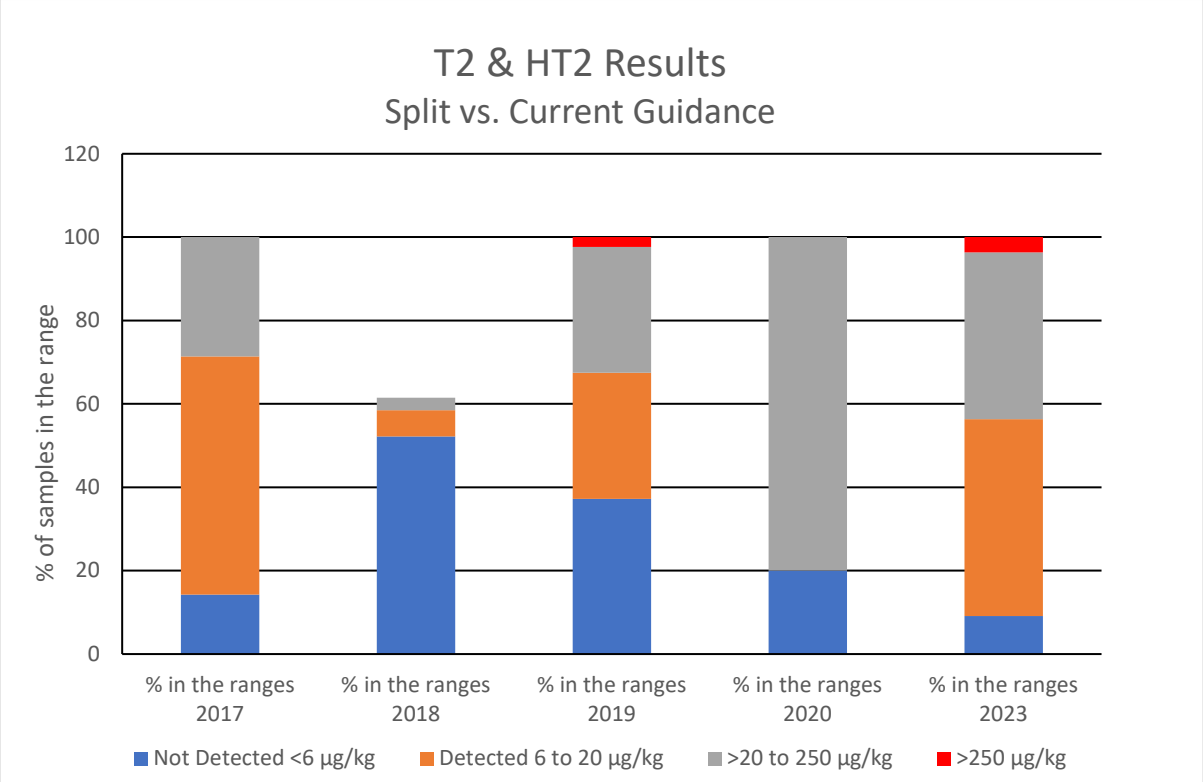
The current guidelines for maximum levels of T-2 and HT-2 in animal feeds are detailed in table 6. The laboratory results summary is presented in figure 6 and appendix 6.

Table 6: Maximum guidelines for T-2 and HT-2 in animal feeds (µg/kg)

Level µg/kg	Limit
<6	Limit of detection
6 – 20	Limit of quantification
250	Guidance level for compound feeds

Most feeds were found to contain less than 250 µg/kg of T2 and HT-2, except in 2019 and 2023. In 2019, a recovery of 1147.8 µg/kg in a sample described as "feed" was found. The next highest recovery more than the guidance level for compound feed was in a 2023 dairy compound of 355.97 µg/kg, along with a second sample of calf and beef nuts which was found to contain 250.96 µg/kg T-2 and HT-2. These outlier results suggest that feed producers should be aware of spikes in content of the mycotoxins T-2 and HT-2 in feed materials, and possible sources, such as oat products, which tend to be a higher mycotoxin risk. Care must be taken to ensure that feeds produced do not exceed T-2 and HT-2 guidance limits, even if incidences of this happening are low.

Figure 6: T-2 and HT-2 results summary (split by guidance limit)



Conclusion

Monitoring of UK feed production over the recent years indicates a low level of mycotoxin in compound feeds for animals. Most samples tested, did not exceed the mycotoxin guidance limits. Companies should however maintain in-house due diligence testing of mycotoxins, according to their risk assessment, of feed

materials and finished feed to minimise the risk of exceeding species-specific guidance limits. The results of this survey indicate that manufacturers should consider raw material sources of T-2/ HT-2 and ZON, to ensure that guidance limits are not exceeded.

For more information, please contact

Sarah-Jane Godfrey
Technical Manager
sarah-jane.godfrey@agindustries.org.uk
01733 385246

Appendix 1: Aflatoxin results segmented by guidance limit

Aflatoxin	Not Detected/Detected <0.01 µg/kg	5 µg/kg Max. Compound feed for dairy cattle and calves, dairy sheep and lambs, dairy goats and kids, piglets and young poultry animals 0.01 to 5 µg/kg	10 µg/kg Max. Other complementary and complete feed >5 to 10 µg/kg	20 µg/kg Max. Compound feed for cattle (except dairy cattle and calves), sheep (except dairy sheep and lambs), goats (except dairy goats and kids), pigs (except piglets) and poultry (except young animals) >10 to 20 µg/kg	>20µg/kg	Total Number of Feed Samples	Maximum Amount Recovered µg/kg
Numbers 2017	3	18	0	0	0	21	0.4
% in the ranges 2017	14	86	0	0	0		
Numbers 2018	17	30	0	0	0	47	0.4
% in the ranges 2018	36	64	0	0	0		
Numbers 2019	14	29	0	0	0	43	2.02
% in the ranges 2019	33	67	0	0	0		
Numbers 2020	1	4	0	0	0	5	1.29
% in the ranges 2020	20	80	0	0	0		
Numbers 2023	14	41	0	0	0	55	1.88
% in the ranges 2023	25	75	0	0	0		
						171	

	Mean µg/kg	Standard Dev. of the Sample
2017	0.072	0.092
2018	0.069	0.091
2019	0.118	0.307
2020	0.300	0.092
2023	0.083	0.252

Appendix 2: DON results segmented by guidance limit

DON	Not Detected <0.05 mg/kg	Point of detection 0.05 to 0.15 mg/kg	0.9 mg/kg Max. compound feed for pigs >0.15 to 0.9 mg/kg	2 mg/kg Max. Compound feed for young animals, except piglets >0.9 to 2 mg/kg	5 mg/kg Max. Other compound feeds >2 to 5 mg/kg	> 5 mg/kg	Total Number of Feed Samples	Maximum Amount Recovered mg/kg
Numbers 2017	1	10	9	1	0	0	21	1.13
% in the ranges 2017	5	48	43	5	0	0		
Numbers 2018	17	9	18	0	2	0	46	4.39
% in the ranges 2018	37	20	39	0	4	0		
Numbers 2019	20	5	17	1	0	0	43	1.27
% in the ranges 2019	47	12	40	2	0	0		
Numbers 2020	2	3	0	0	0	0	5	0.15
% in the ranges 2020	40	60	0	0	0	0		
Numbers 2023	24	16	14	1	0	0	55	0.928
% in the ranges 2023	44	29	25	2	0	0		
							170	

	Mean mg/kg	Standard Dev. of the Sample
2017	0.28	0.25
2018	0.34	0.81
2019	0.22	0.25
2020	0.11	0.05
2023	0.17	0.17

Appendix 3: ZON results segmented by guidance limit

ZON

			100 µg/kg Max. Compound feed for piglets, gilts	250 µg/kg Max. Compound feed for sows and fattening pigs	500 µg/kg Max. compound feed for calves, dairy cattle, sheep (including lamb) and goats (including kids)			
	Not Detected <0.3 µg/kg	Detected 0.03 to <1 µg/kg	1 to 100 µg/kg	>100 to 250 µg/kg	>250 to 500 µg/kg	>500 µg/kg	Total Number of Feed Samples	Maximum Amount Recovered µg/kg
Numbers 2017	0	0	17	3	0	0	20	185
% in the ranges 2017	0	0	85	15	0	0	0	0
Numbers 2018	4	0	39	2	1	1	47	1471
% in the ranges 2018	9	0	83	4	2	2	0	0
Numbers 2019	4	4	32	2	1	0	43	319
% in the ranges 2019	9	9	74	5	2	0	0	0
Numbers 2020	0	1	2	2	0	0	5	22
% in the ranges 2020	0	20	40	40	0	0	0	0
Numbers 2023	4	0	49	2	0	0	55	147
% in the ranges 2023	7	0	89	4	0	0	0	0
							170	

	Mean µg/kg	Standard Dev. of the Sample
2017	42.05	45.93
2018	69.30	221.46
2019	42.38	56.69
2020	14.00	6.32
2023	18.88	28.46

Appendix 4: OTA results segmented by guidance limit

OTA	Not Detected <0.03 µg/kg	Detected 0.03 to <0.1 µg/kg	50 µg/kg Max. Compound feed for pigs 0.1 to 50 µg/kg	100 µg/kg Max. Compund Feed for poultry >50 to 100 µg/kg	>100 µg/kg	Total Number of Feed Samples	Maximum Amount Recovered µg/kg
Numbers 2017	3	3	15	0	0	21	24.3
% in the ranges 2017	14	14	71	0	0	0	0
Numbers 2018	8	6	29	0	0	43	2.4
% in the ranges 2018	19	14	67	0	0	0	0
Numbers 2019	3	5	35	0	0	43	18.3
% in the ranges 2019	7	12	81	0	0	0	0
Numbers 2020	0	1	4	0	0	5	4.5
% in the ranges 2020	0	20	80	0	0	0	0
Numbers 2023	3	8	44	0	0	55	3.93
% in the ranges 2023	5	15	80	0	0	0	0
						167	

	Mean µg/kg	Standard Dev. of the Sample
2017	2.02	5.31
2018	0.50	0.53
2019	1.41	3.15
2020	1.56	1.74
2023	0.54	0.71

Appendix 5: Fumonisin B1 and B2 results segmented by guidance limit

B1 & B2

	Not Detected <=20 µg/kg /Not Detected	Detected >20 to 40 µg/kg	500 µg/kg Max. Compound feed pigs, horses (Equidae), rabbits and pet animals >40 to 5000 µg/kg	10000 µg/kg Max Compound feed fish >5000 to 10000 µg/kg	20000 µg/kg Max. Compound feed for poultry, calves (< 4 months), lambs and kids >10000 to 20000 µg/kg	50000 Max µg/kg Compound feed for adult ruminants (> 4 months) >20000 to 50000 µg/kg	> 500000 µg/kg	Total Number of Feed Samples	Maximum Amount Recovered µg/kg
Numbers 2023	27	15	13	0	0	0	0	55	1972
% in the ranges 2023	49	27	24	0	0	0	0	0	0

	Mean µg/kg	Standard Dev. of the Sample
2017	-	-
2018	-	-
2019	-	-
2020	-	-
2023	117.31	310.39

Appendix 6: T-2 and HT-2 results segmented by guidance limit

T2 & HT-2

	Not Detected <6 µg/kg	Detected 6 to 20 µg/kg	250 µg/kg Max. Compound Feeds >20 to 250 µg/kg	>250 µg/kg	Total Number of Feed Samples	Maximum Amount Recovered µg/kg
Numbers 2017	3	12	6	0	21	39
% in the ranges 2017	14	57	29	0		
Numbers 2018	24	15	7	0	46	236.8
% in the ranges 2018	52	6	3	0		
Numbers 2019	16	13	13	1	43	1147.8
% in the ranges 2019	37	30	30	2		
Numbers 2020	1	0	4	0	5	37.9
% in the ranges 2020	20	0	80	0		
Numbers 2023	5	26	22	2	55	355.97
% in the ranges 2023	9	47	40	4		
					170	

	Mean µg/kg	Standard Dev. of the Sample
2017	20.31	20.82
2018	19.74	39.02
2019	46.18	173.69
2020	26.88	12.88
2023	35.13	57.48