BRIEFING DOCUMENT

Heavy metals

Updated January 2023

Summary

Heavy metals may enter the food chain via accumulation from soils. 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.

Some heavy metals, such as 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

Only some heavy metals have legal maximum limits. Setting or adjusting maximum limits for heavy metals in food sold in Great Britain is now a competency of the UK food safety regulators. Products sold in Northern Ireland or exported to EU member states continue to be subject to EU limits. The Food Standards Agency has indicated that GB limits will not change automatically to align with EU changes. Currently there is only one divergence between GB and NI/EU heavy metal limits, affecting cadmium. The EU is also considering changes for nickel maximum levels in foods.

UK Flour Millers data

Heavy metal analyses of wheat used by UK millers has been carried out since 2003 as part of the AHDB Contaminants Monitoring Project. 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 from the past ten years of testing can be found in this document. Cadmium and nickel data are presented in separate sections.

Arsenic								
Harvest year	**2012**	**2014**	**2015**	**2016**	**2018**	**2020**	**2021**	**2022**
No. of samples	51	75	20	60	50	25	25	25
% of samples > LOD (0.01mg/kg)	51%	4%	35%	15%	30%	16%	28%	20%
Mean (mg/kg)	0.019	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Maximum (mg/kg)	0.05	0.02	0.01	0.03	0.08	0.16	0.07	0.03
% samples above ML	0%	0%	0%	0%	0%	0%	0%	0%
GB and NI/EU Maximum limit (ML)	1.0mg/kg							

Lead								
Harvest year	**2012**	**2014**	**2015**	**2016**	**2018**	**2020**	**2021**	**2022**
No. of samples	51	75	20	60	50	25	25	25
% of samples > LOD (0.01mg/kg)	28%	15%	10%	15%	28%	32%	32%	16%
Mean (mg/kg)	0.011	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Maximum (mg/kg)	0.04	0.06	0.01	0.05	0.03	0.05	0.12	0.09
% samples above ML	0%	0%	0%	0%	0%	0%	0%	0%
GB and NI/EU Maximum limit (ML)	0.2mg/kg							

Mercury								
Harvest year	**2012**	**2014**	**2015**	**2016**	**2018**	**2020**	**2021**	**2022**
No. of samples	51	75	20	60	50	25	25	25
% of samples > LOD (0.01mg/kg)	0%	3%	0%	0%	0%	0%	0%	0%
Mean (mg/kg)	<0.01	0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Maximum (mg/kg)	0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
GB and NI/EU Maximum limit (ML)	None - no legal limits in cereals							

Aluminium						
Harvest year	**2011**	**2016**	**2018**	**2020**	**2021**	**2022**
No. of samples	47	60	50	25	25	25
% samples >LOD (0.5mg/kg)	100%	95%	96%	96%	96%	100%
Mean (mg/kg)	2.7	4.4	5.8	10.8	11.5	3.7
Maximum (mg/kg)	6.5	37.6	32.0	101.0	94.4	12.2
GB and NI/EU Maximum limit (ML)	None					

Copper					
Harvest year	**2016**	**2018**	**2020**	**2021**	**2022**
No. of samples	60	50	25	25	25
% samples >LOD (0.5mg/kg)	100%	100%	100%	100%	100%
Mean (mg/kg)	3.4	3.6	3.4	3.7	3.5
Maximum (mg/kg)	4.6	5.2	4.4	5.7	5.5
GB and NI/EU Maximum limit (ML)	None				

Tin	
Harvest year	**2012**
No. of samples	51
% samples >LOD (0.02mg/kg)	0%
Mean (mg/kg)	<0.02
Maximum (mg/kg)	<0.02
GB and NI/EU Maximum limit (ML)	None

Nickel

The EU is considering setting maximum limits for nickel in some foods and draft limits have been proposed. There will be significant discussion before these are agreed and there is currently no indication the UK food safety regulators will begin a similar review of nickel in food.

Nickel							
Harvest year	**2014**	**2015**	**2016**	**2018**	**2020**	**2021**	**2022**
No. of samples	75	20	60	50	25	25	25
% of samples > LOD (0.01 mg/kg)	100%	100%	100%	100%	100%	100%	100%
Mean (mg/kg)	0.1	0.12	0.13	0.17	0.31	0.27	0.18
Maximum (mg/kg)	0.31	0.19	0.52	0.32	1.21	1.34	0.44
% samples above GB ML (N/A)	No GB limit						
% samples above proposed NI/EU ML (0.5mg/kg)	0%	0%	0%	0%	16%	12%	0%

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 10 August 2021. The UK food safety regulators are currently carrying out a risk assessment of cadmium to determine whether the limits affecting products sold in GB need to be updated.

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

Milling wheat monitoring data suggests that the vast majority of wheat used by UK millers complies with the lower NI/EU limit.

Cadmium								
Harvest year	**2012**	**2014**	**2015**	**2016**	**2018**	**2020**	**2021**	**2022**
No. of samples	51	75	20	60	60	25	25	25
% of samples > LOD (0.01mg/kg)	100%	100%	100%	100%	100%	100%	100%	100%
Mean (mg/kg)	0.05	0.04	0.04	0.04	0.04	0.05	0.04	0.04
Maximum (mg/kg)	0.11	0.11	0.07	0.09	0.09	0.14	0.09	0.09
% samples above NI/EU ML (0.1mg/kg)	4%	1%	0%	0%	0%	4%	0%	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.

'Worst case' cadmium study	**Result (mg/kg cadmium)**		
Region	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%

UK Flour Millers also undertook a study of cadmium in wheat, bran and germ triplet samples. The study found the 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.

Triplet sample study	Result (mg/kg cadmium)		
Sample type	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
% ≥ 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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