BRIEFING DOCUMENT

Deoxynivalenol (DON)

Updated January 2023

Summary

Deoxynivalenol (DON) is a mycotoxin produced by several *Fusarium* fungi species, with wet conditions at the time of flowering a risk factor for DON production in wheat in the UK. There are legal limits for DON in grain and grain-based products intended for human consumption. UK flour milling businesses adopt several strategies to ensure compliance including a significant industry-wide programme of DON testing at harvest. Extensive monitoring data show DON levels in the UK crop have been manageable in recent years.

Deoxynivalenol (DON)

Deoxynivalenol (DON), sometimes called vomitoxin, is a mycotoxin (secondary metabolites produced by moulds and fungi that are toxic to humans and animals if consumed in enough quantities). It mainly occurs in grains such as wheat, barley, oats, rye and maize. The occurrence of DON is associated primarily with *Fusarium graminearum and F.culmorum,* both of which cause the disease Fusarium headblight in wheat and ear blight in maize. The incidence of Fusarium headblight is strongly associated with moisture at the time that the crop is flowering (anthesis), and the timing of rainfall, rather than the amount, is the critical factor.

Fusarium infections during flowering can bleach the ears resulting in grains that are pink or white and shrivelled, this is however not a reliable indication of mycotoxin occurrence, purely of the presence of fusarium. Wet weather delays harvest and increases mycotoxin risk as warm and wet conditions encourage mycotoxin production by Fusarium species. DON levels are very unlikely to increase when the grain is stored post-harvest.

DON is chemically stable and may pose a potential risk to human health if consumed in significant quantities. In addition to DON, there are several derivatives that are important from a toxicological perspective as they break down into DON in the digestive system. These are principally, 3-acetyl-DON (3Ac-DON), 15-acetyl-DON (15Ac-DON) and DON-3-glucoside (DON-3-Glc).

Legislation

The principal piece of legislation regarding mycotoxins is retained Commission Regulation (EC) No. 1881/2006, as amended. This Regulation sets out specific rules in relation to mycotoxins and other contaminants and includes specific maximum levels (MLs) for certain mycotoxins in individual foodstuffs. The EU maximum levels were retained in UK law as part of the EU-UK Withdrawal Agreement and apply to wheat, flour and flour-based products, among other cereals. The EU has undertaken a review of DON limits and has proposed to lower them for all product categories, to apply from 01 July 2024. Although these proposals are yet to be voted on and confirmed, changes are not expected. An overview of the DON statutory levels is as follows:

	DON limit (µg/kg)	
Product	**Current GB, NI and EU ML**	**Proposed new EU and NI ML from 01 July 2024**
Unprocessed wheat and barley	1,250	1,000
Flour / cereal milling products	750	600
Bread, bakery wares and breakfast cereals	500	400
Cereal-based infant food	200	150

As NI is subject to EU food safety regulation, these lower limits will also apply to product sold in NI. GB food safety regulation is now a UK competency and the Food Standards Agency (FSA) has indicated GB limits will not change automatically to align with EU changes, but a review of DON limits will begin in the first quarter of 2023. The timeline for any potential changes to GB limits is not clear beyond this.

There are no statutory maximum levels for animal feeds but there are Guidance Values for DON in grain intended for animal feedstuffs. The European Commission is considering setting maximum limits for DON in animal feedstuffs.

Animal feed product	DON limit (µg/kg)
Feed grains	8,000
Complete feedstuffs for pigs	900
Complete feedstuffs for calves, lambs and kids	2,000

The UK Flour Millers strategy

The national control strategy for DON relies on farmers understanding the issue and taking appropriate steps to amend cultivations, using targeted fungicides and being aware of adverse weather conditions. AHDB has developed a 'risk assessment' for DON (available here), which farmers supplying the milling market are familiar with. All suppliers of wheat to flour mills are required to provide a risk assessment number on the grain passport. Growers must also provide a DON test result on each grain passport demonstrating the grain has been tested and is under the legal maximum.

UK flour millers monitor levels of DON at intake as part of their 'due diligence' procedures. Should a load of grain arrive at a mill and when tested be found over the maximum legal limit the mill reports this to the Red Tractor Assurance Scheme, who follow up with the grower to ensure the issue is rectified on farm.

In addition to monitoring at intake, millers submit samples each September as part of the AHDB Contaminants Monitoring Project. These samples are tested for DON using confirmatory methods (typically HPLC).

Milling wheat tested via AHDB Contaminant Monitoring Project							
Year	Samples (n)	LOQ (µg/kg)	% samples tested positive	Mean* (µg/kg)	Median* (µg/kg)	Minimum (µg/kg)	Maximum (µg/kg)
2022	50	10	52%	21	10	<10	174
2021	51	10	90%	102	61	<10	620
2020	50	10	88%	58	27	<10	537
2019	50	10	76%	68	25	<10	798
2018	50	10	50%	51	8	<10	420
2017	50	10	98%	214	108	<10	1,540
2016	51	5	96%	129	54	9	1,006
2015	75	10	51%	41	10	<10	632
2014	75	10	92%	110	58	<10	755
2013	76	10	99%	214	122	<10	1,040
2012	51	10	100%	402	210	24	2,780
2011	47	10	32%	13	5	<10	87
2010	42	10	48%	25	5	<10	138

*Where <LOQ is assumed as LOQ*0.5

Millers also contribute a significant quantity of data from DON testing as grain arrives at the mill. This monitoring programme takes place early in the season to inform the national control strategy for each harvest. Data are shared across all member companies and with partners across the supply chain. This collaborative work culminates in an annual 'Mycotoxin Stakeholder Group' meeting. This format has been very successful in managing the situation and preventing adverse impacts on flour-based foods.

Milling wheat tested via UKFM harvest monitoring programme					
Year	Total samples	DON result (µg/kg)			
		<500	≥500 to <1000	≥1000 to ≤1250	>1250
2022	1,295	99.0%	0.9%	0.0%	0.0%
2021	2,111	92.3%	6.2%	0.7%	0.8%
2020	1,538	98.7%	1.0%	0.0%	0.3%
2019	1,790	99.1%	0.7%	0.1%	0.2%
2018	1,650	99.7%	0.2%	0.1%	0.0%
2017	1,956	87.4%	10.9%	0.6%	1.1%
2016	1,359	96.0%	3.4%	0.1%	0.4%
2015	2,066	99.1%	0.8%	0.0%	0.0%
2014	1,587	94.4%	5.0%	0.3%	0.3%
2013	1,887	81.3%	16.2%	0.6%	1.9%
2012	3,919	76.3%	19.4%	1.6%	2.7%
2011	2,270	99.3%	0.7%	0.0%	0.0%
2010	2,405	98.7%	1.2%	0.0%	0.0%
2009	2,247	92.0%	7.4%	0.1%	0.4%
2008	3,303	46.9%	43.1%	5.8%	3.7%
2007	2,601	68.2%	25.5%	4.3%	1.9%

UK Flour Millers members have participated in this extensive monitoring programme for over 15 years. Experience shows that 2012 was a 'high' incidence year in contrast to others. Over the past five years there have been manageable levels of DON in the UK wheat crop. 2022 is a very low DON risk year.

Future work

UK Flour Millers will continue to monitor and report on the levels of DON in wheat, as well as any changes to legal limits. Dialogue is maintained with the National Farmers Union, AHDB, the UK Assurance schemes, Agricultural Industries Confederation, the Maltsters Association of Great Britain, the Association of Cereal Food Manufacturers, and others in the grain supply chain. The Mycotoxin Stakeholder Group, made up of representatives of these organizations, continues to meet to discuss and manage the risk presented by DON and ensure the safety of the supply chain.

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