

## BRIEFING DOCUMENT

# Heavy metals

*Updated April 2022*

### Summary

Heavy metals may enter the food chain where some can bio-accumulate. Customers buying flour (and other foods) are aware of this issue and increasingly seek reassurance from suppliers that due diligence testing is carried out. UK Flour Millers collects data to determine levels of the major heavy metals in wheat as part of Agriculture and Horticulture Development Board (AHDB) Contaminants Monitoring Project, which analyses a range of cereals. Levels of arsenic, cadmium, lead and mercury remain low and well below legal limits. This briefing note provides background information on heavy metals together with results of milling wheat analyses, as well as the current legislative levels for food.

### Background

A heavy, or toxic, metal is an inexact term used to describe metals, including the common transition metals, such as copper, lead and zinc. They are often included in the term potentially toxic elements (PTEs). These metals are a cause of environmental pollution (heavy-metal pollution). Heavy metals are stable and are naturally found in soils where they accumulate in a range of concentrations; some are taken into crop plants and thus pass into the food chain. Heavy metals can also be present in drinking water and the air.

As trace elements, some heavy metals are essential to maintain the metabolism of the human body. However, at higher concentrations they can lead to poisoning. They can be dangerous because they tend to bioaccumulate. Bioaccumulation means an increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment. Different heavy metals have different toxicological properties.

The following are generally accepted as heavy or toxic metals: antimony, arsenic, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, selenium and zinc. Iron, cobalt, copper, manganese, molybdenum, selenium and zinc are required by humans but excessive levels can be damaging; other heavy metals such as arsenic, cadmium, lead, mercury and nickel are toxic metals that have no known vital or beneficial effect to humans. In UK agricultural soils heavy metals arise from the presence of naturally occurring high levels (e.g. in areas of mining), previous industrial uses and may also be influenced by the application of biosolids derived from sewage sludges.

### Legislative levels

In the UK there are a number of different bodies setting legislative levels for the heavy metals listed in the table below. Setting heavy metal maximum limits for products sold in Great Britain is now a UK competency. Products sold in Northern Ireland or exported to EU member states will be subject to EU maximum limits. Currently there is only one divergence between GB and NI/EU heavy metal limits, affecting cadmium.

## UK Flour Millers data

In collaboration with AHDB and others in the grain chain, analyses of some heavy metals have been carried out biennially since 2003 as part of the AHDB-funded Contaminants Monitoring Project and results are sent to UK Flour Millers members. Testing shows that milling wheat is not a significant source of heavy metals and levels of the most toxic heavy metals remain low and well below the legal limits. As the heavy metal content of wheat is determined by the soil in which it is grown, the levels are consistent year to year.

Results in milling wheat are as follows:

<b>Arsenic</b>	<b>2007</b>	<b>2011</b>	<b>2012</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2018</b>	<b>2020</b>	<b>2021</b>
No. of samples	50	47	51	75	20	60	50	25	25
% of samples > LOQ (0.01mg/kg)	26%	13%	51%	4%	35%	15%	30%	16%	28%
Mean (mg/kg)	0.015	0.011	0.019	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Maximum (mg/kg)	0.03	0.03	0.05	0.02	0.01	0.03	0.08	0.16	0.07
% samples above ML	0%	0%	0%	0%	0%	0%	0%	0%	0%
GB and NI/EU Maximum limit (ML)	1.0mg/kg								

<b>Lead</b>	<b>2007</b>	<b>2011</b>	<b>2012</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2018</b>	<b>2020</b>	<b>2021</b>
No. of samples	50	47	51	75	20	60	50	25	25
% of samples > LOQ (0.01mg/kg)	96%	19%	28%	15%	10%	15%	28%	32%	32%
Mean (mg/kg)	0.015	0.013	0.011	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Maximum (mg/kg)	0.06	0.06	0.04	0.06	0.01	0.05	0.03	0.05	0.12
% samples above ML	0%	0%	0%	0%	0%	0%	0%	0%	0%
GB and NI/EU Maximum limit (ML)	0.2mg/kg								

<b>Mercury</b>	<b>2005</b>	<b>2007</b>	<b>2011</b>	<b>2012</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2018</b>	<b>2020</b>	<b>2021</b>
No. of samples	50	50	47	51	75	20	60	50	25	25
% of samples > LOQ (0.01mg/kg)	0%	0%	0%	0%	3%	0%	0%	0%	0%	0%
Mean (mg/kg)	<0.01	<0.01	<0.01	<0.01	0.001	<0.01	<0.01	<0.01	<0.01	<0.01
Maximum (mg/kg)	<0.01	<0.01	<0.01	0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01
GB and NI/EU Maximum limit (ML)	None - no legal limits in cereals									

The EU is considering maximum limits for nickel and it likely these will be set in the near future.

<b>Nickel</b>	<b>2014</b>	<b>2015</b>	<b>2017</b>	<b>2018</b>	<b>2020</b>	<b>2021</b>
No. of samples	75	20	60	50	25	25
% of samples > LOQ (0.01 mg/kg)	100%	100%	100%	100%	100%	100%
Mean (mg/kg)	0.1	0.12	0.13	0.17	0.31	0.27
Maximum (mg/kg)	0.31	0.19	0.52	0.32	1.21	1.34
GB and NI/EU Maximum limit (ML)	None					

In 2012 tin and copper were tested for the first time. All samples tested for tin were below 0.02mg/kg, and all samples tested for copper were below 4.13mg/kg. Copper was tested for again in stored wheat samples from harvest 2017 and all samples were below 4.7mg/kg. There are no legal limits for these two metals.

### Cadmium

For products sold in NI or exported to EU member states, new cadmium maximum levels apply to wheat, wheat bran, wheat germ and gluten. The Food Standards Agency is currently carrying out a risk assessment of cadmium to determine whether the limits affecting products sold in GB need to be updated.

Product category	ML (mg/kg)	
	GB	NI / EU
Wheat	0.20	0.10
Wheat bran and wheat gluten	0.20	0.15
Wheat germ	0.20	0.20

Cadmium	2007	2011	2012	2014	2015	2016	2018	2020	2021
No. of samples	50	47	51	75	20	60	60	25	25
% of samples > LOQ (0.01mg/kg)	100%	96%	100%	100%	100%	100%	100%	100%	100%
Mean (mg/kg)	0.049	0.043	0.047	0.035	0.037	0.038	0.038	0.050	0.042
Maximum (mg/kg)	0.5	0.11	0.11	0.11	0.07	0.09	0.09	0.14	0.09
% samples above NI/EU ML (0.1mg/kg)	-	6%	4%	1%	0%	0%	0%	4%	0%
% samples above GB ML (0.2mg/kg)	-	0%	0%	0%	0%	0%	0%	0%	0%

In 2010, UK Flour Millers and AHDB undertook a survey to determine the ‘worst case’ levels of cadmium in wheat from two distinct areas of the UK. These were Hampshire and Dorset (with high natural cadmium levels) and Northamptonshire and the Midlands (where levels in the soil are moderate, but due to soil pH cadmium may bio-accumulate). These areas were chosen after consulting a Rothamsted Research soil map of the UK. Results are shown in the table below. The maximum concentrations found were within current GB limits and the majority were below the new EU legal limits affecting wheat.

Region	Result (mg/kg cadmium)		
	Midlands	South	Total
No. of samples	15	23	38
Mean	0.027	0.061	0.047
Minimum	0.008	0.019	0.008
Maximum	0.068	0.105	0.105
% ≥ EU ML (0.1mg/kg)	0%	4%	3%
% ≥ GB ML (0.2mg/kg)	0%	0%	0%

In 2011, UK Flour Millers undertook a study of cadmium in wheat, bran and germ triplet samples to provide occurrence data during the discussions to set new EU maximum limits for cadmium in cereals and cereal products. The study found the vast majority of results were below the new EU maximum levels, with only one bran sample exceeding. None of the samples exceeded the maximum limits that continue to apply to products sold in GB.

The summary results were:

Sample type	Result (mg/kg cadmium)		
	Wheat	Germ	Bran
No. samples	39	34	39
Mean	0.037	0.114	0.092
Minimum	0.019	0.03	0.037
Maximum	0.057	0.197	0.164
Mean increase in cadmium over the raw wheat level	-	324%	213%
% ≥ EU ML	0%	0%	2.5%
% ≥ GB ML	0%	0%	0%

### Future actions

UK Flour Millers will continue to monitor and report on the levels of heavy metals in wheat and flour, and will continue to engage with policymakers and researchers as maximum levels are reviewed.

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