



# Acrylamide and Furan in Retail Products

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## 1. Acrylamide and Furan in Retail Products (Year 2)

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### Report of Analysis of Retail Products for Acrylamide and Furan for Food Standards Agency – Year 1 Fera Science Ltd.

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### 3. Glossary

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2,3-DMF	2,3-dimethylfuran
2,5-DMF	2,5-dimethylfuran
2MF	2-methylfuran
3MF	3-methylfuran
ALARA	As low as reasonably achievable
EFSA	European Food Safety Authority
EURL	European Reference Laboratory
Fapas®	Food Analysis Performance Assessment Scheme (Proficiency Testing)
FSA	Food Standards Agency
GC-MS	Gas Chromatography Mass Spectrometry
HS-GC-MS	Headspace Gas Chromatography Mass Spectrometry
IS	Internal Standard
LC-MS/MS	Liquid Chromatography Tandem Mass Spectrometry
LOQ	limit of quantification
MOE	Margin of Exposure
NRL	National Reference Laboratory
UKAS	United Kingdom Accreditation Service

## 4. Executive Summary

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This study was commissioned as a result of a call from the Food Standards Agency to produce data on acrylamide, furan and alkyl furans in food to gain information on the occurrence of these contaminants in UK foods to inform future regulatory decisions. The study will run over two consecutive years to allow trending of data year on year. This report summarises the findings of Year 2.

The second year has been successfully completed. One hundred and thirty samples were purchased to an agreed sampling plan. Of these, seventy eight samples were analysed for acrylamide, twelve were analysed for furans, and forty were analysed for both. Analysis for acrylamide was carried out using a method that is accredited to ISO 17025.

A method was developed and validated for 2-methylfuran, 3-methylfuran, 2,5-dimethylfuran, 2-ethylfuran, butylfuran and propylfuran and 2-pentylfuran in foods. Target limits of quantification (LOQ) not higher than 5 µg/kg for foods and 20 µg/kg for coffee, were achieved for most analytes. The method has been accredited to ISO 17025 using Flexible Scope.

As furan and its methyl analogues such as 2-methyl furan and 3-methyl furan are highly volatile, some furan samples were prepared according to the manufacturers' instructions prior to analysis to be tested 'as consumed'.

This survey is intended to be exploratory and to gather data. As such, it should be borne in mind that many of the products included in this survey do not fall within the description categories in Retained Regulation (EU) 2017/2158 <sup>(1)</sup> and therefore BMLs do not apply to many of the products sampled.

The highest levels of acrylamide were observed in vegetable crisps, (carrot and parsnip components contained the highest levels), an extruded veggie straw product, coffee, a sample of dried apricots and a sample of olives in brine. Coffee drinks prepared from the ground or instant coffee contained low levels of acrylamide, which when calculated for the preparation method gave similar levels of acrylamide for the instant or ground coffee used to prepare them.

There are no guidance levels or action levels for furans. The majority of samples contained low levels of furans. The highest levels were observed in coffee, both ground and instant. When these were used to prepare beverages the resulting furan levels were much reduced, typically around 1% of the levels in the dry coffee. For foods such as baby ready

meals, and ready to eat soups, low levels of furan were found. Pentylfuran was found in some products, highest levels were in vegetable crisps, but were indicative due to analytical issues. Further work to improve the analysis of pentylfuran is recommended. This data gives a snapshot of the levels of processing contaminants in a range of products purchased in 2021. The results from this year and Year 1 will be combined in a final report and will be used to draw comparisons between acrylamide and furan levels in similar samples across 2 years.

## 5. Introduction

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### 5.1 Background to the study

Acrylamide, furan and alkyl furans (e.g. 2-methyl furan and 3-methyl furan) are organic chemicals produced when food is heated to high temperatures during cooking and food processing. EFSA published risk assessments of acrylamide and furan in food in 2015 and 2017 respectively. The Food Standards Agency (FSA) has concluded that exposure to these process contaminants should be as low as reasonably achievable (ALARA) and has previously funded monitoring of acrylamide and furans to gather occurrence data in UK retail foods. This study will build on the previous studies by providing analytical data on the occurrence of acrylamide and furan, 2-methylfuran and 3-methylfuran, as well as other alkylfurans, namely 2,5-dimethylfuran, 2,3-dimethylfuran, 2-ethylfuran, 2-butylfuran, 2-propylfuran and 2-pentylfuran, in selected foodstuffs.

Retained European Commission Regulation (EU) 2017/2158 <sup>(1)</sup>, established mitigation measures and 'benchmark levels' (BML) for the reduction of the presence of acrylamide in food. Member States and food business operators are required to monitor acrylamide levels in the foodstuffs listed in Annex IV of the regulation. In addition, Commission Recommendation (EU) 2019/1888 <sup>(2)</sup>, published in November 2019, suggested a non-exhaustive list of products for monitoring. Commission Recommendation 2007/196/EC <sup>(3)</sup> sets out a recommendation for the monitoring of the presence of furan, 2-methylfuran and 3-methylfuran in foodstuffs. At the end of the transition period applicable EU legislation as it stood on 31<sup>st</sup> December 2020 was converted into domestic law, therefore the 'benchmark levels' are applicable in Great Britain and Northern Ireland.

### 5.2 Acrylamide

Acrylamide is a natural chemical that is formed when starchy foods such as bread and potatoes are cooked for long periods at high temperature. When these foods are cooked (fried, baked, roasted, toasted or grilled) to above 120°C acrylamide can be formed.

Acrylamide is formed mainly from sugars and the amino acid asparagine, which are both found naturally in foods, as a result the chemical process, the Maillard Reaction.

Acrylamide does not usually occur in foods that have been cooked using lower temperatures such as boiling, but it has been found in a wide range of processed and

home-cooked foods including potato crisps and chips (fries), bread, crispbreads and coffee.

### **5.3 Furan and alkyl furans**

Furan and furan analogues are formed naturally in foods during roasting or heating. Furans are produced from several precursors including ascorbic acid, amino acids, carbohydrates, unsaturated fatty acid and carotenoids. They can be found in a variety of foods including coffee, and canned or jarred foods. An EFSA Scientific Opinion published in 2017 <sup>(4)</sup> reviewed occurrence data for furan but reported no occurrence data was available for methyl furans (2-methylfuran, 3-methylfuran and 2,5-dimethylfuran), therefore no assessment of exposure to these compounds could be made. The highest exposures of furan were estimated to occur in the youngest population group, i.e. infants. Furan was assessed as being potentially nephrotoxic, hepatotoxic and due to some indications of genotoxicity the CONTAM Panel decided it was not appropriate to establish a tolerable daily intake, instead they used a Margin of Exposure approach. The calculated MOE was smaller than 10,000 which would indicate a health concern. Due to the fact that methyl furans occur together and the potential for chronic dietary exposure to these compounds EFSA stated that methylfurans may add significantly to the overall exposure and therefore increase the cause for concern for hepatotoxicity. The CONTAM Panel recommended that additional data on the occurrence of methylfurans in food as well as changes in concentration of furan and methylfurans during the different steps of coffee preparation should be produced.

### **5.4 Aims and Objectives of the Study**

This study was commissioned as a result of a specific call from the Food Standards Agency to produce data on acrylamide, furan and alkyl furans in food in response to the European Commission monitoring recommendations and to gain information on the occurrence of these contaminants in UK foods.

A sampling plan of target foodstuffs was agreed with the FSA, with sampling to be conducted on each of two years. In Year 2, 130 samples were purchased to be analysed for acrylamide or furans or both. Analysis over two years is intended to allow trending of data year on year. Samples for acrylamide analysis were selected to be exploratory and includes foods from the Annex in Commission Recommendation (EU) 2019/1888 <sup>(2)</sup>, and the products listed in Retained Commission Regulation (EU) 2017/2158 <sup>(1)</sup>.



Analysis for acrylamide was carried out using a method that fully meets the requirements in Annex III of Retained Commission Regulation (EU) 2017/2158 <sup>(1)</sup> and is accredited to ISO 17025. For 2-methylfuran, 3-methylfuran, 2,5-dimethylfuran, 2-ethylfuran and 2-pentylfuran in foods, a method was validated, with a target limit of quantification (LOQ) not higher than 5 µg/kg for foods and 20 µg/kg for coffee, and accredited to ISO 17025 (UKAS) based on guidelines from Commission Recommendations 2007/331/EC <sup>(5)</sup> and 2007/196/EC <sup>(3)</sup>. Additional compounds 2,3-dimethylfuran, 2-propylfuran and 2-butylfuran were included in 2021.

As furan and its methyl analogues such as 2-methylfuran and 3-methylfuran are highly volatile, some furan samples were prepared according to the manufacturers' instructions prior to analysis and tested as received and as consumed to allow for any losses during preparation.

The study has run over two years, this report summarises the results of the Year 2 sampling plan.

This survey is intended to be exploratory and to gather data. It should be borne in mind that many of the products included in this survey do not fall within the description categories in Retained Regulation (EU) 2017/2158 <sup>(1)</sup> and therefore benchmark levels do not apply to many of the products sampled.

## 6. Methodology

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### 6.1 Samples

Sample purchase and collection was subcontracted to HallMark Veterinary & Compliance Services. A draft sampling plan was provided by the Food Standards Agency, this was used to plan purchase and collection of samples. The detailed sampling plan was agreed in advance by the Food Standards Agency before sampling started. Samples were collected from a number of regions throughout the UK over an 8 week period in July and August 2021. Samples were purchased from a broad range of retailers and included a variety of brands. Products were broadly categorised according to the food descriptions in Retained Commission Regulation (EU) 2017/2158 <sup>(1)</sup>. In addition, Commission Recommendation (EU) 2019/1888<sup>(2)</sup> sets out a list of food types that should be monitored for the presence of acrylamide and samples of these products were also included. The sampling scheme for Year 2 was designed, as far as possible to replicate the sampling from Year 1 to allow comparisons to be made year on year.

### 6.2 Sample preparation

Samples were prepared and stored according to the Food Standards Agency “Guidelines for undertaking surveys” <sup>(6)</sup>.

For samples requiring acrylamide analysis only, the whole sample was homogenised and split into portions for analysis and storage. Potato products such as croquettes and potato based meals and other vegetable chips such as onion rings and sweet potato fries samples were analysed as received.

For samples that required both furan and acrylamide analysis, the samples were split equally. A homogenised sample was prepared from one portion for acrylamide analysis. Samples for furan were kept intact and opened and mixed in cooled conditions before being placed immediately in cooled headspace vials for analysis. Where appropriate, samples for furan analysis were also analysed as purchased and as consumed. For example, some foods for young children and infants were sampled and analysed immediately from the container after opening and after heating according to the manufacturers’ instructions.

Coffee was analysed as purchased and as consumed. Coffee brews were prepared following packet instructions, the exact sample weight and volume of hot water were recorded during preparation.

### **6.3 Analysis for acrylamide**

Analysis for acrylamide was carried out using an ISO 17025 accredited method. The method is based on the CEN/TS 17083:2017 Foodstuffs - Determination of acrylamide in food and coffee by gas chromatography-mass spectrometry (GC-MS) <sup>(7)</sup>. Quality control samples including procedural blanks, in-house reference samples and spiked samples were included in each batch.

### **6.4 Analysis for Furan and alkyl furans**

A method for furan, 2-methyl furan and 3-methyl furan was already in place in the laboratory. The method was expanded to include furan, 2-methyl furan, 3-methyl furan, 2,5-dimethylfuran, 2,3-dimethylfuran, 2-ethylfuran, 2-pentylfuran, 2-butylfuran and 2-propylfuran. Method development to investigate the most appropriate conditions for different matrices was carried out. Satisfactory validation was obtained for all analytes except 2-pentylfuran, 2-butylfuran and 2-propylfuran in some matrices, and where reported these results are for information and are not accredited.

Isotopically labelled standards Furan-d4, 2-methyl-furan-D6, 3-methyl-furan-D3, 2-ethylfuran-D5, 2,5-dimethylfuran-D6 and 2-pentylfuran-D11 were used in the analysis. Quality control samples including procedural blanks, in-house reference samples and spiked samples were included in each batch. Results are UKAS accredited (ISO 17025), following accreditation of the method via Flexible Scope.

## 7. Results and Discussion

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### 7.1 Sampling

All 130 samples planned were collected during the 8 week sample collection period. There were no significant deviations in terms of the samples per retailer and areas, some minor deviations were due to occasional unavailability of the sample or insufficient quantity available at the selected supermarkets. When this was the case, initially pre-assigned retailers were swapped for samples from small retailers and wholesalers. All samples were transferred to the laboratory under appropriate conditions, e.g. chilled or frozen, samples were couriered using cold boxes and were immediately placed in fridges or freezer on receipt. Samples were logged in using a Laboratory Information Management System (LIMS) and were each assigned a unique number.

### 7.2 Sample preparation

Samples for acrylamide analysis only were homogenised using the most suitable equipment, and if necessary, using cryomilling. Stones and brine were removed from products in jars.

Baby foods were prepared according to the manufacturers for instructions, using water to reconstitute dried products where required. For vegetable crisps and chips, the packets were opened, and the samples sorted into the individual vegetable varieties. These were homogenised and analysed separately.

All sample homogenisation methods have been previously shown to produce an acceptably homogenous sample as they are used routinely for the preparation of proficiency test samples.

### 7.3 Acrylamide analysis by GC-MS

The method is based on CEN TS 17083:2017 Foodstuffs – Determination of acrylamide in food and coffee by Gas Chromatography-Mass Spectrometry (GC-MS)) <sup>(7)</sup> and is accredited to ISO 17025.

For analysis the test portion was extracted with hot water, isotopically labelled acrylamide was added as an internal standard. High fat samples were defatted with hexane, cleared with Carrez solution and centrifuged.

Sample extracts were brominated and extracted with ethyl acetate. Following removal of the ethyl acetate and evaporation, triethylamine is added to partially debrominate, after

which the sample extracts were injected onto a GC/MS system for quantification using selected ion monitoring.

#### **7.4 Furan and alkyl furan analysis by Headspace GC-MS**

Samples were analysed by headspace GC-MS, using isotopically labelled standards where they are available. Internal standards used were: Furan-d4, 2-methyl-furan-D6, 3-methyl-furan-D3, 2-ethylfuran-D5, 2,5-dimethylfuran-D6, and 2-pentylfuran-D11. 2-ethylfuran D5 was used as an internal std for propyl and butylfuran, and 2,5-dimethylfuran-D6 was used as internal standard for 2,3-dimethylfuran.

#### **7.5 Analytical quality assurance**

All analyses were performed by trained staff in a UKAS accredited laboratory. All test methods were validated in house. Analysis for acrylamide was already accredited to ISO17025. Analysis for furans was in-house validated during this study and is accredited by Flexible Scope.

Each batch of samples included procedural blanks, in-house reference samples and / or spiked samples. Isotopically labelled standards were used to control the methods where they were available.

The laboratory also participates in the Fapas® proficiency testing scheme for acrylamide and furan (Series 30). Three rounds were undertaken during Year 2 of the survey for acrylamide in a variety of food products (all included in this survey). All results were satisfactory. There was no round for furans during the reporting period, therefore a previous Fapas® test material and a reference standard supplied by LGC were used to assess method performance. Results for acrylamide PT performance are given in Table 30. Batch QC data for acrylamide and furan analyses are given in Table 31 and Table 32 respectively. Results for furan accuracy and precision checks are given in Table 33 and Table 34.

For samples found to contain higher concentration residues, or where residues were close to or above relevant Benchmark levels, the analysis was repeated in duplicate to confirm the initial finding. All confirmed results are the mean of at least 3 determinations.

## 7.6 Acrylamide results

### 7.6.1 Bread samples

Twelve samples of 'Bread' samples were analysed for acrylamide. These included two rye bread and a rye and buckwheat boule, six samples that contained olive (ciabatta and bloomer) and speciality flat bread and bloomers. Eight samples were below the LOQ (<30 µg/kg) acrylamide. Two samples of bloomer with olives contained acrylamide above the LOQ, these were S21-029481, a Trio of olive bloomer that contained 57 µg/kg, and S21-031870 a bloomer with Kalamata olives that contained 56 µg/kg. A ciabatta with olives (S21-030362) contained 45 µg/kg and a sample of mixed olive rolls (S21-031498) contained 82 µg/kg. The results are given in Table 11. A BML of 50 µg/kg is given for 'soft bread – wheat-based bread' in Retained Commission Regulation (EU) 2017/2158 <sup>(1)</sup>. All of these products listed wheat as their main ingredient, however it is not clear if they meet the definition of 'soft bread'. It is possible that the inclusion of olives as an ingredient contributed to the acrylamide content, as acrylamide has been reported in olives <sup>(8)</sup> and was also found in an olive sample tested in this survey. However, this cannot be confirmed as the sample was homogenised and analysed as a whole product.

### 7.6.2 Breakfast Cereals (excluding porridge)

Five samples, two honey roasted muesli and three other traditional breakfast cereals, were analysed and results are given in Table 12. Acrylamide levels found ranged from 55 µg/kg in a sample of cornflakes (S21-029925) to 286 µg/kg in a wheat biscuit (S21-030722). Benchmark levels range from 100 µg/kg for maize, oat, spelt, barley and rice based products to 300 µg/kg for bran products, whole grain cereals and wheat and rye based products. All samples were below their respective BML.

### 7.6.3 Fine Bakery Wares (excluding cakes and pastry)

Sixteen samples of fine bakery wares were analysed for acrylamide. Results are presented in Table 13. Eleven samples of pre-packed or instore bakery products including croissants, doughnuts, pancakes and other products e.g. churros, Danish pastries and Yumyums were included.

The two samples of croissants did not contain acrylamide above the LOQ (<30 µg/kg). Acrylamide was not found above the LOQ in the doughnut sample. For the two yum yums samples, one was below the LOQ, while the other (S21-030715) contained 118 µg/kg, the churros sample did not contain acrylamide (<30 µg/kg). The highest level of acrylamide

found in these bakery products was 196 µg/kg in sample S21-030632, a sample of buttermilk pancakes.

The other five products were samples of shortbread, cream crackers, rye cracker bread, oat cakes and wholegrain crackers. Of these, the shortbread did not contain acrylamide above the LOQ (<30 µg/kg), the other four products contained levels from 117 to 326 µg/kg. The highest level was found in the rye crispbread sample (S21-030627).

There are BMLs for biscuits (350 µg/kg), crackers (400 µg/kg) and crispbread (350 µg/kg), none of the samples that fit in these categories exceeded the Benchmark levels. The remainder of samples in the Fine Bakery Wares group contained no detectable or very low levels of acrylamide, all contained <100 µg/kg acrylamide. There are no BMLs for these products.

#### 7.6.4 Coffee

Five samples of coffee, two instant and three ground were analysed for acrylamide, both as purchased then 'as consumed'. Acrylamide levels in the instant coffee – 'as bought' were 443 and 687 µg/kg, the highest level was found in a sample of decaff coffee (S21-0029483). The BML for instant coffee is 850 µg/kg, and neither product exceeded this. The BML applies to the product as sold.

The acrylamide levels in the drinks prepared from these samples, the 'as consumed' samples, were 4.7 and 5.3 µg/L respectively.

For the ground coffee the acrylamide levels ranged from 121 to 305 µg/kg, the BML for roast coffee is 400 µg/kg. None of the samples exceeded this. The levels in the corresponding 'as consumed' samples ranged from 4.8 to 13.9 µg/L. For analysis acrylamide is extracted from the sample using hot water, which is the same as the brewing process, typically, 15 g was brewed in 250 ml water for roast coffee, whereas for instant 5 g was used. Therefore, the agreement between dry and brewed coffee is expected. Results are presented in Table 14.

#### 7.6.5 Foods intended for infants and young children – savoury meals

Ten savoury ready meals intended for infants and young children (based on cereals) were purchased. These were analysed as purchased. Nine samples contained acrylamide below the LOQ (<30 µg/kg). One sample (S21-029922) of chicken and sweet potato curry contained 36 µg/kg.

#### 7.6.6 Foods intended for infants and young children – rice, rusks, and porridge

Ten samples of cereal based foods intended for infants and young children including baby rice, porridge, rusks and baby biscuits/biscotti were purchased. These were analysed as purchased, and results are given in Table 16.

Seven products including rusks, muesli, baby rice, porridge and teething biscuits contained acrylamide below the LOQ.

The sample of vanilla and banana baby biscuit (S21-030714), contained 232 µg/kg acrylamide, a sample of apple biscotti (S21-031495) contained 259 µg/kg and a soft banana biscotti (S21-029923) contained 276 µg/kg. All results are the mean of three measurements. The BML for Biscuits and rusks for infants and young children is 150 µg/kg.

#### 7.6.7 Other products based on cereals and potatoes – potato products

Eight potato products were analysed. These were five products such as rosti and croquettes, and three potato based ready meals. Samples were analysed as purchased. All results are given in Table 17.

Sample S21-0031597 (mini roasties) contained the lowest level, acrylamide was not found above the LOQ. The levels found in the four other products ranged from 51 µg/kg for sample S21-0029614, cheese croquettes, to 94 µg/kg in potato waffles (S21-0030611).

The three potato based ready meals (e.g. potato and cheese, potato and meat) were also analysed as purchased. Potato Dauphinoise and the cottage pie both contained <30 µg/kg acrylamide. A sample of cheese & bacon potato skins (S21-030635) contained 106 µg/kg. Retained Regulation (EU) 2017/2158 contains a BML of 500 µg/kg for French Fries (ready to eat), i.e. as sold direct to consumers from takeaways. None of these products would be categorised as ready to eat and so the Benchmark does not apply. It is most likely that any possible future regulatory levels for this type of products would be set for products as sold, rather than as consumed. All of the potato samples were below 500 µg/kg.

#### 7.6.8 Other products based on cereals and potatoes – cereal snacks.

Five samples of cereal snacks (e.g. Rice Cakes & corn cakes, Rice cakes and Rice Crackers) were analysed for acrylamide (Table 17).

Three were rice cakes, and one was a rice and corn cake. Levels in these samples ranged from 82 to 416 µg/kg. There was one rice cracker sample, it contained 94 µg/kg. There are no BMLs for these products.

#### 7.6.9 Snacks intended for infants and young children



Fifteen samples of snacks marketed for young children were included in the study. These included a selection of products such as rice cakes, oat bars, and extruded vegetable snacks. There is a BML of 150 µg/kg acrylamide for biscuits and rusks for infants and young children, however the definition of these products is as defined in Retained Regulation (EU) 609/2013 <sup>(9)</sup>. Six samples were rice cakes or oat bars and would fit the definition from Retained Regulation (EU) No 609/2013 of 'processed cereal-based food - rusks and biscuits which are to be used either directly or, after pulverisation, with the addition of water, milk or other suitable liquids'. The other products included in the survey, for example veggie straws, or carrot puffs, while marketed for children, do not meet this definition and therefore the BMLs do not apply.

Five samples contained <30 µg/kg acrylamide, (Table 18), all samples that the BML would apply to were in this category. Four samples contained levels between 32 and 73 µg/kg these were rice cakes, crunchy wheels, sweetcorn and carrot tubes and melty veggie sticks. Four samples contained from 103 µg/kg (carrot & lentil sticks) to 132 µg/kg (S21-030301 carrot puffs). The highest level of 1758 µg/kg was found in sample S21-029615, veggie straws. This result is an average of three determinations as the analysis was repeated to confirm the result.

#### 7.6.10 Others – vegetable crisps and vegetable fries or chips

Seven samples of vegetable crisps were included in the survey, results are given in Table 20. Where the product was a mixture of vegetables, these were hand sorted into the individual types and these analysed separately.

The sample of hummus chips (S21-031546) and the sample of mushroom crisps (S21-029608) contained no acrylamide (<30µg/kg). The samples of lentil chips (S21-030298 and S21-030435) contained 276 and 79 µg/kg respectively.

The other three samples were mixtures of beetroot, carrot and parsnip (S21-030297 and S21-031496), and beetroot, parsnip and sweet potato (S21-030719). For sample S21-030297 the lowest acrylamide concentration was found in the parsnip component (78 µg/kg), while the carrot contained 2464 µg/kg and the beetroot contained 586 µg/kg. For S21-031496 the carrot component contained 1191 µg/kg, the parsnip 490 µg/kg and the beetroot 1026 µg/kg. For S21-030719 the sweet potato contained 597 µg/kg, the parsnip 2114 µg/kg and the beetroot 1456 µg/kg. These results were the average of 3 determinations.

Five samples of vegetable chips or fries, and onion rings were analysed. These were analysed as purchased. The mixed root vegetable sample was split into the vegetable

types before analysis. The sample of onion rings (S21-030127) contained 59 µg/kg. Sample S21-031494, sweet potato fries, contained <30 µg/kg, while a sweet potato chips samples S21-031596 contained 59 µg/kg. The three vegetables in mixed root vegetable sample S21-030612 contained <30 µg/kg (parsnip), 33 µg/kg (carrot) and 30 µg/kg (beetroot). The honey glazed parsnips did not contain acrylamide (<30µg/kg). There are no BMLs applicable for any of these products.

#### 7.6.11 Others – miscellaneous products

A small number of each of the following products listed in the Annex of Recommendation (EU) 2019/1888 were included in the survey: Roasted Nuts, Roasted Oilseeds, Dried Fruits, Roasted cocoa beans and derived products, Olives in brine, and Confectionary e.g. toffee, nougat. All results are given in Table 19.

Four samples of roasted nuts were analysed, two contained no acrylamide above the LOQ, one sample (S21-030121) contained 45 µg/kg and one (S21-029921) contained 78 µg/kg. Two of the three roasted oilseeds did not contain acrylamide (<30 µg/kg), while the other sample (S21-030631) contained 70 µg/kg. Five dried fruit samples were analysed, three contained <30 µg/kg, the sample of chopped dates (S21-029485) contained 73 µg/kg and the sample of apricots (S21-030716) contained 451 µg/kg (average of 3 analyses). The two confectionary samples, and two of the three olives samples did not contain acrylamide. The third olive sample (S21-029924) contained 490 µg/kg. This was a sample of black pitted olives in brine.

Three samples of cocoa nibs were analysed, they contained from 69 to 274 µg/kg. There are no BMLs set for any of these products.

## 7.7 Furan and alkyl furan results

### 7.7.1 Potato crisps, snacks, crackers and other potato products from potato dough

Five samples of potato products were analysed for furans, results are in Table 21. Furan was detected in all samples in the range 9 µg/kg to 55 µg/kg. The lowest level was found in potato crisps (S21-029603), the highest in 'popped potato chips' (S21-031864). Low concentrations of 2-methylfuran were found in four of the samples, one sample contained a very low concentration of 3-methylfuran just above the LOQ of 5 µg/kg (S21-030629). Ethyl-furan was found in all samples at levels from 8 to 94 µg/kg, the highest level was found in sample S21-029919 which contained furan and 2-methyl furan but no 3-methylfuran. None of the samples contained 2,5-dimethylfuran, 2,3-dimethylfuran, butylfuran or propylfuran above the LOQ. Three samples contained pentyl furan in the range 56 to 89 µg/kg, although these results are indicative due to the low recovery determined.

### 7.7.2 Other breakfast cereals

Three samples of traditional breakfast cereal were analysed for furans (Table 22). All three samples contained low levels of furan and 2-methylfuran. No other furans were detected in any of the samples above the LOQ.

The cornflake sample (S21-029925) contained 25 µg/kg furan and 8.9 µg/kg 2-methylfuran. The wheat biscuit (S21-030722) contained 16.5 µg/kg furan and 16.1 µg/kg 2-methylfuran, while the multigrain hoops (S21-030364) contained 17.4 µg/kg furan and 8 µg/kg 2-methylfuran.

### 7.7.3 Other fine bakery products (Crackers, biscuits etc)

Five samples of crackers, rye bread, oat cakes and shortbread were analysed (Table 23). Furan was detected in the shortbread sample (S21-030300) at a very low level, but no other furans were detected in this sample.

Furan levels in the other four samples ranged from <5 to 121 µg/kg. These four samples contained 2MF, from 10 to 82 µg/kg, two samples contained 3MF and these also contained ethylfuran. 2,3-DMF, 2,5-DMF, propylfuran and butylfuran were not detected in any sample. The two samples that contained rye both contained pentylfuran, at levels of 135 and 171 µg/kg. Again these values are indicative due to high recovery.

### 7.7.4 Coffees as sold and as consumed

Three ground coffees and two instant coffees were analysed 'as sold' and also 'as consumed', after making a beverage following the manufacturers instructions. All results are given in Table 24.

For the instant coffees, propylfuran was not found in any of the samples above the LOQ. The LOQ was higher for some samples (<20 µg/kg) due to background interferences in these matrices. Furan was found in both samples at 41 µg/kg (S21-029838) and 435 µg/kg (S21-029483). Sample S21-029838 contained 199 µg/kg 2MF and 26 µg/kg 2,5-dimethyl furan, but none of the other furans were detected in this sample. Only 2-MF was detected (3.7 µg/kg) in the beverage prepared from this sample.

2-methylfuran was the compound found at the highest concentration in the other instant coffee sample (S21-029483) at a level of 1522 µg/kg. 3MF was found at a level of 66 µg/kg, and 2,5-dimethyl furan was found at a level 158 µg/kg. The other furans were not detected in this sample. Only low levels of furan and 2-MF were detected in the coffee beverage made from this sample.

The levels of furan were much higher in the roast coffee samples, however propylfuran and butylfuran were not detected in any sample above the LOQ (20 and 25 µg/kg respectively). Furan concentrations ranged from 2132 to 3243 µg/kg, 2MF levels ranged from 8893 to 11866 µg/kg, 3MF levels were from 399 to 598 µg/kg, ethylfuran levels were from 140 to 162 µg/kg, and 2,5-DMF levels were from 1176 to 1408 µg/kg, 2,3-DMF levels were from 76 to 132 µg/kg. Pentyl furan was detected in all three ground coffee samples at levels from 99 to 284 µg/kg, but these are indicative values as they were not confirmed by the qualifier ion.

The prepared beverages from the ground samples contained very low levels of furans compared to the product as sold. Ethylfuran and propylfuran were not detected at an LOQ of 2.5 µg/kg, 3MF and 2,5-DMF were detected in all three samples, (range from 3.4 to 11 µg/kg) at levels just above the LOQ. All three samples analysed 'as consumed' contained furan and 2MF, but at levels from 18.7 to 29.5 µg/kg and 58 to 96 µg/kg, which were approximately 1% of the concentration in the dry ground coffee as sold.

#### 7.7.5 Baby food, ready meal pouches etc.

Ten samples of baby ready meals were analysed, as sold and also following preparation following the manufacturers' instructions. The results of the products analysed 'as consumed' are given in Table 25, the results for as sold could not be reported due to uncertainty with the method robustness.

The levels of furans found in the samples were low, the range of furan concentrations in the as consumed samples was from 25.4 to 160 µg/kg, 2,5-DMF, propylfuran and butylfuran were not detected in any sample. Low levels of 2MF and 3MF were found, but none exceeded 19 µg/kg, and for some samples these compounds were not detected. One sample contained 2,3-DMF at a level of 7.2 µg/kg. All samples contained ethylfuran, the range of concentrations was from 6.6 to 56.3 µg/kg. Four samples contained pentylfuran above the LOQ at levels from 28 to 107 µg/kg.

There were problems with the 'as sold' sample analysis and therefore a lower sample weight was used for the 'as consumed' samples which resulted in better method performance. The 'as sold' samples were not re-analysed as the containers had been opened for the initial test.

#### 7.7.6 Processed cereal based food intended for infants and young children

Ten samples of cereal based baby food were analysed, samples that would be reconstituted or warmed before consumption were analysed both as sold and as consumed. Results are reported in Table 26.

The baby rice and biscotti (three samples) did not contain any furans as the dry cereal or after reconstitution. Two cereals contained very low levels of furans, but after preparing according to instructions, none were found above the LOQ. One sample of creamed porridge, sold as a wet food contained low levels of furan, 2MF, ethylfuran and pentylfuran, after warming these were present at similar levels to the original sample, except for pentylfuran which dropped from 29.7 µg/kg to <25 µg/kg

#### 7.7.7 Vegetable crisps

Five samples of vegetable crisps were analysed (Table 27). As for acrylamide analysis mixed products were split into their single vegetable components before analysis, resulting in thirteen samples or components being tested. Furan, 2-MF, ethylfuran and pentylfuran were detected in all samples, furan levels ranged from 6 to 30 µg/kg, 2-MF levels ranged from 5.9 to 34 µg/kg and ethylfuran levels ranged from 5.9 to 9.4 µg/kg. 3-MF was the next most frequently detected, found in 10 out of 11 samples analysed, levels ranged from 6.1 to 8.7 µg/kg where it was detected. Propylfuran was detected in 5 out of 13 samples at levels from 5 to 6.7 µg/kg and 2,5-DMF was detected in 2 out of 13 samples at levels of 7.1 and 7.3 µg/kg. 2,3-DMF and butylfuran were not detected in any sample. Pentylfuran was detected in all samples, however these could not all be confirmed as either the ion ratios did not confirm or the concentrations were out of range of the calibration curve. For

the confirmed results these ranged from 57 to 193 µg/kg. The indicative / non-confirmed results ranged from 49 to 696 µg/kg.

Despite using an isotopically labelled internal standard for pentylfuran, the analysis has not proved robust, with high & low recoveries, or interferences observed in the qualifier ion channel meaning results cannot be confirmed. Further work to improve the analysis of this analyte is required, and an alternative to headspace analysis should be assessed. Using a solvent extraction method followed by GC-MS could be a suitable approach.

#### 7.7.8 Other miscellaneous samples – soups

Four samples of soup were analysed (Table 28). The soups were analysed as consumed, low levels of furan (at a level close to 20 µg/kg), were found in all samples. Two samples contained low levels of 2-MF (at 6.3 and 6.7 µg/kg), one sample contained 3-MF at 5.3 µg/kg and another contained ethylfuran at 7 µg/kg. None of the other furans were found in any of the samples above the respective LOQs.

#### 7.7.9 Other miscellaneous samples – fruit juices

Three samples of fruit juice were analysed for furans (Table 29), no furans were detected above the LOQ in any sample.

## 8. Summary and Conclusions

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8.1 The second year of a sampling study to produce data on the occurrence and levels of acrylamide and furans has been successfully completed.

8.2 In total 130 samples were purchased. Seventy eight samples were analysed for acrylamide only, twelve were analysed for furans only and forty were analysed for both acrylamide and furans using methods accredited to ISO17025.

8.3 The scope of the method for furan testing was expanded following inclusion of additional isotopically labelled internal standards. The method now includes the compounds furan, 2MF, 3MF, ethylfuran, 2,5-DMF, 2,3-DMF, propylfuran, butylfuran and pentylfuran. The method has been accredited to ISO17025 using Flexible Scope.

8.4 The majority of samples analysed for acrylamide were chosen to address the need for exploratory data including for products listed in Recommendation (EU) 2019/1888 and therefore do not have BMLs. The highest levels of acrylamide were observed in vegetable crisps, a veggie straw product, dry coffee, and a sample of dried apricots, very similar to the results obtained in Year 1.

8.5 There are no guidance levels or action levels for furans, the data from this study will be used to provide information where there are gaps in current understanding of occurrence. The majority of samples contained low levels of furans. The highest levels were observed in coffee, both ground and instant. When these were used to prepare beverages the resulting furan levels were much reduced, typically around 1% of the levels in the dry coffee. For foods such as baby ready meals, and ready to eat soups, low levels of furan were found.

8.6 Pentylfuran was detected in many types of samples. Highest levels were observed in vegetable crisps, coffee and rye breads. Despite using an isotopically labelled pentylfuran standard the method performance was variable, with high and low recoveries for spiked samples, and interferences observed. This meant some results could not be confirmed and most were reported as indicative. Further work on methodology for pentylfuran is recommended to address these issues.

8.6 This data gives a snapshot of the levels of processing contaminants in a range of products. The results will be combined with those of Year 1 to allow trending comparison to be made between similar products over 2 years.



## 9. Acknowledgements

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## Annex 1: Samples

**Table 1. Proposed Sampling Plan for Acrylamide and Furan survey – Year 2**

Group Descriptor	Descriptor or sampling instructions	Acrylamide	Furan, Alkylfurans
Potato Crisps, snacks, crackers and other potato products from potato dough	Pre-packed (multi-pack), Plain and salted, not flavours	-	5
Bread	Speciality breads (No plain white bread. Pumpernickel, Rye bread, Ciabatta with olives, onion bread and similar products)	12	-
			-
			-
Breakfast Cereals excluding porridge	Honey roasted muesli	2	-
	Other breakfast cereals	3	3
Fine Bakery Wares (excluding cakes and pastry)	Croissants, Doughnuts, Pancakes, Churros & Similar Products (Pre-packed and instore bakery. Includes croissant, doughnut, pancake, churros, yumyums, butteries, eclairs, danishes)	11	-
	Other fine bakery products (Crackers, biscuits etc)	5	5
Coffee	as sold and as consumed	5	5
Baby foods & processed cereal based food intended for infants and young children.	Savoury ready meals	10	10
	Baby foods e.g. rice, porridge, rusks	10	10

**Table 1. Contd. Proposed Sampling Plan for Acrylamide and Furan survey – Year 2**

<b>Group Descriptor</b>	<b>Descriptor or sampling instructions</b>	<b>Acrylamide</b>	<b>Furan, Alkylfurans</b>
Other products based on cereals and potatoes	Cereal Snacks (e.g. Rice Cakes, Rice Crackers, Maize Crackers etc)	5	-
	Potato Products e.g. rosti, croquettes	5	-
	Potato based ready meals (e.g. potato and cheese, casserole, potato and meat)	3	-
Others	Roasted Nuts	4	-
	Roasted Oilseeds	3	-
	Dried Fruits	5	-
	Roasted cocoa beans and derived products	3	-
	Olives in brine	3	-
	Confectionary e.g. fudge, caramel, nougat	2	-
	Vegetable Crisps	7	7
	Vegetable Fries/chips	5	-
	Snacks intended for infants and young children	15	-
	Ready to eat soup (as consumed)	-	4
Others	Fruit Juices	-	3

**Estimated total samples: 130**

**Table 2. Details Potato Crisps, snacks, crackers and other potato products from potato dough**

# Potato Crisps, snacks, crackers and other potato products from potato dough

Laboratory sample code	Group Descriptor	Product description	Brand name	Best before date	Batch code	Country of origin	UK town where purchased	Date of purchase
S21-029603	#	Salted Flavour Crisps	Asda	18/09/2021	1174 02:20 M17	UK	Crawley	13/01/2021
S21-029919	#	French Fries	Walkers	16/10/2021	GBC 901 180D 10:50 6880	UK	Chester	20/07/2021
S21-030123	#	Pringles Original	Pringles	23/09/2023	L 1175035750 0422 4297,4304,4274	UK	Nottingham	21/07/2021
S21-030629	#	Hula Hoops Original	KP	13/11/2021	YHFW1A 1194 15:23	UK	London	02/08/2021
S21-031864	#	Potato Chips Sea Salt	Pop Chips	09/07/2022	Y P1C 1187	UK	Newport	18/08/2021

**Table 3. Details for Bread samples**

Laboratory sample code	Group Descriptor	Product description	Brand name	Best before date	Batch code	Country of origin	UK town where purchased	Date of purchase
S21-029481	Olive Bread	Olive Bloomer	Tesco	13/07/2021	BB 13/07 0283336001709	UK	Hull	12/07/2021
S21-029606	Rye Bread	Whole Grain Rye Bread	Schneider Brot	11/08/2021	A2	Germany	Crawley	13/07/2021
S21-030122	Olive Bread	Green Olive Loaf Slices	Seedful	29/04/2022	29.04.2022 51	UK	Nottingham	21/07/2021
S21-030128	Other Bread	Caramelised Red Onion & Mozzarella Flatbread	Asda Extra Special	23/07/2021	01561 194 C2	UK	Nottingham	21/07/2021
S21-030362	Olive Bread	Olive Ciabatta	Sainsbury's Taste the Difference	30/07/2021	0733 7021 D0237 11:20	UK	London	27/07/2021
S21-030363	Olive Bread	Olive Ciabatta	Tesco Finest	31/07/2021	Not Declared	UK	London	27/07/2021

**Table 3. Contd. Details for Bread samples**

Laboratory sample code	Group Descriptor	Product description	Brand name	Best before date	Batch code	Country of origin	UK town where purchased	Date of purchase
S21-030432	Rye Bread	Rye & Buckwheat Boule	Sainsbury's Taste the Difference	29/07/2021	2374 2268	UK	Newcastle upon Tyne	28/07/2021
S21-031498	Olive Bread	Olive Rolls	Waitrose and Partners	Not declared	Date Sold: 16/08/21 - Baked in Store	UK	Hull	16/08/2021
S21-031593	Rye Bread	Rye Loaf	M&S	Not declared	00819350 08:01	UK	Chester	17/08/2021
S21-031870	Olive Bread	Kalamata Olive Bloomer	Sainsbury's Taste the Difference	21/08/2021	107 0713	UK	York	20/08/2021
S21-031865	Other Bread	Organic Sunflower Seed Bread	Mestemacher	01/01/2022	28060138	Germany	Newport	18/08/2021
S21-031869	Other Bread	Cranberry, Raisin & Cashew Bloomer	Tesco	19/08/2021	0283969001800	UK	Bristol	18/08/2021

**Table 4. Details for Breakfast Cereals excluding porridge**

Laboratory sample code	Group Descriptor	Product description	Brand name	Best before date	Batch code	Country of origin	UK town where purchased	Date of purchase
S21-029604	Honey roasted muesli	Honey Granola	Jordans	06/09/2022	LB 1159 15:38	UK	Crowborough	13/07/2021
S21-030360	Honey roasted granola	Honey Granola	Dorset Cereals	01/05/2022	MHP1182 R 08:05	UK	London	27/07/2021
S21-029925	Other cereals	Corn Flakes	Kellogg's	30/05/2022	L1150 0346 04 03:46 P:30/05/21	UK	Chester	20/07/2021
S21-030364	Other cereals	Multigrain Cheerios	Cheerios	31/03/2022	P1B1 1089 0953 04:45	UK	London	27/07/2021
S21-030722	Other cereals	Weetabix	Weetabix	11/02/2022	1042 14:08 6	UK	Ipswich	03/08/2021

**Table 5. Details for Fine Bakery Wares (excluding cakes and pastry)**

Laboratory sample code	Group Descriptor	Product description	Brand name	Best before date	Batch code	Country of origin	UK town where purchased	Date of purchase
S21-029607	Doughnuts	Sugar Ring Doughnuts	M&S	Not declared	473 01/10/20	UK	Crawley	13/07/2021
S21-029612	Croissants	Butteries	Murdoch Allan	17/07/2021	5029912040374	UK	Glasgow	14/07/2021
S21-029831	Croissants	Butter Croissants	Luxury	21/07/2021	6009 ID63375E 03/2021	UK	London	19/07/2021
S21-030129	Churros	Sol y mar 500 gr	Sol & Mar	01/10/2022	07:05 118 21/4	UK	Nottingham	21/07/2021
S21-030302	Eclairs	Large Chocolate Eclairs	Morrisons Market Street	30/07/2021	07:20	UK	Nottingham	26/07/2021
S21-030431	Danishes	Danish Pastry Raisin Whirls	Sainsburys	29/07/2021	28 07 583 2268	UK	Newcastle upon Tyne	28/07/2021
S21-030609	Eclairs	Belgian Chocolate Eclairs,	Tesco	05/08/2021	22:40	UK	Crowborough	02/08/2021
S21-030632	Pancakes	Giant Buttermilk Pancakes	Rowan Hill	09/08/2021	1209 01:42 P1	UK	London	02/08/2021
S21-030715	Yumyums	Yum Yums	Sainsbury's	05/08/2021	3039 2100	UK	Nottingham	03/08/2021
S21-031497	Croissants	Butter Croissants	Bon Appetit	29/08/2021	IDENT B0221211 027 E0709 (x2)	UK	Hull	16/08/2021



**Table 5. contd. Details for Fine Bakery Wares (excluding cakes and pastry)**

Laboratory sample code	Group Descriptor	Product description	Brand name	Best before date	Batch code	Country of origin	UK town where purchased	Date of purchase
S21-031500	Yum yums	Yum Yums	Waitrose	17/08/2021	BB 17 Aug	UK	Hull	16/08/2021
S21-029601	Crackers, biscuits etc.	Cream Crackers	Rivercote	05/02/2022	1 143 BB 09:41	UK	Crowborough	13/07/2021
S21-030300	Crackers, biscuits etc.	Shortbread Fingers	Morrisons	28/02/2022	L1144 21:05	UK	Nottingham	26/07/2021
S21-030366	Crackers, biscuits etc.	Orkney Thick Oatcakes	Stockan's	12/01/2022	005167	UK	London	27/07/2021
S21-030605	Crackers, biscuits etc.	Dark Rye breads	Ryvita	13/09/2022	1 1167 18:55	UK	Crowborough	02/08/2021
S21-030627	Crackers, biscuits etc.	Rye Crispbread with Sesame Seeds	Rivercote	17/06/2022	4 1169 03:24	UK	London	02/08/2021

**Table 6. Details for Coffee samples**

Laboratory sample code	Group Descriptor	Product description	Brand name	Best before date	Batch code	Country of origin	UK town where purchased	Date of purchase
S21-029483	Coffee	Decaff Coffee (Instant)	Kenco	22/06/2023	08:05 L1173	Netherlands	Hull	12/07/2021
S21-029832	Coffee	Ground Coffee	Lavazza	30/03/2023	AD16DL	Italy	Croydon	19/07/2021

Laboratory sample code	Group Descriptor	Product description	Brand name	Best before date	Batch code	Country of origin	UK town where purchased	Date of purchase
S21-029838	Coffee	Roast Instant Coffee	Aldi	30/04/2024	L1126 01:27	UK	London	19/07/2021
S21-030299	Coffee	Ground Coffee	Café Direct	11/07/2022	31133 181242 04:38	UK	Nottingham	26/07/2021
S21-030437	Coffee	Roast Coffee	Costa	11/09/2022	L20254 R3 11:03	UK	Lisburn	28/07/2021

**Table 7. Details for Baby Food, e.g. Ready meals; (pouches, jars etc)**

Laboratory sample code	Product description	Brand name	Best before date	Batch code	Country of origin	UK town where purchased	Date of purchase
S21-029835	Spaghetti Bolognese	Asda little angels	14/05/2022	1771	UK	Croydon	19/07/2021
S21-029836	Chicken casserole with rice	Mamia Organic	31/05/2022	21-179	UK	London	19/07/2021
S21-029922	Chicken & Sweet Potato Curry	For Aisha	28/04/2022	Lot 118	UK	Chester	20/07/2021
S21-030436	Vegetable & Lentil Bake	Ella's Kitchen	30/06/2022	1132 06/202216:13 B7LC	UK	Lisburn	28/07/2021
S21-030607	Sunday Chicken Dinner	Heinz	01/11/2022	1127 0430 C11	UK	Crowborough	02/08/2021
S21-030634	Organic Vegetables with Rice and Chicken	HiPP Organic	31/08/2022	DE LA8384 P03/21 340293	UK	London	02/08/2021
S21-030717	Cottage Pie	Ella's Kitchen	01/06/2022	06/2022 B4 1146 20:03 LA	UK	Nottingham	03/08/2021
S21-030724	Sweet Potato Chicken and Veggies	Heinz	18/05/2022	0903 J-1139 03:23	UK	Ipswich	03/08/2021

**Table 7. Contd. Details for Baby Food, for example, Ready meals; (pouches, jars etc)**

Laboratory sample code	Product description	Brand name	Best before date	Batch code	Country of origin	UK town where purchased	Date of purchase
S21-030725	Organic Butternut Squash Mac & Cheese	Piccolo	17/07/2022	U137	UK	Ipswich	03/08/2021
S21-030726	Garden Vegetable Risotto	Babease	18/05/2022	21-138	UK	Ipswich	03/08/2021

**Table 8. Details for Processed cereal based food intended for infants and young children**

Laboratory sample code	Product description	Brand name	Best before date	Batch code	Country of origin	UK town where purchased	Date of purchase
S21-029482	Rusks	Farleys	01/11/2022	1126 08:27:36 and 1126 08:27:31	UK	Hull	12/07/2021
S21-029486	Organic Apple and Banana Bircher Muesli	HiPP Organic	31/08/2022	6185321 02:28 052A	UK	Hull	12/07/2021
S21-029611	Baby rice	Cow & Gate	26/11/2022	04:13 L9	UK	Glasgow	14/07/2021
S21-029923	Biscotti Banana	Kiddylicious	30/04/2022	211602 17:23 2.2	UK	Chester	20/07/2021
S21-030124	Creamed porridge (ready made)	Heinz	01/05/2022	0330 0417 A15:23	UK	Nottingham	21/07/2021
S21-030606	Creamy Porridge	HIPP Organic	31/07/2022	6192279 19:16 174 B	UK	Crowborough	02/08/2021
S21-030714	Vanilla and banana biscuits	Ella's Kitchen	01/12/2021	01/12/2021 1152B	UK	Nottingham	03/08/2021
S21-030723	Teething Biscuits	Bickiepegs	31/05/2023	21037	UK	Ipswich	03/08/2021
S21-031094	Organic Baby Rice	Aptamil	23/10/2022	10378934 L9	UK	Haverhill	11/08/2021
S21-031495	Organic Apple Biscotti	Mamia Organic	19/05/2022	bb 19-05-2022 Lot 212003	UK	Hull	16/08/2021

**Table 9. Details for Other products based on cereals and potatoes**

Laboratory sample code	Group descriptor	Product description	Brand name	Best before date	Batch code	Country of origin	UK town where purchased	Date of purchase
S21-029830	Rice cakes	Blueberry & Vanilla Rice and Corn Cakes	Kallo	12/03/2022	21 161 20:51 C1	UK	Croydon	19/07/2021
S21-029833	Rice cakes	Rice cakes with yogurt flavoured coating	Harvest Morn	01/03/2022	19:05 21158CQ	UK	London	19/07/2021
S21-030430	Rice cakes	Marmite Rice Cakes	Kallo	15/07/2022	21 196 03:01 C1	UK	Newcastle upon Tyne	28/07/2021
S21-030434	Rice cakes	Sweet Chilli Rice Crackers	The Snack Organisation	27/06/2022	27JUN2022 D	UK	Lisburn	28/07/2021
S21-030630	Rice cakes	Salt & Vinegar Rice Cakes	Snack a Jacks	22/01/2022	GBS 4F1 173 06:21 8746	UK	Thornton Heath	02/08/2021
S21-029614	Potato products	Cheddar Cheese Croquettes	Inspired Cuisine	21/07/2021	WO 135365	UK	Glasgow	14/07/2021
S21-030303	Potato products	Frozen Baked Jacket Potatoes	McCain	06/06/2022	22062021 10:04	UK	Nottingham	26/07/2021
S21-030433	Potato products	Hash Browns	McCain	31/08/2022	W11022021 23:33 02	UK	Newcastle upon Tyne	28/07/2021
S21-030611	Potato products	Potato Waffles	Birds Eye	01/12/2022	L1176NL124 12:08	UK	Crowborough	02/08/2021

**Table 9. Contd. Details for Other products based on cereals and potatoes**

Laboratory sample code	Group descriptor	Product description	Brand name	Best before date	Batch code	Country of origin	UK town where purchased	Date of purchase
S21-031597	Potato products	Mini Roasties	Aunt Bessie's	31/05/2023	L1 123 B03 0BJ 01:26	UK	Chester	17/08/2021
S21-030126	Potato products	Potato Dauphinoise	Deluxe	27/07/2021	27 JUL	UK	Nottingham	21/07/2021
S21-030635	Potato based ready meals	Cheese & Bacon Potato Skins	Sainsbury's	09/08/2021	09 AUG	UK	Nottingham	03/08/2021
S21-031493	Potato based ready meals	Cottage Pie	Charlie Bighams	19/08/2021	SG2	UK	Hull	16/08/2021

**Table 10. Others, miscellaneous products**

Laboratory sample code	Group Descriptor	Product description	Brand name	Best before date	Batch code	Country of origin	UK town where purchased	Date of purchase
S21-029615	Snacks intended for infants and young children	Veggie Straws	Eat Real	09/06/2022	BC: 165 (L6/16507:14)	UK	Glasgow	14/07/21
S21-029920	Snacks intended for infants and young children	Organic carrot cake oat bars	Mamia Organic	25/02/2022	L 0B5251 21:15	UK	Chester	20/07/21
S21-030301	Snacks intended for infants and young children	Carrot Puffs	Organix	08/02/2022	P206766 L1232	UK	Nottingham	26/07/21
S21-030626	Snacks intended for infants and young children	Organic Cheese and Leek Multigrain Wheels	Ella's Kitchen	18/12/2021	158 21 L4A	UK	Thornton Heath	02/08/21
S21-030628	Snacks intended for infants and young children	Apple Rice Cakes	Organix	31/05/2022	H 21151 B 15:59	UK	London	02/08/21
S21-031499	Snacks intended for infants and young children	Banana & Cocoa Oat Bars	Piccolo	19/07/2022	15:30 (all 4 packs)	Italy	Hull	16/08/21
S21-031592	Snacks intended for infants and young children	Organic Blackcurrant Oaty Bars	Organix	29/01/2022	4/154 09:26	UK	Chester	17/08/21
S21-031858	Snacks intended for infants and young children	Blackcurrant + beetroot oat bars	Ella's kitchen	22/11/2021	1173N 03:48	UK	Chester	18/08/21



**Table 10. Contd. Others, miscellaneous products**

Laboratory sample code	Group Descriptor	Product description	Brand name	Best before date	Batch code	Country of origin	UK town where purchased	Date of purchase
S21-031859	Snacks intended for infants and young children	Veggie sticks	Organix	28/02/2022	L1262	UK	Stroud	18/08/21
S21-031860	Snacks intended for infants and young children	Carrot + Lentil Sticks	Ella's Kitchen	12/12/2021	152 21 L4A	UK	Bristol	18/08/21
S21-031861	Snacks intended for infants and young children	Apple and carrot, rice sticks	Kiddylicious	02/06/2022	L121531	UK	Bristol	18/08/21
S21-031862	Snacks intended for infants and young children	Sweetcorn & Carrot Seed Tubes	Little Freddie	08/02/2022	08:33 039 21L4A 50161035	UK	Bristol	18/08/21
S21-031863	Snacks intended for infants and young children	Cerelac, Wheat, Oat & Carrot Snack	Nestle Cerelac	30/09/2021	L01610301 18:08 / 21:43	UK	Bristol	18/08/21
S21-031866	Snacks intended for infants and young children	Cheese and Onion snack	Organix	07/12/2021	L1143	UK	Newport	18/08/21
S21-031867	Snacks intended for infants and young children	Carrot Sticks	Organix	04/01/2022	L1182	UK	Newport	18/08/21

**Table 10. Contd. Others, miscellaneous products**

Laboratory sample code	Group descriptor	Product description	Brand name	Best before date	Batch code	Country of origin	UK town where purchased	Date of purchase
S21-029602	Roasted nuts	Mixed Nuts	Alesto	15/02/2022	L1 111C2611 16:50	UK	Crowborough	13/07/2021
S21-029921	Roasted nuts	Roasted and salted almonds, peanuts, hazelnuts, cashew nuts and pecans.	Clancy's	31/03/2022	L11720 22:36	UK	Chester	20/07/2021
S21-030121	Roasted nuts	Roasted Salted Pistachio Nuts	Wonderful	17/09/2022	A21125 14:05 B	Belgium	Nottingham	21/07/2021
S21-030359	Roasted nuts	Cashews Salted	KP	13/11/2021	1160 W5 20:03	UK	London	27/07/2021
S21-030631	Roasted oil seeds	Honey Roasted Pumpkin and Sunflower Seeds	Munchy Seeds	31/10/2021	11172	UK	Beckenham	02/08/2021
S21-031093	Roasted oil seeds	Toasted pumpkin & sunflower seeds	Sainsbury's	31/05/2022	L1076006 12:25 S-B0348	UK	Haverhill	11/08/2021
S21-031545	Roasted oil seeds	Roasted & salted Pumpkin Seeds	Cypressa	01/02/2022	21125	UK	Stroud	14/08/2021

**Table 10. Contd. Others, miscellaneous products**

Laboratory sample code	Group descriptor	Product description	Brand name	Best before date	Batch code	Country of origin	UK town where purchased	Date of purchase
S21-029485	Dried fruit	Stoned Dates	Whitworths	01/05/2022	L1116/K 14:47 210755	UK	Hull	12/07/2021
S21-030624	Dried fruit	Organic Soft Apricots	Crazy Jacks	31/08/2022	H 1125 16:26 210805	UK	Thornton Heath	02/08/2021
S21-030625	Fruit product	Baked Raspberries	Urban Fruit	31/05/2022	21181 REBRA 14 10:48	UK	Thornton Heath	02/08/2021
S21-030716	Dried fruit	Soft Apricots	Morrisons	01/04/2022	118 N9 02:10 LOT:3869	UK	Nottingham	03/08/2021
S21-031548	Dried fruit	Oxford Whole Foods Diced Pineapple	OXFORD WHOLE FOODS	01/02/2022	16521	UK	Stroud	14/08/2021
S21-029480	Roasted cocoa beans	Cacao Nibs	Food Thoughts	31/08/2022	BBE AUG 2022 1085	UK	Hull	12/07/2021
S21-029840	Roasted cocoa beans	Organic Cacao nibs	Naturya	01/07/2022	W00792	UK	Aberdeen	19/07/2021
S21-031868	Roasted cocoa beans	Organic Raw Cacao Nibs	Morrisons	20/07/2022	5010251976899	UK	Bristol	18/08/2021
S21-029839	Olives in brine	Pitted Green Olives	Crespo	08/03/2024	L10151 08:21 012496	Spain	Aberdeen	19/07/2021
S21-029924	Olives in brine	Black pitted olives in brine	Cypressa	28/02/2023	L-0401/5278 01:30	UK	Chester	20/07/2021
S21-030365	Olives in brine	Pitted Olives	Odysea	09/12/2023	L:21772-04	UK	London	27/07/2021

**Table 10. Contd. Others, miscellaneous products**

Laboratory sample code	Group descriptor	Product description	Brand name	Best before date	Batch code	Country of origin	UK town where purchased	Date of purchase
S21-030361	Confectionary	Soft Nougat	Barratt	31/05/2022	LE 1155 08:20	UK	London	27/07/2021
S21-031547	Confectionary	Original Special Toffee Bag	Thorntons	31/12/2021	158RE-140 3 11:50	UK	Stroud	14/08/2021
S21-029608	Vegetable Crisps	Shitake Mushroom Crisps	DJ&A	09/12/2021	L210431046	UK	Glasgow	14/07/2021
S21-030297	Vegetable Crisps	Veg crisps	Tyrrells	13/11/2021	21187	UK	Nottingham	26/07/2021
S21-030298	Vegetable Crisps	Lentil Chips	The Daily Crave	16/02/2022	1612231 1:22:51 am	UK	Derby	26/07/2021
S21-030435	Vegetable Crisps	Sea Salt Lentil chips	Proper	27/12/2021	1791 23:16 L.6	UK	Lisburn	28/07/2021
S21-030719	Vegetable Crisps	Veg Chips Lightly Salted	Kettle	30/10/2021	065255 E157	UK	Ipswich	03/08/2021
S21-031496	Vegetable Crisps	Vegetable Crisps with Sea Salt	Aldi	30/10/2021	BB 30 10 21 1 21 205	UK	Hull	16/08/2021
S21-031546	Vegetable Crisps	Hummus chips	Eat Real	03/07/2022	L4/18908:48/08:47	UK	Gloucester	14/08/2021
S21-030127	Vegetable fries/chips	Onion Rings	Asda	22/07/2021	22 JUL	UK	Nottingham	21/07/2021
S21-030610	Vegetable fries/chips	Honey Glazed Parsnips	Aunt Bessie's	14/12/2022	CB 01 0348 075 1034	UK	Crowborough	02/08/2021

**Table 10. Contd. Others, miscellaneous products**

Laboratory sample code	Group descriptor	Product description	Brand name	Best before date	Batch code	Country of origin	UK town where purchased	Date of purchase
S21-030612	Vegetable fries/chips	Mixed Root Vegetable Fries	Strong Roots	06/05/2023	18L1126MI 17:57 EMB62863C	UK	Crowborough	02/08/2021
S21-031494	Vegetable fries/chips	Sweet Potato Fries	McCain	19/08/2022	PD: 19 AUG 2020 20:02:06	UK	Hull	16/08/2021
S21-031596	Vegetable fries/chips	Sweet Potato Chips	Slimming World	08/07/2023	711189DS(1)17:49	UK	Chester	17/08/2021
S21-029484	Soup	Broccoli & Stilton Soup	Crosse & Blackwell	01/03/2023	W KCHW 1088 17:31 11	UK	Hull	12/07/2021
S21-029605	Soup	Carrot and Coriander Soup	Heinz	01/05/2023	BN K7 1168 04:41	UK	Crawley	13/07/2021
S21-029834	Soup	Condensed Soup Cream of Mushroom	Batchelors	31/05/2023	E2CR 1133 12:13 10	UK	Beckenham	19/07/2021
S21-030633	Soup	Cream of Chicken Soup	Newgate	31/01/2023	E1LD 1035 20:49 11	UK	London	02/08/2021
S21-029613	Fruit Juices	Orange Juice with Juicy Bits	The Juice Company	30/08/2021	02:54 211c	UK	Glasgow	14/07/2021
S21-030608	Fruit Juices	Apple & Elderflower juice	Copella	12/09/2021	CHV16:32	UK	Crowborough	02/08/2021
S21-031595	Fruit Juices	Tropical Juice	Innocent	20/09/2021	DE S12032308	UK	Chester	17/08/2021

## Annex B: Tables

**Table 11. Acrylamide results for Bread products (µg/kg) corrected for recovery.**

Laboratory sample code	Product description	Brand name	Group Descriptor	Acrylamide Result (µg/kg)
S21-029481	Olive Bloomer*	Tesco	Olive Bread	50.8
S21-029606	Whole Grain Rye Bread	Schneider Brot	Rye Bread	<30
S21-030122	Green Olive Loaf Slices	Seedful	Olive Bread	<30
S21-030128	Caramelised Red Onion & Mozzarella Flatbread	Asda Extra Special	Other Bread	<30
S21-030362	Olive Ciabatta	Sainsbury's Taste the Difference	Olive Bread	44.7
S21-030363	Olive Ciabatta	Tesco	Olive Bread	<30
S21-030432	Rye & Buckwheat Boule*	Sainsbury's Taste the Difference	Rye Bread	<30
S21-031498	Olive Rolls*	Waitrose and Partners	Olive Bread	94
S21-031593	Rye Loaf	M&S	Rye Bread	<30
S21-031870	Kalamata Olive Bloomer*	Sainsbury's Taste the Difference	Rye Bread	60.6
S21-031865	Organic Sunflower Seed Bread	Mestemacher	Other Bread	<30
S21-031869	Cranberry, Raisin & Cashew Bloomer	Tesco	Other Bread	<30

(\* n=3)

Retained Commission Regulation (EU) 2017/2158 sets Benchmark levels for 'Bread' as follows:

Soft bread (a) Wheat based bread 50 µg/kg (b) Soft bread other than wheat based bread 100 µg/kg

**Table 12. Acrylamide results for Breakfast cereals excluding porridge (µg/kg) corrected for recovery.**

Laboratory sample code	Product description	Brand name	Group Descriptor	Acrylamide Result (µg/kg)
S21-029604	Honey Granola	Jordans	Honey roasted museli	121
S21-030360	Honey Granola	Dorset Cereals	Honey roasted museli	79.5
S21-029925	Corn Flakes	Kellogs	Other cereal	55.4
S21-030364	Multigrain Cheerios*	Nestle	Other cereal	194
S21-030722	Weetabix	Weetabix	Other cereal	286

(\* n=3)

Retained Commission Regulation (EU) 2017/2158 sets BMLs for 'Breakfast cereals (excl. porridge)' as follows:

Breakfast cereals (excl. porridge)

- bran products and whole grain cereals, gun puffed grain 300 µg/kg
- wheat and rye based products 300 µg/kg
- maize, oat, spelt, barley and rice based products 150 µg/kg

**Table 13. Acrylamide results for Fine Bakery Wares (excluding cakes and pastry) ( $\mu\text{g}/\text{kg}$ ) corrected for recovery.**

Laboratory sample code	Product description	Brand name	Group Descriptor	Acrylamide Result ( $\mu\text{g}/\text{kg}$ )
S21-029607	Sugar Ring Doughnuts	M&S	Doughnuts	<30
S21-029612	Butteries	Murdoch Allan	Croissants	52.6
S21-029831	Butter Croissants	Iceland	Croissants	<30
S21-030129	Churros	Lidl	Churros	<30
S21-030302	Chocolate Eclairs	Morrisons	Eclairs	36.8
S21-030431	Raisin Whirls	Sainsburys	Danishes	<30
S21-030609	Chocolate Eclairs	Tesco	Eclairs	56.0
S21-030632	Buttermilk Pancakes	Lidl	Pancakes	196
S21-030715	Yum Yums	Sainsbury's	Yum Yums	118
S21-031497	Butter Croissants	Aldi	Croissants	<30
S21-031500	Yum Yums	Waitrose	Yum Yums	<30
S21-029601	Cream Crackers	Lidl	Crackers, biscuits etc.	117
S21-030300	Butter Shortbread Fingers	Morrisons	Crackers, biscuits etc.	<30
S21-030366	Thick Oatcakes	Stockan's	Crackers, biscuits etc.	182
S21-030605	Dark Rye Crispbread	Ryvita	Crackers, biscuits etc.	238
S21-030627	Wholegrain Rye Crispbread	Lidl	Crackers, biscuits etc.	326

Retained Commission Regulation (EU) 2017/2158 sets BMLs as follows:

Biscuits and wafers

350  $\mu\text{g}/\text{kg}$

Crackers with the exception of potato based crackers

400  $\mu\text{g}/\text{kg}$

Crispbread

350  $\mu\text{g}/\text{kg}$

Ginger bread

800  $\mu\text{g}/\text{kg}$

Products similar to the other products in this category

300  $\mu\text{g}/\text{kg}$

There are no BMLs for doughnuts and croissants.



**Table 14. Acrylamide results for Coffee – as sold and as consumed, ( $\mu\text{g}/\text{kg}$ ) corrected for recovery.**

Laboratory sample code	Product description	Brand name	Group Descriptor	Acrylamide Result ( $\mu\text{g}/\text{kg}$ ) As sold	Acrylamide Result ( $\mu\text{g}/\text{L}$ ) As consumed
S21-029483	Decaff Coffee (Instant)	Kenco	Coffee	687	5.3
S21-029832	Ground Coffee	Lavazza	Coffee	305	10.8
S21-029838	Roast Instant Coffee	Aldi	Coffee	443	4.7
S21-030299	Ground Coffee	Café Direct	Coffee	289	13.9
S21-030437	Roast Coffee	Costa	Coffee	127*	4.8

(\* n=2)

Retained Commission Regulation (EU) 2017/2158 sets Benchmark levels as follows:

Roast coffee                      400  $\mu\text{g}/\text{kg}$

Instant (soluble) coffee      850  $\mu\text{g}/\text{kg}$

The BML applies to the product as sold.

**Table 15. Acrylamide results for Baby foods intended for infants and young children – savoury meals (as bought) (µg/kg) corrected for recovery.**

Laboratory sample code	Product description	Brand name	Group Descriptor	Acrylamide Result (µg/kg)
S21-029835	Spaghetti Bolognese	Asda little angels	Baby food savoury ready meals	<30
S21-029836	Chicken casserole with rice	Mamia Organic	Baby food savoury ready meals	<30
S21-029922	Chicken & Sweet Potato Curry	For Aisha	Baby food savoury ready meals	35.5
S21-030436	Vegetable & Lentil Bake	Ella's Kitchen	Baby food savoury ready meals	<30
S21-030607	Sunday Chicken Dinner	Heinz	Baby food savoury ready meals	<30
S21-030634	Organic Vegetables with Rice and Chicken	HiPP Organic	Baby food savoury ready meals	<30
S21-030717	Cottage Pie	Ella's Kitchen	Baby food savoury ready meals	<30
S21-030724	Sweet Potato Chicken and Veggies	Heinz	Baby food savoury ready meals	<30
S21-030725	Organic Butternut Squash Mac & Cheese	Piccolo	Baby food savoury ready meals	<30
S21-030726	Vegetable Risotto	Babease	Baby food savoury ready meals	<30

**Table 16. Acrylamide results for Baby foods and processed cereal based food intended for infants and young children (as bought), µg/kg, corrected for recovery.**

Laboratory sample code	Product description	Brand name	Group Descriptor	Acrylamide Result (µg/kg)
S21-029482	Rusks	Farleys	Infant cereal based product	<30
S21-029486	Organic Apple and Banana Birche Muelsli	HiPP Organic	Infant cereal based product	<30
S21-029611	Baby rice	Cow & Gate	Infant cereal based product	<30
S21-029923	Biscotti Banana*	Kiddylicious	Infant cereal based product	276*
S21-030124	Creamed porridge (ready made)	Heinz	Infant cereal based product	<30
S21-030606	Creamy Porridge	HIPP Organic	Infant cereal based product	<30
S21-030714	Vanilla and banana biscuits*	Ella's Kitchen	Infant cereal based product	232*
S21-030723	Teething Biscuits	Bickiepegs	Infant cereal based product	<30
S21-031094	Organic Baby Rice	Aptamil	Infant cereal based product	<30
S21-031495	Organic Apple Biscotti*	Mamia Organic	Infant cereal based product	259*

(\* n=3)

**Table 17. Acrylamide results for Other products based on cereals and potatoes cereal snacks, potato products and potato based meals, ( $\mu\text{g}/\text{kg}$ ) corrected for recovery.**

Laboratory sample code	Product description	Brand name	Group Descriptor	Acrylamide Result ( $\mu\text{g}/\text{kg}$ )
S21-029830	Rice and Corn Cakes	Kallo	Rice cakes	286
S21-029833	Rice cakes with yogurt flavoured coating	Harvest Morn	Rice cakes	81.5
S21-030430	Marmite Rice Cakes*	Kallo	Rice cakes	308*
S21-030434	Sweet Chilli Rice Crackers	The Snack Organisation	Rice cakes	93.5
S21-030630	Salt & Vinegar Rice Cakes	Snack a Jacks	Rice cakes	110
S21-029614	Cheddar Cheese Croquettes	Inspired Cuisine	Potato products	50.8
S21-030303	Frozen Baked Jacket Potatoes	McCain	Potato products	84.1
S21-030433	Hash Browns	McCain	Potato products	67.1
S21-030611	Potato Waffles <sup>#</sup>	Birds Eye	Potato products	88.9 <sup>#</sup>
S21-031597	Mini Roasties	Aunt Bessie's	Potato products	<30
S21-030126	Potato Dauphinoise	Deluxe	Potato products	<30
S21-030635	Cheese & Bacon Potato Skins	Sainsbury's	Potato based ready meals	106
S21-031493	Cottage Pie	Charlie Bighams	Potato based ready meals	<30

(\* n=3, # n=2)

**Table 18. Acrylamide results for Other products – Processed cereal based snacks intended for young children ( $\mu\text{g}/\text{kg}$ ) corrected for recovery.**

Laboratory sample code	Product description	Brand name	Group Descriptor	Acrylamide Result ( $\mu\text{g}/\text{kg}$ )
S21-029615	Veggie Straws*	Eat Real	Infant cereal based product	1738*
S21-029920	Organic carrot cake oat bars	Mamia Organic	Infant cereal based product	<30
S21-030301	Carrot Puffs*	Organix	Infant cereal based product	140*
S21-030626	Organic Cheese and Leek Multigrain*	Ella's Kitchen	Infant cereal based product	37.6
S21-030628	Apple Rice Cakes*	Organix	Infant cereal based product	33.7*
S21-031499	Banana & Cocoa Oat Bars	Piccolo	Infant cereal based product	<30
S21-031592	Organic Blackcurrant Oat Bars	Organix	Infant cereal based product	<30
S21-031858	Blackcurrant + beetroot oat bars	Ella's kitchen	Infant cereal based product	<30
S21-031859	Veggie sticks*	Organix	Infant cereal based product	80.4*
S21-031860	Carrot + Lentil Sticks*	Ella's Kitchen	Infant cereal based product	110*
S21-031861	Apple and carrot, rice sticks	Kiddylicious	Infant cereal based product	<30
S21-031862	Sweetcorn & Carrot Seed Tubes	Little Freddie	Infant cereal based product	36.6
S21-031863	Cerelac, Wheat, Oat & Carrot Snack	Nestle Cerelac	Infant cereal based product	<30
S21-031866	Cheese and Onion snack*	Organix	Infant cereal based product	119*
S21-031867	Carrot Sticks*	Organix	Infant cereal based product	135*

(\* n=3)

**Table 19. Acrylamide results for Other products – Roasted nuts, oilseeds, dried fruit, roasted cocoa beans and olives (µg/kg) corrected for recovery.**

Laboratory sample code	Product description	Brand name	Group Descriptor	Acrylamide Result (µg/kg)
S21-029602	Mixed Nuts	Alesto	Roasted nuts	<30
S21-029921	Roasted and salted almonds, peanuts, hazelnuts, cashew nuts and pecans.	Clancy's	Roasted nuts	77.7
S21-030121	Roasted Salted Pistachio Nuts	Wonderful	Roasted nuts	44.7
S21-030359	Cashews Salted	KP	Roasted nuts	<30
S21-030631	Honey Roasted Pumpkin and Sunflower Seeds	Munchy Seeds	Roasted oil seeds	70
S21-031093	Toasted pumpkin & sunflower seeds	Sainsbury's	Roasted oil seeds	<30
S21-031545	Roasted & salted Pumpkin Seeds	Cypressa	Roasted oil seeds	<30
S21-029485	Stoned Dates	Whitworths	Dried fruit	73
S21-030624	Organic Soft Apricots*	Crazy Jacks	Dried fruit	451*
S21-030625	Baked Raspberries	Urban Fruit	Fruit product	<30
S21-030716	Soft Apricots	Morrisons	Dried fruit	<30
S21-031548	Oxford Whole Foods Diced Pineapple	Oxford Whole Foods	Dried fruit	<30
S21-029480	Cacao Nibs	Food Thoughts	Roasted cocoa beans	170
S21-029840	Organic Cacao nibs	Naturya	Roasted cocoa beans	274
S21-031868	Organic Raw Cacao Nibs	Morrisons	Roasted cocoa beans	68.8
S21-029839	Pitted Green Olives	Crespo	Olives in brine	<30
S21-029924	Black pitted olives in brine*	Cypressa	Olives in brine	490*
S21-030365	Pitted Olives	Odysea	Olives in brine	<30

(\* n=3)

**Table 20. Acrylamide results for Other products – confectionary, vegetable crisps, vegetable chips/fries (µg/kg) corrected for recovery**

Laboratory sample code	Product description	Brand name	Group Descriptor	Acrylamide Result (µg/kg)
S21-030361	Soft Nougat	Barratt	Confectionary	<30
S21-031547	Original Special Toffee Bag	Thorntons	Confectionary	<30
S21-029608	Shitake Mushroom Crisps	DJ&A	Vegetable Crisps	<30
S21-030297	Veg crisps – carrot*	Tyrrells	Vegetable Crisps	2464*
S21-030297	Veg crisps – beetroot*	Tyrrells	Vegetable Crisps	586*
S21-030297	Veg crisps – parsnip*	Tyrrells	Vegetable Crisps	77.8*
S21-030298	Lentil Chips	The Daily Crave	Vegetable Crisps	276
S21-030435	Sea Salt Lentil chips	Proper	Vegetable Crisps	79.1
S21-030719	Veg Chips Lightly Salted – parsnip*	Kettle	Vegetable Crisps	2114*
S21-030719	Veg Chips Lightly Salted – beetroot*	Kettle	Vegetable Crisps	1456*
S21-030719	Veg Chips Lightly Salted – sweet potato*	Kettle	Vegetable Crisps	597*
S21-031496	Vegetable Crisps with Sea Salt – parsnip*	Aldi	Vegetable Crisps	490*
S21-031496	Vegetable Crisps with Sea Salt – beetroot*	Aldi	Vegetable Crisps	1026*
S21-031496	Vegetable Crisps with Sea Salt – carrot*	Aldi	Vegetable Crisps	1191*
S21-031546	Hummus chips	Eat Real	Vegetable Crisps	<30
S21-030127	Onion Rings	Asda	Vegetable fries/chips	58.5
S21-030610	Honey Glazed Parsnips	Aunt Bessie's	Vegetable fries/chips	<30

(\* n=3)

**Table 20 contd. Acrylamide results for Other products based on cereals and potatoes – confectionary, vegetable crisps, vegetable chips/fries (µg/kg) corrected for recovery.**

Laboratory sample code	Product description	Brand name	Group Descriptor	Acrylamide Result (µg/kg)
S21-030612	Mixed Root Vegetable Fries - beetroot	Strong Roots	Vegetable fries/chips	30
S21-030612	Mixed Root Vegetable Fries - carrot	Strong Roots	Vegetable fries/chips	33.1
S21-030612	Mixed Root Vegetable Fries - parsnip	Strong Roots	Vegetable fries/chips	<30
S21-031494	Sweet Potato Fries	McCain	Vegetable fries/chips	<30
S21-031596	Sweet Potato Chips	Slimming World	Vegetable fries/chips	58.6



**Table 21. Furan results for potato snacks ( $\mu\text{g}/\text{kg}$ ) corrected for recovery.**

Laboratory sample code	Product description	Brand name	Furan	2MF	3MF	Ethyl	2,5DMF	2,3DMF	Propyl	Butyl	Pentyl
S21-029603	Salted Flavour Crisps	Asda	9.1	7.0	<5	11.7	<5	<5	<5	<25	72.2
S21-029919	French Fries	Walkers	21.7	11.1	<5	94.0	<5	<5	<5	<25	88.8
S21-030123	Pringles Original	Pringles	18.2	<5	<5	8.3	<5	<5	<5	<25	<25.0
S21-030629	Hula Hoops Original	KP	38.2	14.7	9.2	24.1	<5	<5	<5	<25	55.9
S21-031864	Potato Chips Sea Salt	Pop Chips	55.0	6.6	<5	20.1	<5	<5	<5	<25	<25

**Table 22. Furan results of other breakfast cereals ( $\mu\text{g}/\text{kg}$ ) corrected for recovery.**

Laboratory sample code	Product description	Brand name	Furan	2MF	3MF	Ethyl	2,5DMF	2,3DMF	Propyl	Butyl	Pentyl
S21-029925	Corn Flakes	Kellogg's	25.2	8.9	<5	<5	<5	<5	<5	<25	<25
S21-030364	Multigrain Cheerios	Cheerios	17.4	8.0	<5	<5	<5	<5	<5	<25	<25
S21-030722	Weetabix	Weetabix	16.5	16.1	<5	<5	<5	<5	<5	<25	<25

**Table 23. Furan results of Other Fine Bakery Wares (excluding cakes and pastry), other - Crackers, biscuits etc ( $\mu\text{g}/\text{kg}$ ) corrected for recovery.**

Laboratory sample code	Product description	Brand name	Furan	2MF	3MF	Ethyl	2,5DMF	2,3DMF	Propyl	Butyl	Pentyl
S21-029601	Cream Crackers	Rivercote	26.5	19.3	<5	<5	<5	<5	<5	<25	<25
S21-030300	Shortbread Fingers	Morrisons	5.1	<5	<5	<5	<5	<5	<5	<25	<25
S21-030366	Thick Oatcakes	Stockan's	<5	10.0	<5	<5	<5	<5	<5	<25	<25
S21-030605	Rye breads	Ryvita	121	82.3	12.6	26.4	<5	<5	<5	<25	135
S21-030627	Rye Crispbread with Sesame Seeds	Rivercote	62.9	40.4	7.9	22.7	<5	<5	<5	<25	171

**Table 24. Furan Results of Coffee, as sold and as consumed (µg/kg) corrected for recovery.**

Laboratory sample code	Product description	Brand name	Furan	2MF	3MF	Ethyl	2,5DMF	2,3DMF	Propyl	Butyl	Pentyl
S21-029483	Decaff Coffee (Instant) -as sold	Kenco	435	1522	66	<20	158	<20	<20	<25	<25
S21-029483	Decaff Coffee (Instant) -as consumed	Kenco	4.1	11.0	<2.5	<2.5	<2.5	<2.5	<2.5	<25	<25
S21-029832	Ground Coffee -as sold	Lavazza	2132	8893	448	162	1334	132	<20	<25	284
S21-029832	Ground Coffee -as consumed	Lavazza	18.7	58.1	3.4	<2.5	6.7	<2.5	<2.5	<25	<25
S21-029838	Roast Instant Coffee -as sold	Aldi	41	199	<20	<20	26	<20	<20	<25	<25
S21-029838	Roast Instant Coffee -as consumed	Aldi	<2.5	3.7	<2.5	<2.5	<2.5	<2.5	<2.5	<25	<25
S21-030299	Ground Coffee -as sold	Café Direct	3243	11866	598	140	1176	76	<20	<25	99
S21-030299	Ground Coffee -as consumed	Café Direct	29.7	80.4	4.6	<2.5	4.6	<2.5	<2.5	<25	<25
S21-030437	Roast Coffee -as sold	Costa	2728	11627	399	143	1408	94	<20	<25	162
S21-030437	Roast Coffee -as consumed	Costa	29.5	96.3	4.3	<2.5	10.5	<2.5	<2.5	<25	<25

(levels not confirmed by qualifier ion)

**Table 25. Furan Results of Baby food, ready meals pouches etc – as consumed (µg/kg) corrected for recovery.**

Laboratory sample code	Product description	Brand name	Furan	2MF	3MF	Ethyl	2,5DMF	2,3DMF	Propyl	Butyl	Pentyl
S21-029835	Spaghetti Bolognese	Asda little angels	56.1	11.4	<5	27.5	<5	<5	<5	<5	28.4
S21-029836	Chicken casserole with rice	Mamia Organic	44.8	7.6	7.1	8.1	<5	<5	<5	<5	<25
S21-029922	Chicken & Sweet Potato Curry	For Aisha	160	18.5	17.1	16.2	<5	<5	<5	<5	34.7
S21-030436	Vegetable & Lentil Bake	Ella's Kitchen	72.9	12.9	10.2	13.4	<5	<5	<5	<5	<25
S21-030607	Sunday Chicken Dinner	Heinz	16.9*	<5	<5	9.0	<5	<5	<5	<5	<25
S21-030634	Organic Vegetables with Rice and Chicken	HiPP Organic	30.8	6.9	<5	9.4	<5	<5	<5	<5	30.0
S21-030717	Cottage Pie	Ella's Kitchen	25.4	5.9	7.5	6.6	<5	<5	<5	<5	<25
S21-030724	Sweet Potato Chicken and Veggies	Heinz	147	16.5	16.5	56.3	<5	7.2	<5	<5	107
S21-030725	Organic Butternut Squash Mac & Cheese	Piccolo	55.3	12.0	6.2	29.7	<5	<5	<5	<5	<25
S21-030726	Vegetable Risotto	Babease	72.2*	<5	<5	7.9	n/r	n/r	n/r	n/r	n/r

(\* n=2, furan only), (n/r – no results due to analysis issues)

**Table 26. Furan Results of Cereal based food for infants and young children, (µg/kg) corrected for recovery.**

Laboratory sample code	Product description	Brand name	Preparation	Furan	2MF	3MF	Ethyl	2,5DMF	2,3DMF	Propyl	Butyl	Pentyl
S21-029482	Rusks	Farleys	As sold	<5	<5	<5	<5	<5	<5	<5	<25	43.8
S21-029486	Apple and Banana Muesli	HiPP Organic	As sold	5.2	<5	<5	<5	<5	<5	<5	<25	32.1
S21-029486	Apple and Banana Muesli	HiPP Organic	As on packet	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<25	<25
S21-029611	Baby rice	Cow & Gate	As sold	<5	<5	<5	<5	<5	<5	<5	<25	<25
S21-029611	Baby rice	Cow & Gate	As on packet	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<25	<25
S21-029923	Biscotti Banana	Kiddylicious	As sold	<5	<5	<5	<5	<5	<5	<5	<25	<25
S21-030124	Creamed porridge (ready made)	Heinz	As sold	90.5	13.9	<2.5	8.6	<2.5	<2.5	<2.5	<25	29.7
S21-030124	Creamed porridge (ready made)*	Heinz	As on packet	90.9	16.3	<5	9.8	<5	<5	<5	<25	<25
S21-030606	Creamy Porridge	HIPP Organic	As sold	<5	<5	<5	<5	<5	<5	<5	<25	29.9
S21-030606	Creamy Porridge	HIPP Organic	As on packet	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<25	<25
S21-030714	Vanilla and banana biscuits	Ella's Kitchen	As sold	<5	<5	<5	<5	<5	<5	<5	<25	26.8
S21-030723	Teething Biscuits	Blckiepegs	As sold	12.2	<5	<5	<5	<5	<5	<5	<25	<25

(\* n=2)

**Table 26. contd. Furan Results of Cereal based food for infants and young children, ( $\mu\text{g}/\text{kg}$ ) corrected for recovery.**

Laboratory sample code	Product description	Brand name	Preparation	Furan	2MF	3MF	Ethyl	2,5DMF	2,3DMF	Propyl	Butyl	Pentyl
S21-031094	Organic Baby Rice	Aptamil	As sold	<5	<5	<5	<5	<5	<5	<5	<25	<25
S21-031094	Organic Baby Rice	Aptamil	As on packet	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<25	<25
S21-031495	Organic Apple Biscotti	Mamia Organic	As sold	<5	7.5	<5	<5	<5	<5	<5	<25	<25

**Table 27. Furan Results of others, vegetable crisps, (µg/kg) corrected for recovery.**

Laboratory sample code	Product description	Brand name	Furan	2MF	3MF	Ethyl	2,5DMF	2,3DMF	Propyl	Butyl	Pentyl
S21-029608	Shitake Mushroom Crisps	DJ&A	8.9	18.6	<5	5.9	7.3	<5	<5	<25	56.7
S21-030297	Veg crisps -carrot	Tyrrells	17.1	30.6	7.3	10.6	<5	<5	6.2	<25	430
S21-030297	Veg crisps -parsnip	Tyrrells	7.2	9.3	<5	10.0	<5	<5	5.0	<25	289
S21-030297	Veg crisps -beetroot	Tyrrells	10.7	12.7	<5	7.8	<5	<5	5.3	<25	459
S21-030298	Lentil Chips	The Daily Crave	23.2	12.2	6.4	91.3	<5	<5	<5	<25	102
S21-030435	Sea Salt Lentil chips	Propper	9.7	5.9	6.6	12.1	<5	<5	<5	<25	186
S21-030719	Veg Chips Lightly Salted - carrot	Kettle	15.5	22.8	8.7	20.2	<5	<5	5.5	<25	696
S21-030719	Veg Chips Lightly Salted - parsnip	Kettle	18.6	24.1	8.2	26.1	<5	<5	6.7	<25	627
S21-030719	Veg Chips Lightly Salted - beetroot	Kettle	29.9	34.4	6.8	10.3	7.1	<5	<5	<25	391
S21-031496	Vegetable Crisps with Sea Salt - carrot	Aldi	11.7	19.5	6.1	7.4	<5	<5	<5	<25	344
S21-031496	Vegetable Crisps with Sea Salt - parsnip	Aldi	8.9	12.0	<5	8.0	<5	<5	<5	<25	193
S21-031496	Vegetable Crisps with Sea Salt - beetroot	Aldi	18.6	21.6	<5	6.9	<5	<5	<5	<25	317
S21-031546	Hummus chips	Eat Real	6.0	6.0	<5	11.5	<5	<5	<5	<25	49.1

(Results indicative as either out of cal range/ion not confirmed)

**Table 28. Furan Results of others – ready to eat soup – as consumed (µg/kg) corrected for recovery.**

Laboratory sample code	Product description	Brand name	Furan	2MF	3MF	Ethyl	2,5DMF	2,3DMF	Propyl	Butyl	Pentyl
S21-029484	Broccoli & Stilton Soup	Crosse & Blackwell	18.6*	<5	<5	<5	<5	<5	<5	<25	<25
S21-029605	Carrot and Coriander Soup	Heinz	20.4	6.3	5.3	<5	<5	<5	<5	<25	<25
S21-029834	Condensed Soup Cream of Mushroom	Batchelors	20.4	6.7	<5	<5	<5	<5	<5	<25	<25
S21-030633	Cream of Chicken Soup	Newgate	20.9	<5	<5	7.0	<5	<5	<5	<25	<25

(\*n=2)

**Table 29. Furan Results of others – fruit juices (µg/kg) corrected for recovery.**

Laboratory sample code	Product description	Brand name	Furan	2MF	3MF	Ethyl	2,5DMF	2,3DMF	Propyl	Butyl	Pentyl
S21-029613	Orange Juice with Juicy Bits	The Juice Company	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
S21-030608	Apple & Elderflower juice	Copella	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
S21-031595	Tropical Juice	Innocent	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5



**Table 30. Results of Fapas® PT rounds undertaken during Year 2.**

Fapas PT rounds	Z-score
Fapas® Round and matrix	Acrylamide
30115 French Fries	0.8
30117 Coffee (Instant)	-0.8
30118 Crispbread	0.1

No suitable PT rounds were available for furans during this time period.

Performance for furans assessed against LGC standard and Fapas® reference material—see Table 34 and Table 35.

**Table 31. Quality control data for acrylamide analysis.**

<b>Fera Analysis Batch No.</b>	<b>Average Recovery (%)</b>	<b>n</b>	<b>IHR</b>	<b>Z-Score*</b>
PC21-03322	84	2	3085	-0.34
PC21-03436	99	2	3092	0.64
PC21-03570	95	1	3085	-0.62
PC21-03829	114	2	3092	1.65
PC21-03990	108	2	3092	0.87
PC21-04015	101	2	3085	-0.11
PC21-04177	96	2	3092	-0.15
PC21-04260	116	2	3092	0.17
PC21-04313	98	2	3092	-0.03
PC21-04707	95	2	3085	-0.09
PC21-04836	99	2	30104	1.11
PC21-04878	101	1	30104	1.21

\*Z-Score calculated from analytical result compared to assigned value for the In-House Reference material. A Z-score between -2 and +2 is acceptable.

**Table 32. Recovery data for Furan analysis. Recovery (%), n= 1-2**

<b>Fera Analysis Batch No.</b>	<b>Matrix</b>	<b>Spike level</b>	<b>Furan</b>	<b>2MF</b>	<b>3MF</b>	<b>Ethyl</b>	<b>2,5DMF</b>	<b>2,3DMF</b>	<b>Propyl</b>	<b>Butyl</b>	<b>Pentyl</b>
PC21-00168	Cereal (dry infant)	25	89	94	84	93	87	100	67	41	71
PC21-00169	Cereal (wet infant)	5	82	87	89	101	92	104	47	38	90
PC21-05501	Coffee (dry)	500	75	99	79	92	106	74	58	33	94
PC21-05502	Coffee (brew)	50	80	90	95	94	94	25	95	90	91
PC21 05540	Cereal (dry)	25	110	107	92	88	89	105	55	32	147
PC21 05582	Crisps	25	62	86	92	82	95	116	61	30	15
PC21-05774	Juice (orange)	5	100	120	104	110	93	86	102	66	116
PC22-00359	Wet food (savoury)	25	104	99	105	97	105	109	73	53	54

**Table 33. Summary of Furans QC – accuracy and precision LGC std check. LGC standard recovery %**

Batch ID	Furan	2MF	3MF	Ethyl	2,5DMF	Butyl	Pentyl
PC21-00168	116	94	90	99	111	103	89
PC21-00169	122	106	103	112	140	104	85
PC21-05501	108	93	95	109	113	113	106
PC21-05502	109	99	99	108	114	101	87
PC21-05540	92	95	88	99	124	102	84
PC21-05582	117	103	99	111	119	115	90
PC22-00359	77	71	74	83	101	76	75
Average	106	95	93	103	117	102	88
RSD %	15	12	11	10	11	13	11

**Table 34. FAPAS reference material furan check (µg/kg)**

<b>Batch ID</b>	<b>Upper/Lower</b>	<b>Furan</b>	<b>2MF</b>	<b>3MF</b>
FAPAS 3088	Upper	3560	12000	705
FAPAS 3088	Lower	2000	7560	337
PC21-05501	N=1	2753	7866	337

## Annex C: References

1. [Commission Regulation \(EU\) 2017/2158](#) of 20 November 2017 establishing mitigation measures and benchmark levels for the reduction of the presence of acrylamide in food
2. [Commission Recommendation \(EU\) 2019/1888](#) of 7 November 2019 on the monitoring of the presence of acrylamide in certain foods
3. Commission Recommendation of 28 March 2007 on the monitoring of the presence of furan in foodstuffs, 2007/196/EC.  
<http://data.europa.eu/eli/reco/2007/196/oj>
4. EFSA CONTAM Panel (EFSA Panel on Contaminants in the Food Chain), Knutsen HK, Alexander J, Barregard L, Bignami M, Bruschweiler B, Ceccatelli S, Cottrill B, Dinovi M, Edler L, Grasl-Kraupp B, Hogstrand C, Hoogenboom LR, Nebbia CS, Oswald IP, Petersen A, Rose M, Roudot A-C, Schwerdtle T, Vleminckx C, Vollmer G, Chipman K, De Meulenaer B, Dinovi M, Mennes W, Schlatter J, Schrenk D, Baert K, Dujardin B and Wallace H, 2017. Scientific opinion on the risks for public health related to the presence of furan and methylfurans in food. EFSA Journal 2017;15(10):5005, 142 pp.  
<https://doi.org/10.2903/j.efsa.2017.5005> ISSN: 1831-4732
5. [Commission Recommendation of 3 May 2007 on the monitoring of acrylamide levels in food \(notified under document number C \(2007\) 1873\)](#).
6. [Food Standards Agency Guidelines for Undertaking Surveys](#)
7. [CEN/TS 17083:2017 Foodstuffs - Determination of acrylamide in food and coffee by gas chromatography-mass spectrometry \(GC-MS\)](#).
8. Montaña, A., Casado, F.J., and Carle, R. 2016, Chapter 12 - Acrylamide in Table Olives. Acrylamide in Food, Analysis, Content and Potential Health Effects, Pages 229-251. Acrylamide in Food  
<https://doi.org/10.1016/B978-0-12-802832-2.00012-7>
9. [Regulation \(EU\) No 609/2013 of the European Parliament and of the Council of 12 June 2013 on food intended for infants and young children](#), food for special medical purposes, and total diet replacement for weight control and repealing Council Directive 92/52/EEC, Commission Directives 96/8/EC, 1999/21/EC, 2006/125/EC and 2006/141/EC, Directive 2009/39/EC of the European Parliament and of the Council and Commission Regulations (EC) No 41/2009 and (EC) No 953/2009

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