Acrylamide and Furans Survey Summary

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Authors: Susan MacDonald, Antony Lloyd, Danny Chan, Lisa Bryce, Isabel Grijalvo Diego, Stephen Chapman
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Introduction

Food samples were selected to be exploratory as well as including food groups specified in European Commission Recommendation (EU) 2019/1888 on monitoring acrylamide in food and Retained EU Legislation Commission Regulation (EU) 2017/2158, which sets benchmark levels for some foods. A total of 292 products were sampled, with 162 in Year 1 and 130 in Year 2.

Retained EU Legislation Commission Regulation (EU) 2017/2158 stipulates that for various foods, food business operators should use the measures in the Regulation and include them as part of their food safety management system. This Regulation also established ’benchmark levels’ (BMLs) which applied from 11 April 2018. These benchmark levels were established to provide a measure for how well mitigation methods used to reduce acrylamide are performing. Not all foods sampled by this survey are covered by the benchmark levels set out in Regulation 2017/2158, as sampling was intended to gather data on a wider variety of products.

The highest levels of acrylamide were observed in vegetable crisps (of which carrot and parsnip components contained the highest levels), an extruded vegetable snack product, coffee, a sample of dried apricots and a sample of olives in brine. These findings were similar in both 2020 and 2021.

Where an acrylamide level exceeds a BML, the Food Standards Agency (FSA) asks the local authority to investigate with the food business operator what action has been taken to limit acrylamide and to see if more can be done. An exceedance does not necessarily mean a health risk or that enforcement action may be needed.

There are no action levels for furans. Most samples contained low levels of furans. The highest levels were observed in coffee. When these were used to prepare beverages the resulting levels of furans were much reduced, typically around 1-2% of the levels in the dry coffee.

Background

Acrylamide and furans are produced naturally when some foods are cooked or processed at high temperatures. In October 2016, The Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT) published a risk assessment on acrylamide in the diet of infants and young children and concluded there was a potential concern regarding the development of cancers. In February 2019, the COT published a statement on chemicals in the diet of infants and young children, including furans, and found that exposures to furans are of potential concern. There is limited data on methyl furans in food, which means these conclusions can change as we gain new information.

Levels of acrylamide and furans should be as low as reasonably achievable (ALARA). To achieve this, the FSA is working to gather data on these substances in food and to make sure that the mitigation measures in Retained EU Legislation Commission Regulation (EU) 2017/2158 are being implemented.

Acrylamide

Acrylamide is formed when foods containing the natural occurring amino acid asparagine and certain sugars are heated at temperatures over 120°C. Acrylamide has been found in a range of home-cooked and processed foods, including potato crisps, French fries, bread, crisp breads, and coffee.

Furan and alkylfurans

Furans (meaning furan and furan analogues, known as alkylfurans) are also formed in cooking and food processing. They are found in foods such as coffee, potato snacks and canned foods which have been heated to a high temperature (for example roasting, frying, canning etc.). Alkylfurans such as 2-methylfuran, 3-methylfuran and 2,5-dimethylfuran may occur together with furan and increase overall dietary exposures to furans, necessitating the collection of occurrence data.

Furans evaporate easily, but they cannot evaporate from processed food contained in an airtight sealed pack until the container is opened. Furans may be present in the sealed food though levels will reduce over time once the pack is opened.

Methodology

Sampling

A detailed sampling plan was agreed with the contractor, Fera Science. Sample purchase and collection was subcontracted to Hallmark Veterinary & Compliance Services. A total of 292 samples were purchased over the two-year period. In year one 162 samples were purchased and in year two 130 samples were purchased. Products were categorised according to Retained EU

Legislation Commission Regulation (EU) 2017/2158 where applicable. In addition, Commission Recommendation (EU) 2019/1888 suggests food types that could be monitored for the presence of acrylamide and these products were also included.

Analysis

The contractor, Fera Science, prepared and stored samples according to the Food Standards Agency “Guidelines for undertaking surveys.” Full details of all analytical methods and procedures carried out by Fera Science, including analytical quality assurance, can be found in the contractor’s report.

Results

A total of 292 samples were received by Fera in July and August 2020 and July and August 2021. Samples for home-cooking were cooked according to manufacturers’ instructions. Samples with multiple cooking instructions were prepared using both sets of instructions, for example oven and microwave. These are represented as separate samples below.

Acrylamide

A total of 208 samples were analysed for acrylamide. A summary of the acrylamide concentrations (mean and range) by food category is shown in Table 1. Where applicable, these are compared against BMLs set out in Retained EU Legislation Commission Regulation (EU) 2017/2158 for that category. For samples taken in Northern Ireland in 2021, BMLs set in European Law would apply; however, at the time of sampling, these BMLs were equivalent.

Table 1: Concentrations of acrylamide in food (µg/kg)

Description	Sampling year	Samples	Acrylamide mean	Acrylamide min	Acrylamide max	Acrylamide BML	Acrylamide n>BML
Soft bread	-	-	-	-	-	-	-
Wheat based bread	2020	11	83.4	<30	88.5	50	2
Wheat based bread	2021	7	62.6	<30	94	50	3
Soft bread other than wheat-based bread	2020	1	-	<30	<30	100	-
Soft bread...	2021	5	-	<30	<30	100	-
Breakfast cereals (excluding porridge)	-	-	-	-	-	-	-
Maize, oat, spelt, barley and rice-based products	2020	3	68.8	49.4	106	150	-
Maize...	2021	3	85.3	55.4	121	150	-

Other breakfast cereals	2020	2	205	132	278	300	-
Other breakfast cereals	2021	2	240	194	286	300	-
Fine bakery wares (excluding cakes and pastry)	-	-	-	-	-	-	-
Croissants, doughnuts, pancakes, churros & similar products	2020	18	58.9	<30	72.8	-	-
Croissants...	2021	11	92	<30	196	-	-
Biscuits and wafers	-	-	-	-	-	-	-
Crackers	2020	2	54.05	42.1	66	400	-
Crackers	2021	1	-	117	117	400	-
Biscuits	2020	3	153	5.2	236	350	-
Biscuits	2021	4	248	<30	326	350	-
Coffee (as sold)	-	-	-	-	-	-	-
Roast coffee	2020	6	220	163	356	400	-
-	2021	3	240	127	305	400	-
Instant coffee	2020	4	767	646	884	850	1
-	2021	2	565	443	687	850	-
Coffee (as consumed)	-	-	-	-	-	-	-
Roast coffee	2020	6	199.8	158	299	-	-
-	2021	3	9.8	4.8	13.9	-	-
Instant coffee	2020	4	728.5	535	894	-	-
-	2021	2	5	4.7	5.3	-	-
Coffee substitutes	-	-	-	-	-	-	-
Coffee substitutes not based on cereals and chicory (as sold)	2020	5	-	<30	56	-	-

Coffee substitutes not based on cereals and chicory (as consumed)	2020	5	59	<30	93	-	-
Baby foods & processed cereal-based food intended for infants and young children.	-	-	-	-	-	-	-
Savoury ready meals	2021	10	-	<30	35.5	40	-
Baby foods & savoury ready meals intended for infants and young children	2021	5	-	<30	<30	40	-
Biscuits and rusks for infants and young children	2021	5	256	<30	276	150	3
Other products based on cereals and potatoes	-	-	-	-	-	-	-
Cereal Snacks (for example, Rice Crackers, Maize Crackers etc)	2020	3	-	<30	70	400	-
Cereal Snacks (for example, Rice Crackers, Maize Crackers etc)	2021	1	-	93.5	-	400	-
Cereal Snacks (for example, Rice Cakes)	2020	7	204	89.8	414	350	1
Cereal Snacks (for example, Rice Cakes)	2021	4	196	81.5	308	350	-
Potato Products for example, rosti, croquettes	2020	15	163.5	<30	409	750	-
-	2021	5	59.2	<30	88.9	750	-
Potato based ready meals (for example, potato and cheese, casserole, potato, and meat)	2020	7	121.4	<30	218	750	-
-	2021	3	-	<30	106	750	-
Others	-	-	-	-	-	-	-

Jacket potatoes	2020	1	84.1	84.1	84.1	-	
Jacket potatoes	2021	2	662.5	228	1097	-	
Roasted Nuts	2020	4	-	<30	91.8	-	-
Roasted Nuts	2021	4	61.2	<30	77.7	-	-
Roasted Oilseeds	2020	3	-	<30	<30	-	-
Roasted Oilseeds	2021	3	-	<30	70	-	-
Dried Fruits	2020	5	251	<30	454	-	-
Dried Fruits	2021	5	261.8	<30	451	-	-
Roasted Cocoa Beans and Derived Products	2020	3	314	<30	364	-	-
Roasted Cocoa Beans and Derived Products	2021	3	171	68.8	274	-	-
Olives in Brine	2020	3	-	<30	281	-	-
Olives in Brine	2021	3	-	<30	490	-	-
Confectionery for example, fudge, caramel, nougat	2020	4	-	<30	<30	-	-
Confectionery	2021	2	-	<30	<30	-	-
Vegetable Crisps	2020	11	1154	<30	2634	-	-
Vegetable Crisps	2021	13	941	<30	2464	-	-
Vegetable Fries/Chips	2020	8	205	<30	433	-	-
Vegetable Fries/Chips	2021	7	45.05	<30	58.6	-	-
Processed cereal based snacks intended for infants and young children (0-3 yrs) excluding biscuits and rusks	2020	14	106	<30	182	40*	5
Processed cereal based snacks	2021	14	87	<30	140	40*	5

* BML does not apply to all products within this category

Furans

A total of 112 samples were analysed for furans. A summary of the concentrations (mean and range) of furans and methylfurans by food category is shown in the following tables.

Table 2: Concentrations of furan in food (µg/kg)

Description	Sampling date	Samples	Furan Mean	Furan min	Furan max
Potato snacks	2020	5	32.8	11	77
Potato snacks	2021	5	28.44	9.1	55
Breakfast cereals excluding porridge	2020	3	37	21	55
Breakfast cereals excluding porridge	2021	3	19.7	16.5	25.2
Fine bakery wares (excluding cakes and pastry)					
Other fine bakery products (crackers, biscuits etc)	2020	5	61.25	<5	158
Other fine bakery products	2021	5	53.8	<5	120.8
Coffee	-	-	-	-	-
As sold	2020	10	2316.4	74	5076
-	2021	5	2701	<1000	3243
As consumed	2020	10	50.3	<5	75
-	2021	5	20.5	<2.5	29.7
Coffee substitutes not based on chicory or cereals	-	-	-	-	-
As sold	2020	5	1948	<20	1948
As consumed	2020	5	6	<5	6
Baby foods & processed cereal based foods intended for infants and young children	-	-	-	-	-
Ready meals	2020	10	19.67	13	42
Ready meals	2021	10	67.2	14.4	160.4
Muesli, Rice, Porridge	2020	12	19.75	<5	30
Biscuits and Rusks	2020	4	20	<5	33

Baby foods for example rice, porridge and rusks	2021	10	93.1	<2.5	93.1
Vegetable crisps	2020	11	14.72	5	44
Vegetable crisps	2021	13	14.31	6	29.9
Soups and fruit juices	2020	7	18.5	<5	28
Soups and fruit juices	2021	7	20.2	<2.5	20.9

Table 3: Concentrations of 2-methylfuran in food (µg/kg)

Description	Sampling date	Samples	2-methylfuran Mean	2-methylfuran min	2-methylfuran max
Potato snacks	2020	5	10	<5	12
Potato snacks	2021	5	9.85	<5	14.7
Breakfast cereals excluding porridge	2020	3	17	15	19
Breakfast cereals excluding porridge	2021	3	11	8	16.1
Fine bakery wares (excluding cakes and pastry)	-	-	-	-	-
Other fine bakery products (crackers, biscuits etc)	2020	5	52.5	<5	116
Other fine bakery products	2021	5	38	<5	82.3
Coffee	-	-	-	-	-
As sold	2020	10	8389.7	231	20920
-	2021	5	8477	1522	11866
As consumed	2020	10	108.78	<5	255
-	2021	5	49.9	3.7	96.3
Coffee substitutes not based on chicory or cereals	-	-	-	-	-
As sold	2020	5	1985	<20	1985
As consumed	2020	5	6	<5	6
Baby foods ans processed cereal based foods intended for infants and young children	-	-	-	-	-

Ready meals	2020	10	5	<5	5
Ready meals	2021	10	11.46	5.9	18.5
Muesli, Rice, Porridge	2020	12	7	<5	11
Biscuits and Rusks	2020	4	6.5	<5	8
Baby foods for example rice, porridge and rusks	2021	10	18.1	<2.5	18.1
Vegetable crisps	2020	11	22	<5	65
Vegetable crisps	2021	13	17.67	6	34.4
Soups and fruit juices	2020	7	5	<5	5
Soups and fruit juices	2021	7	6.5	<2.5	6.7

Table 4: Concentrations of 3-methylfuran in food (µg/kg)

Description	Sampling date	Samples	3-methylfuran Mean	3-methylfuran min	3-methylfuran max
Potato snacks	2020	5	5	<5	5
Potato snacks	2021	5	9.2	<5	9.2
Breakfast cereals excluding porridge	2020	3	5	<5	5
Fine bakery wares (excluding cakes and pastry)	-	-	-	-	-
Other fine bakery products (crackers, biscuits etc)	2020	5	28.5	<5	36
Other fine bakery products	2021	5	10.25	<5	12.6
Coffee	-	-	-	-	-
As sold	2020	10	459.78	<20	825
As consumed	2020	10	7.4	<5	10
-	2021	5	4.1	<2.5	4.6
Coffee substitutes not based on chicory or cereals	-	-	-	-	-
As sold	2020	5	43	<20	43

Baby foods and processed cereal based foods intended for infants and young children	-	-	-	-	-
Ready meals	2020	10	6.5	<5	7
Ready meals	2021	10	10.77	<5	17.1
Vegetable crisps	2020	11	6.8	<5	10
Vegetable crisps	2021	13	7.16	<5	8.7
Soups and fruit juices	2021	7	5.3	<2.5	5.3

Table 5: Concentrations of 2-ethylfuran in food (µg/kg)

Description	Sampling date	Samples	2-ethylfuran Mean	2-ethylfuran min	2-ethylfuran max
Potato snacks	2020	5	55.4	20	147
Potato snacks	2021	5	31.64	8.3	94
Breakfast cereals excluding porridge	2020	3	14	<5	14
Fine bakery wares (excluding cakes and pastry)	-	-	-	-	-
Other fine bakery products (crackers, biscuits etc)	2020	5	21.5	<5	36
Other fine bakery products	2021	5	24.55	<5	26.4
Coffee	-	-	-	-	-
As sold	2020	10	206	<20	307
Coffee substitutes not based on chicory or cereals	-	-	-	-	-
As sold	2020	5	26	<20	26
Baby foods and processed cereal based foods intended for infants and young children	-	-	-	-	-
Ready meals	2020	10	18.41	6.6	56.3
Ready meals	2021	10	11.46	5.9	18.5
Muesli, Rice, Porridge	2020	12	18	<5	32

Biscuits and Rusks	2020	4	6	<5	6
Baby foods for example rice, porridge and rusks	2021	10	11.4	<2.5	11.4
Vegetable crisps	2020	11	16.2	7	29
Vegetable crisps	2021	13	17.5	5.9	91.3
Soups and fruit juices	2020	7	26	<5	26
Soups and fruit juices	2021	7	7	<2.5	7

Table 6: Concentrations of 2,5-dimethylfuran in food (µg/kg)

Description	Sampling date	Samples	2,5-dimethylfuran Mean	2,5-dimethylfuran min	2,5-dimethylfuran max
Fine bakery wares (excluding cakes and pastry)	-	-	-	-	-
Other fine bakery products (crackers, biscuits etc)	2020	5	5	<5	5
Coffee	-	-	-	-	-
As sold	2020	10	836.3	22	1827
-	2021	5	1726.5	<1000	1776
As consumed	2020	10	8.83	<5	11
-	2021	5	7.27	<2.5	10.5
Coffee substitutes not based on chicory or cereals	-	-	-	-	-
As sold	2020	5	193	<20	193
Baby foods and processed cereal based foods intended for infants and young children	-	-	-	-	-
Muesli, Rice, Porridge	2020	12	7	<5	11
Biscuits and Rusks	2020	4	6.5	<5	8
Vegetable crisps	2020	11	8	<5	8
Vegetable crisps	2021	13	7.2	<5	7.3

Table 7: Concentrations of 2,3-dimethylfuran in food (µg/kg)

Description	Sampling date	Samples	2,3-dimethylfuran Mean	2,3-dimethylfuran min	2,3-dimethylfuran max
Baby foods and processed cereal based foods intended for infants and young children	-	-	-	-	-
Ready meals	2021	10	7.2	<5	7.2

Table 8: Concentrations of 2-propylfuran in food (µg/kg)

Description	Sampling date	Samples	2-propylfuran Mean	2-propylfuran min	2-propylfuran max
Baby foods and processed cereal based foods intended for infants and young children	-	-	-	-	-
Muesli, Rice, Porridge	2020	12	5	<5	5
Vegetable crisps	2021	13	5.74	<5	6.7

Table 9: Concentrations of 2-butylfuran in food (µg/kg)

Description	Sampling date	Samples	2-butylfuran Mean	2-butylfuran min	2-butylfuran max
Coffee	-	-	-	-	-
As sold	2020	10	5	<20	5
Vegetable crisps	2021	13	6.3	<5	8.6

Table 10: Concentrations of 2-pentylfuran in food (µg/kg)

Description	Sampling date	Samples	2-pentylfuran Mean	2-pentylfuran min	2-pentylfuran max
Potato snacks	2021	5	52.8	25	88.8
Breakfast cereals excluding porridge	2021	3	17.57	13.4	19.8
Fine bakery wares (excluding cakes and pastry)	-	-	-	-	-
Other fine bakery products (crackers, biscuits etc)	2021	5	74.86	15.9	171.2
Coffee	-	-	-	-	-
As sold	2020	10	9	8	10

Coffee substitutes not based on chicory or cereals	-	-	-	-	-
As sold	2020	5	56	<20	56
Baby foods and processed cereal based foods intended for infants and young children	-	-	-	-	-
Ready meals	2021	10	31.71	11.1	107.2
Baby foods for example rice, porridge and rusks	2021	10	10.42	<2.5	15.6
Vegetable crisps	2021	13	318.38	49.1	696.2
Soups and fruit juices	2021	7	7.85	<2.5	9.4

All brand owners have received their results with the opportunity to comment where the BML was exceeded. Individual analytical results for each product and category including brand names, batch numbers and best before dates, where available, can be found in the contractor's report.

Conclusion

This survey gives a 'snapshot' of the range of levels of acrylamide and furans in different products on sale in the UK during the sampling period. Levels of these process contaminants can vary depending on raw materials used by the manufacturer and processing conditions. It is not possible to draw definitive conclusions for individual brands sampled from this data.

Most of the samples analysed for acrylamide were chosen to collect exploratory data and so do not have BMLs. In both years, the highest levels of acrylamide were observed in vegetable crisps, dry coffee, a sample of dried apricots, and one of black olives. The levels of acrylamide in coffee were drastically reduced when measured 'as consumed', after the coffee had been prepared as a beverage. The results were similar in Years 1 and 2.

Furans evaporate easily and levels in some packaged foods can be reduced by heating and stirring in an open saucepan. Packets that are repeatedly opened and closed during use will a reduce levels of furans during the shelf life of the product. Furans will also evaporate from hot drinks in an open container. The COT recommends that efforts to reduce furans should continue and monitoring should be continued to deepen our knowledge.

There are no action levels for furans and the data from this study is for information gathering only. Most samples contained low levels of furans. The highest levels were observed in coffee, however as with acrylamide when the coffee was prepared as a beverage the resulting levels of furans were much reduced, typically around 1-2% of the levels in the dry coffee. For foods such as baby ready meals and ready to eat soups, low levels of furans were found.

The results from this survey do not increase our concern about the risk to human health. Food businesses are required to use acrylamide mitigation measures in their food safety management systems. Businesses are also expected to undertake representative sampling and analysis where appropriate to monitor the levels of acrylamide in their products. This exploratory data provides information that may be used to design future sampling studies and to support decision making in the possible setting of future regulatory levels. More information on acrylamide legislation is

available on the FSA website.

Summary of Units

microgram (µg): one thousandth of a milligram (mg)

gram (g): one thousandth of a kilogram (kg)

kilogram (kg): one thousand grams

µg/kg: microgram per kilogram