
UK FLOUR MILLERS BRIEFING DOCUMENT

Deoxynivalenol (DON)

Revised November 2020

Summary

Deoxynivalenol (DON) is a mycotoxin produced by several *Fusarium* species but most commonly in the UK *Fusarium graminearum* and *Fusarium culmorum*. These species produce fusarium head blight symptoms in wheat. Fusarium head blight occurs because of moisture during flowering and is associated with timing of rainfall rather than the amount. The EU has set legal limits for DON in grain intended for human consumption. UK flour millers adopt several strategies to ensure compliance.

Mycotoxins

There are more than 300 recorded mycotoxins, which are substances produced by certain moulds and fungi as secondary metabolites which are toxic to humans and animals at low levels. The main mycotoxins of interest to food safety are the Aflatoxins, Ochratoxin A, Patulin, Fusarium toxins (DON, ZON, fumonisins and T2 & HT2), Alternaria toxins and Ergot alkaloids (see other Briefings).

Deoxynivalenol (DON)

Deoxynivalenol (DON), sometimes called vomitoxin, is a type B trichothecene. 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 Fusarium headblight in wheat and ear blight in maize. A direct relationship between the incidence of Fusarium headblight and DON incidence in wheat has been established. 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. Levels of DON in wheat are determined by a number of factors including varietal susceptibility, previous crop, cultivation practices and fungicide use.

Fusarium infections during flowering can bleach the ears resulting in grains that are pink or white and shrivelled, this is however no indication of mycotoxin occurrence, purely of the presence of fusarium. Similar symptoms may be produced by *Microdochium* fungi but these do not produce mycotoxins.

Wet weather delays harvest and increases mycotoxin risk as warm and wet conditions encourage mycotoxin production by *Fusarium* species. DON is very unlikely to increase post-harvest under UK conditions.

Toxicology

DON is chemically stable, can survive food processing stages and may pose a potential risk to human health as well as livestock. DON has been implicated in incidences of toxicosis in humans and farm animals but is one of the least severe mycotoxins. In incidences of human food poisoning where DON has been implicated, patients showed a range of symptoms including abdominal pains, dizziness, headache and vomiting, however, as DON is usually found along with other

trichothecenes, it is highly likely that other related compounds were also present. DON does not bioaccumulate and is not a known carcinogen.

There are several derivatives of DON, principally 3-acetyl-DON (3Ac-DON), 15-acetyl-DON (15Ac-DON) and DON-3-glucoside (DON-3-Glc), which are often detected during analysis for DON and which are broken down to DON within the mammalian digestive system.

Legislation

The principal piece of EU legislation regarding mycotoxins is 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 for certain mycotoxins in individual foodstuffs based on their toxicity and their contribution to consumers' diets, as well as on the ALARA principle (As Low As Reasonably Achievable). According to this principle, maximum levels should be set at the lowest level that can be reasonably achieved by food processors and manufacturers using good practices.

Those mycotoxins for which there are currently specific maximum levels include Aflatoxins, Ochratoxin A, Patulin and the Fusarium toxins including deoxynivalenol, zearalenone and fumonisins.

For DON, these statutory levels are:

	DON (ppb)
Unprocessed common wheat and barley	1,250
Unprocessed durum wheat and oats	1,750
Flour	750
Finished products	500
Infant food	200

There are no statutory levels for animal feeds but the EU has set Guidance Values for DON in Grain Intended for Animal Feedstuffs.

	DON (ppb)
Feed Grains	8,000
Complete feedstuffs for pigs	900
Complete feedstuffs for calves, lambs and kids	2,000

The European Commission is currently considering changes to the DON maximum levels. If changes are made, they will occur after the end of the Brexit transition period and so will not apply automatically in UK law, although the Food Standards Agency may choose to adopt similar regulations. **UK Flour Millers** will monitor any changes and brief members to ensure continued compliance.

Mycotoxin testing

There are three basic methodologies for testing mycotoxins. These include simple rapid tests that purely indicate the presence or absence of mycotoxins and similar kits which quantify levels present.

Qualitative lateral flow dipstick methods: indicates the presence of a specific mycotoxin above a certain threshold.

Quantitative assay methods: measures the concentration of a specific mycotoxin. They are available in two formats; Quantitative lateral flow which is suitable when a single determination is required and Micro-titer plate ELISA; suitable for analysing multiple samples.

Confirmatory analysis: uses highly developed instruments and trained staff in laboratories with current UK Accreditation Serves (UKAS) status. Its methods are validated against (EC) No 401/2006. This method costs around £90-125 per test.

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 has been communicated to farmers. 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 as set by the EU, the mill reports this to both the Red Tractor Assurance Scheme, who follow up with the grower, and the FSA.

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.

Year	No. of samples	LOQ (µg/kg)	% samples tested positive	Mean* (µg/kg)	Median* (µg/kg)	Minimum (µg/kg)	Maximum (µg/kg)
2010	42	10	48%	25	5	<10	138
2011	47	10	32%	13	5	<10	87
2012	51	10	100%	402	210	24	2,780
2013	76	10	99%	214	122	<10	1,040
2014	75	10	92%	110	58	<10	755
2015	75	10	51%	41	10	<10	632
2016	51	5	96%	129	54	9	1,006
2017	50	10	98%	214	108	<10	1,540
2018	50	10	50%	51	8	<10	420
2019	50	10	76%	68	25	<10	798
2020	50	10	88%	58	27	<10	537

*Where <LOQ is assumed as LOQ*0.5

Millers also contribute data from intake sampling in the early part of the new harvest to inform the overall national strategy each year. This collaborative work with others in the grain supply chain 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.

UK Flour Millers members have been collecting data on DON levels in wheat for the past ten years. Experience indicates that 2008 and 2012 were ‘high’ incidence years in contrast to the other years. Over the past three years there has been low levels of DON in the UK wheat crop.

Year	Total UK Flour Millers samples	Below 500ppb	500 – 1000ppb	1001-1250ppb	Above 1250ppb
2007	2,601	68.2%	25.5%	4.3%	1.9%
2008	3,303	46.9%	43.1%	5.8%	3.7%
2009	2,247	92.0%	7.4%	0.1%	0.4%
2010	2,405	98.7%	1.2%	0%	0%
2011	2,270	99.3%	0.7%	0%	0%
2012	3,919	76.3%	19.4%	1.6%	2.7%
2013	1,887	81.3%	16.2%	0.6%	1.9%
2014	1,587	94.4%	5.0%	0.3%	0.3%
2015	2,066	99.1%	0.8%	0.0%	0.0%
2016	1,359	96.0%	3.4%	0.1%	0.4%
2017	1,956	87.4%	10.9%	0.6%	1.1%
2018	1,650	99.7%	0.2%	0.1%	0.0%
2019	1,790	99.1%	0.7%	0.1%	0.2%
2020	1,538	98.7%	1.0%	0.0%	0.3%

Future work

UK Flour Millers will continue to monitor and report on the levels of DON in wheat and the legal limits and guidance values. 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, will continue to meet to manage the risk presented by DON and ensure the safety of the supply chain.