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Total Diet Study – Acrylamide Investigation: Phase 2 analysis of selected category samples

A report prepared for the Food Standards Agency

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1. Executive Summary

Acrylamide is a contaminant that is formed during food processing and was likely therefore to be present in some of the food categories comprising the TDS such as potato products, breakfast cereals and savoury snacks. In a Phase 1 project, acrylamide was measured in Groups 1-28 of the 2014 TDS samples and the results used to inform the selection of Category samples comprising Groups that contained significant amounts (based on intakes) of acrylamide. This report details the results obtained from the subsequent analysis of 42 Category samples (Phase 2). The results from this study will assist the Agency in calculations of dietary exposure to acrylamide.

CONTENTS

TABLES

FIGURES

TERMS AND ABBREVIATIONS

ALARA	As Low As Reasonably Achievable
Asn	Asparagine
FERA	Food and Environment Research Agency
IV	EC Indicative Value
JECFA	Joint Expert Committee on Food Additives
NDNS	National Diet and Nutrition Survey
TDS	Total Diet Study

2. Introduction

2.1 The Total Diet Study

The Total Diet Study (TDS) is an important part of the UK's surveillance programme for chemicals in food and has been carried out on a continuous annual basis since 1966. Results from the TDS are used to estimate dietary exposures of the general UK population to chemicals in food, such as nutrients, metals and contaminants, to identify changes or trends in exposure and make assessments on the safety and quality of the food supply. The key principle of a TDS is that it is representative of the whole diet. A TDS is different from many surveys as all foods are firstly prepared for consumption, rather than being analysed as sold, before being pooled into Groups for analyses. The design of the TDS typically involves the collection of categories of food which are then combined into Groups of similar foods for analysis. For the 2014 survey, Groups were prepared from 138 categories of foods with each category comprising 24 samples (i.e. sample one from each of 24 local authorities selected by an appointed sampling contractor). The relative proportion of categories within each Group (i.e. the amount of each category making up the pooled Group sample) reflects its importance in the average UK household diet. For this survey, the relative proportions of each category comprising the Groups were derived from three previous years of food purchase data from the Family Food Survey (previously the National Food Survey). In previous TDS, approximately 120 categories were prepared for consumption and combined into Groups 1-20. For this survey, the number of categories was increased to 138 and eight additional Groups were created (Groups 21-28, see Table 1).

Table 1. Groups and categories comprising the 2014 TDS

Group number	Group name	Category number	Category name	Proportions of each category (g) in the food Groups
1	Bread	1	White sliced bread	394
		2	White unsliced bread	50
		3	Brown bread	63
		4	Wholemeal and granary bread	210
		5	Other bread	283
2	Miscellaneous cereals	6	Flour	76
		7	Buns, cakes and pastries	187
		8	Savoury biscuits	21
		9	Sweet biscuits	104
		10	Chocolate biscuits	59
		11	Breakfast cereals	171
		12	Rice	111
		13	Other cereal products	61
		14	Pasta	109
		15	Pizza	101

Table 1 continued...

3	Carcase meat	16	Beef	543
		17	Lamb	190
		18	Pork	267
4	Offals	19	Lambs liver	203
		20	Pigs liver	111
		21	Other liver	151
		22	Kidney	243
		23	Other offals (excluding kidney and liver)	291
5	Meat products	24	Uncooked bacon	118
		25	Cooked ham and bacon	72
		26	Corned meat	14
		27	Other canned or cooked meats	62
		28	Pork sausages	101
		29	Beef sausages	7
		30	Other sausages	13
		31	Ready to eat meat products	147
		32	Meat based ready meals	274
		33	Meat based takeaways	118
		34	Other meat products	11
		35	Burgers	62
6	Poultry	36	Chicken (RAW)	704
		37	Other poultry (RAW)	72
		38	Cooked poultry	125
		39	Poultry products	99
7	Fish	40	White fish	147
		41	Fatty fish	92
		42	Shellfish	78
		43	Canned salmon	18
		44	Other canned/ bottled fish	162
		45	Fish based ready meals and fish products	349
		46	Takeaway fish based meals	154
8	Oils and fats	47	Fat spreads or blended spreads	163
		48	Reduced fat fat spreads or blended spreads	250
		49	Low fat/light fat spreads or blended spreads	86
		50	Vegetable oils	428
		51	Lard	19
		52	Other fats	54
9	Eggs	53	Eggs	910
		54	Egg products	90
10	Sugars and preserves	55	Sugar	347
		56	Jam and fruit curds	56
		57	Marmalade	31
		58	Syrup, Honey, Treacle, Maple Syrup	41
		59	Jelly	1
		60	Chocolate confectionery	354
		61	Sugar confectionery	170

Table 1 continued...

11	Green vegetables	62	Cabbage	146
		63	Sprouts	48
		64	Cauliflower	251
		65	Lettuce and leafy salads	262
		66	Peas	151
		67	Green beans	103
		68	Other fresh green vegetables	40
12	Potatoes	69	Fresh potatoes	683
		70	Potato products	317
13	Other vegetables	71	Onions, leeks	171
		72	Carrots	156
		73	Turnips, swedes	24
		74	Other fresh vegetables	252
		75	Mushrooms	55
		76	Tomatoes	135
		77	Cucumbers	64
		78	Dried pulses	13
		79	Herbs, spices	8
		80	Vegetable based ready meals	108
		81	Dried soups	15
14	Canned or jarred vegetables	85	Canned, carton or jarred soups	300
		86	Canned or jarred tomatoes	184
		87	Canned or jarred peas	64
		88	Canned or jarred beans	387
		89	Other canned or jarred vegetables	65
15	Fresh fruit	90	Oranges	63
		91	Other citrus fruits	98
		92	Apples	193
		93	Pears	55
		94	Stone fruit	74
		95	Bananas	280
		96	Grapes	70
		97	Other fresh fruit	166
16	Fruit products	98	Canned peaches, pears, pineapples	34
		99	Other canned or frozen fruit	53
		100	Dried fruit	55
		101	Fruit juices and vegetable juices	858
17	Non-alcoholic Beverages (Excluding tap water and bottled water)	102	Tea	458
		103	Takeaway Tea	5
		104	Instant coffee	247
		105	Ground coffee	12
		106	Takeaway coffee	10
		107	Branded food drinks	4
		108	Cocoa, drinking chocolate	10
		109	Concentrated soft drinks	95
		110	Ready to drink soft drinks	156
		113	Alternatives to milk	3

Table 1 continued...

18	Milk	114	Whole (full fat) milk (cows)	219
		115	Skimmed/Semi skimmed milks (cows)	781
19	Dairy products	116	Condensed milk or Evaporated Milk	29
		117	Instant milk	13
		118	Natural cheese	175
		119	Processed cheese	18
		120	Butter	67
		121	Ice-cream	243
		122	Yoghurt	297
		123	Other milk products	101
		124	Cream	39
		125	Canned milk puddings	17
20	Nuts	126	Ground nuts including peanut butter	470
		127	Tree nuts	530
21	Alcoholic drinks[a]	128	Beer	580
		129	Cider	101
		130	Wine	259
		131	Alcopops and cocktails	13
		132	Spirits	48
22	Meat substitutes[b]	133	Soy, mycoprotein or vegetable protein based meat substitutes	1000
23	Snacks[a]	134	Potato crisps and potato based snacks	734
		135	Other snacks (not potato based)	266
24	Desserts[a]	136	Desserts (unfrozen)	739
		137	Desserts (frozen but not ice cream)	261
25	Sandwiches[b]	138	Sandwiches	1000
26	Condiments[a]	82	Meat or yeast extracts	30
		83	Spreads, dressings	245
		84	Pickles, sauces	726
27	Tap water[b]	111	Tap water	1000
28	Bottled waters[b, c]	112	Bottled waters	1000

[a] New category; [b] New single category; [c] previously a category in the non-alcoholic beverages group

The purpose of the 2014 TDS was to calculate up to date background exposure to inorganic contaminants, acrylamide and mycotoxins from the whole diet.

2.2 Acrylamide

Acrylamide is a chemical substance that can form naturally when some foods are subjected to high temperatures during cooking (including home-cooking) and processing. Acrylamide is formed from the naturally occurring amino acid asparagine when foods are heated at temperatures typically greater than 120°C in the presence of sugars and other amino acids. Although acrylamide does not occur in such foods subjected

to lower temperatures and relatively short process times e.g. boiled potatoes, it has been found in a wide range of home-cooked and processed foods, including potato crisps, French fries, bread, crispbreads and coffee.

The potential release of acrylamide into potable water from the use of polyacrylamide based coagulants and flocculants for drinking water purification has also been considered although the amounts of residual acrylamide (monomer) in these materials are very low and subject to controls.

Regular and prolonged exposure over a lifetime to foods containing acrylamide has the potential to increase the risk of developing cancer. Experts, including the international Joint Food and Agriculture Organisation and the World Health Organisation Expert Committee on Food Additives (JECFA 2006), have concluded that current global levels of dietary exposure to acrylamide indicate a human health concern. In the UK, the Food Standards Agency (FSA) has concluded that exposure to acrylamide should be as low as reasonably achievable (ALARA).

There are no statutory maximum levels for acrylamide in foods although a maximum limit of 0.1 µg/l has been set for drinking water in the EU[1] (Council Directive 98/83/EC) and the UK (SI 3184, as amended; SI 2785). The latest European Commission Recommendation[2] on investigations into the levels of acrylamide in food specifies 'indicative values' (IV) for acrylamide for certain categories of food. While these IV are not intended as maximum limits, they are intended to initiate investigations by enforcement authorities into food business operators' understanding of acrylamide and actions taken to mitigate its production.

An acrylamide "toolbox" is available to industry to provide guidance on measures to reduce acrylamide levels in various categories of foods[3].

2.3 Project brief and lines of approach

Acrylamide is a contaminant that is formed primarily during the thermal processing of food and was likely therefore to be present in some of the categories comprising the 2014 TDS such as potato products, breakfast cereals and savoury snacks. Analysis of acrylamide and estimates of dietary exposure were previously reported in 2005 (FSA) using Group samples (1-20) from the 2003 UK TDS.

This project was undertaken to assist the Agency in calculations of dietary exposure to acrylamide. The analytical investigation was carried out in two phases: phase 1 comprised the analysis of all 28 Groups for acrylamide using an accredited method of analysis, and the analytical results were used to inform the selection of Category samples for further investigation / analyses (Hamlet et al 2015); in Phase 2 (this project), 42 Category samples were obtained from FERA for the measurement of acrylamide (see Table 2).

[1] Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption, oj L 330, 32-54, 5.12.98

[2] Commission Recommendation of 8 November 2013 on investigations into the levels of acrylamide in food (2013/647/EU), oj L 301, 15-17, 12.11.13

[3] Available at: http://www.fooddrinkeurope.eu/publications/category/toolkits/

Table 2. 2014 TDS category samples selected for the analysis of acrylamide

Category number	Category name
1	White sliced bread
2	White unsliced bread
3	Brown bread
4	Wholemeal and granary bread
5	Other bread
7	Buns, cakes and pastries
8	Savoury biscuits
9	Sweet biscuits
10	Chocolate biscuits
11	Breakfast cereals
13	Other cereal products
15	Pizza
31	Ready to eat meat products
32	Meat based ready meals
33	Meat based takeaways
45	Fish based ready meals and fish products
46	Takeaway fish based meals
60	Chocolate confectionery
69	Fresh potatoes
70	Potato products
71	Onions, leeks
73	Turnips, Swedes
75	Mushrooms
80	Vegetable based ready meals
82	Meat or yeast extracts
83	Spreads, dressings
84	Pickles, sauces
86	Canned or jarred tomatoes
88	Canned or jarred beans
98	Canned peaches, pears, pineapples
99	Other canned or frozen fruit
100	Dried fruit
104	Instant coffee
105	Ground coffee
106	Takeaway coffee
107	Branded food drinks
108	Cocoa, drinking chocolate
126	Ground nuts including peanut butter
127	Tree nuts
134	Potato crisps and potato based snacks
135	Other snacks (not potato based)
136	Desserts (unfrozen)

3. Experimental

3.1 Sample collections and preparation

Homogeneous sub-samples (100 g) of each Category sample selected from the 2014 TDS were delivered to PAS in polystyrene containers containing “freeze packs” directly from FERA (York). All samples were stored at -18°C until required for analysis.

3.2 Analysis of acrylamide

Defrosted samples were stirred thoroughly with a glass rod prior to analysis. Acrylamide was determined as the brominated derivative, 2-bromopropenamide using GC/MS/MS, according to the method of Hamlet, Sadd & Liang (2008). Method performance (typical): limits of detection and quantification were 0.5 and 3.0 µg/kg respectively; the estimated value for the method uncertainty (single determination) was ±4% (expanded relative uncertainty with a coverage factor of 2).

3.3 Analytical quality assurance

The analysis of samples was performed by trained staff in a UKAS accredited laboratory operating an internal audit and review process. The test method for acrylamide was validated in-house and accredited by UKAS (ISO 17025).

Each batch of samples (1-20 samples) included a procedural blank and an In-House Reference Material (IHRM) and / or spiked sample. Method performance was monitored by assessing the data from IHRMs and / or spiked reference materials in accordance with the rules governing Shewhart control charts (this data is summarised in Table 4 of the Appendices). The laboratory also participated in the FAPAS proficiency testing schemes available for acrylamide (see Table 5 of the Appendices). In addition, 7 out of 42 (17%) of the Category samples were subjected to a repeat analysis: the acceptance criteria for the duplicate was for the result to be within ±10% of the first measurement (see Table 6 of the Appendices).

4. Results

Table 3 shows the amounts of acrylamide measured in each of the 42 Category samples (data are mean of replicate analyses where applicable) and the corresponding amounts of acrylamide in the Groups to which each Category belongs (Hamlet et al 2015). Acrylamide data for the individual samples and replicates, together with the upper and lower bound acrylamide concentrations can be found in Table 7 of the Appendices.

The summary in Figure 1, which has been ordered by increasing acrylamide concentrations, and shows that categories with the highest amounts of acrylamide (>100 µg/kg) were the sweet and savoury biscuits, fresh potatoes (cooked), potato products (cooked) and other snacks (not potato based); lowest amounts of acrylamide (≤10 µg/kg) were measured in takeaway fish based meals, coffee, cocoa and branded food drinks (as consumed), canned or jarred tomatoes, white unsliced bread, tree nuts, canned or jarred beans, meat or yeast extracts, other cereal products, spreads and dressings, mushrooms, turnips and Swedes, other canned or frozen fruit, and canned peaches, pears and pineapples.

Table 3. Amounts of acrylamide measured in the 2014 TDS Category samples and their corresponding Groups

Category				Group		
Sample code	No	Description	Acrylamide (µg/kg) [a]	No	Description	Acrylamide (µg/kg) [a]
16C-01164	1	White sliced bread	13	1	Bread	16
16C-01165	2	White unsliced bread	9			
16C-01166	3	Brown bread	29			
16C-01167	4	Wholemeal and granary bread	20			
16C-01168	5	Other bread	14			
16C-01169	7	Buns, cakes and pastries	22	2	Miscellaneous Cereals	65
16C-01170	8	Savoury biscuits	203			
16C-01171	9	Sweet biscuits	289			
16C-01172	10	Chocolate biscuits	264			
16C-01173	11	Breakfast cereals	60			
16C-01174	13	Other cereal products	5			
16C-01175	15	Pizza	15			
16C-01176	31	Ready to eat meat products	31	5	Meat Products	17
16C-01177	32	Meat based ready meals	16			
16C-01178	33	Meat based takeaways	27			
16C-01179	45	Fish based ready meals and fish products	14	7	Fish	9
16C-01180	46	Takeaway fish based meals	10			
16C-01181	60	Chocolate confectionery	25	10	Sugars and Preserves	20
16C-01182	69	Fresh potatoes	183	12	Potatoes	181
16C-01183	70	Potato products	126			
16C-01184	71	Onions, leeks	52	13	Other Vegetables	21
16C-01185	73	Turnips, Swedes	1			
16C-01186	75	Mushrooms	2			
16C-01187	80	Vegetable based ready meals	19			
16C-01188	86	Canned or jarred tomatoes	9	14	Canned Vegetables	12
16C-01189	88	Canned or jarred beans	7			
16C-01190	98	Canned peaches, pears, pineapples	1	16	Fruit Products	7
16C-01191	99	Other canned or frozen fruit	1			
16C-01192	100	Dried fruit	13			

Table 3 continued...

Category				Group		
Sample code	No	Description	Acrylamide (µg/kg) [a]	No	Description	Acrylamide (µg/kg) [a]
16C-01193	104	Instant coffee	10	17	Non-alcoholic Beverages	6
16C-01194	105	Ground coffee	6			
16C-01195	106	Takeaway coffee	9			
16C-01196	107	Branded food drinks	5			
16C-01197	108	Cocoa, drinking chocolate	6			
16C-01198	126	Ground nuts including peanut butter	43	20	Nuts	25
16C-01199	127	Tree nuts	7			
16C-01200	134	Potato crisps and potato based snacks	465	23	Snacks	360
16C-01201	135	Other snacks (not potato based)	119			
16C-01202	136	Desserts (unfrozen)	16	24	Desserts	20
16C-01203	82	Meat or yeast extracts	6	26	Condiments	22
16C-01204	83	Spreads, dressings	2			
16C-01205	84	Pickles, sauces	23			

[a] results are mean of replicate analyses where applicable (LOD 0.5 µg/kg); [b] data from Hamlet et al (2015)

While EC Indicative values[4] did not apply to the composite Groups and Categories as tested, they did apply to specific products comprising each Category such as: soft wheat bread (80 µg/kg); sweet biscuits and crackers (500 µg/kg); crispbread (450 µg/kg); roast and instant coffee (450 µg/kg and 900 µg/kg respectively, product as sold) and potato crisps and crackers (1000 µg/kg).

[4] Commission Recommendation of 8 November 2013 on investigations into the levels of acrylamide in food (2013/647/EU), oj L 301, 15-17, 12.11.13

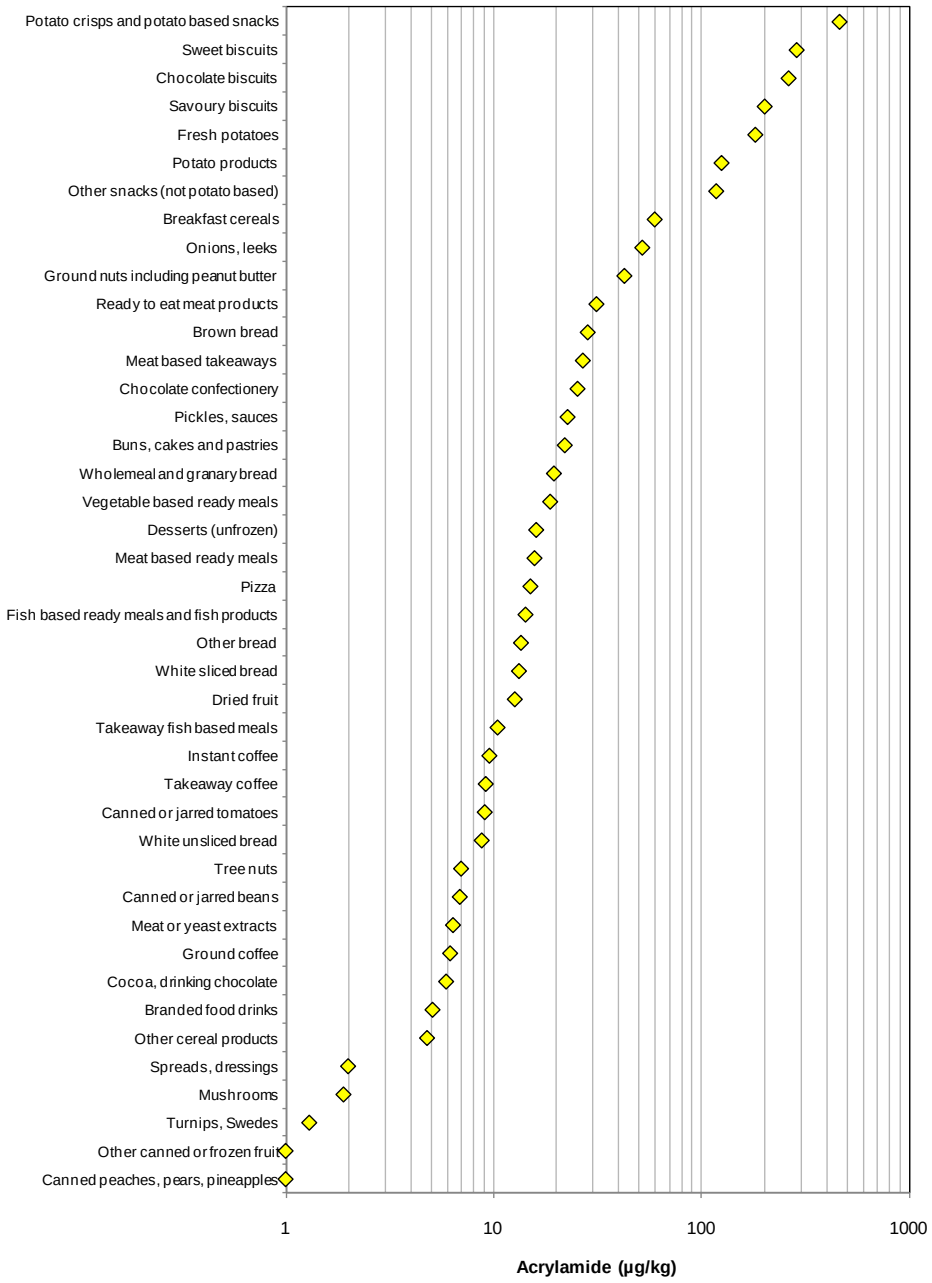

Figure 1. Summary of acrylamide amounts measured in the 2014 TDS Category samples arranged in order of increasing concentrations (log scale)

5. Conclusions

- Highest concentrations of acrylamide (>100 µg/kg) were found in: the sweet and savoury biscuits; fresh potatoes (cooked); potato products (cooked) and other snacks (not potato based).
- Lowest amounts of acrylamide (≤10 µg/kg) were measured in: takeaway fish based meals; coffee, cocoa and branded food drinks (as consumed); canned or jarred tomatoes; white unsliced bread; tree nuts; canned or jarred beans; meat or yeast extracts; other cereal products; spreads and dressings; mushrooms; turnips and Swedes; other canned or frozen fruit; and canned peaches, pears and pineapples.

6. Appendices

6.1 Analytical quality assurance (AQA)

Table 4. Summary of data obtained from the analysis of IHRMs and spiked samples during this project

(A) Acrylamide IHRM data

	Reference values (µg/kg)				Measured values (µg/kg)			
	n	mean	range [a]	SE	n	mean	range	SE
IHRM [b]	9	41.6	39.7-43.6	0.3	3	41.4	40.6-42.8	0.69

[a] upper and lower warning limits (mean ±2 SD; [b] dried cereal based material

(B) Acrylamide spiked recovery data

Nominal spike level (µg/kg)	Recovery (%) [a]			
	n	mean	range	SE
100	1	-	101.6	-
497	1	-	93.3	-

[a] the acceptable recovery range was 80-120%

Table 5. FAPAS acrylamide z-scores (Jan 2015 – Sep 2015)

Series	n	z-score	
		mean	range
30	4	0.0	-0.4 to 0.4

Table 6. Results from the repeat determinations of acrylamide in selected samples

Sample Code	Category No	Category description	Date of analysis	Acrylamide (µg/kg) [a]	Comments
16C-01166	3	Brown bread	07/03/2016	27 (29)	sample not homogeneous (visually)
16C-01167	4	Wholemeal and granary bread	07/03/2016	20 (20)	
16C-01172	10	Chocolate biscuits	22/02/2016	258 (264)	
16C-01193	104	Instant coffee	22/02/2016	10 (10)	
16C-01197	108	Cocoa, drinking chocolate	26/02/2016	6 (6)	
16C-01200	134	Potato crisps and potato based snacks	26/02/2016	508 (465)	
16C-01205	84	Pickles, sauces	07/03/2016	23 (23)	

[a] initial result in parentheses

A)

B)

Figure 2. Images of sample 16C-01167: A) before; and B) after mixing with a glass rod

6.2 Individual sample results

Table 7. Acrylamide concentrations in individual Category samples: upper and lower bound values; LOD, LOQ and RU

Sample Code	Category No	Category description	Date of analysis	Acrylamide (µg/kg)			LOD (µg/kg)	LOQ (µg/kg)	RU (%)	Comments
				measured	Lower bound[a]	Upper bound[b]				
16C-01164	1	White sliced bread	22/02/2016	13	13	13	0.5	3	4.2	
16C-01165	2	White unsliced bread	22/02/2016	9	9	9	0.5	3	4.2	
16C-01166	3	Brown bread	22/02/2016	29	29	29	0.5	3	4.2	
16C-01166R	3	Brown bread	07/03/2016	27	27	27	0.5	3	4.2	repeat determination
16C-01167	4	Wholemeal and granary bread	22/02/2016	20	20	20	0.5	3	4.2	sample not homogeneous (visually)
16C-01167R	4	Wholemeal and granary bread	07/03/2016	20	20	20	0.5	3	4.2	repeat determination; sample not homogeneous (visually)
16C-01168	5	Other bread	22/02/2016	14	14	14	0.5	3	4.2	
16C-01169	7	Buns, cakes and pastries	22/02/2016	22	22	22	0.5	3	4.2	
16C-01170	8	Savoury biscuits	22/02/2016	203	203	203	0.5	3	4.2	
16C-01171	9	Sweet biscuits	22/02/2016	289	289	289	0.5	3	4.2	
16C-01172	10	Chocolate biscuits	22/02/2016	264	264	264	0.5	3	4.2	
16C-01172AQA	10	Chocolate biscuits	22/02/2016	258	258	258	0.5	3	4.2	AQA duplicate
16C-01173	11	Breakfast cereals	22/02/2016	60	60	60	0.5	3	4.2	
16C-01174	13	Other cereal products	22/02/2016	5	5	5	0.5	3	4.2	
16C-01175	15	Pizza	22/02/2016	15	15	15	0.5	3	4.2	
16C-01176	31	Ready to eat meat products	22/02/2016	31	31	31	0.5	3	4.2	
16C-01177	32	Meat based ready meals	22/02/2016	16	16	16	0.5	3	4.2	
16C-01178	33	Meat based takeaways	22/02/2016	27	27	27	0.5	3	4.2	
16C-01179	45	Fish based ready meals and fish products	22/02/2016	14	14	14	0.5	3	4.2	
16C-01180	46	Takeaway fish based meals	22/02/2016	10	10	10	0.5	3	4.2	

Table 7 continued...

Sample Code	Category No	Category description	Date of analysis	Acrylamide (µg/kg)			LOD (µg/kg)	LOQ (µg/kg)	RU (%)	Comments
				measured	Lower bound[a]	Upper bound[b]				
16C-01181	60	Chocolate confectionery	22/02/2016	25	25	25	0.5	3	4.2	
16C-01182	69	Fresh potatoes	22/02/2016	183	183	183	0.5	3	4.2	
16C-01183	70	Potato products	22/02/2016	126	126	126	0.5	3	4.2	
16C-01184	71	Onions, leeks	22/02/2016	52	52	52	0.5	3	4.2	
16C-01185	73	Turnips, Swedes	22/02/2016	1	0	3	0.5	3	4.2	result <LOQ
16C-01186	75	Mushrooms	22/02/2016	2	0	3	0.5	3	4.2	result <LOQ
16C-01187	80	Vegetable based ready meals	22/02/2016	19	19	19	0.5	3	4.2	
16C-01188	86	Canned or jarred tomatoes	22/02/2016	9	9	9	0.5	3	4.2	
16C-01189	88	Canned or jarred beans	22/02/2016	7	7	7	0.5	3	4.2	
16C-01190	98	Canned peaches, pears, pineapples	22/02/2016	1	0	3	0.5	3	4.2	result <LOQ
16C-01191	99	Other canned or frozen fruit	22/02/2016	1	0	3	0.5	3	4.2	result <LOQ
16C-01192	100	Dried fruit	22/02/2016	13	13	13	0.5	3	4.2	
16C-01193	104	Instant coffee	22/02/2016	10	10	10	0.5	3	4.2	
16C-01193AQA	104	Instant coffee	22/02/2016	10	10	10	0.5	3	4.2	AQA duplicate
16C-01194	105	Ground coffee	26/02/2016	6	6	6	0.5	3	4.2	
16C-01195	106	Takeaway coffee	26/02/2016	9	9	9	0.5	3	4.2	
16C-01196	107	Branded food drinks	26/02/2016	5	5	5	0.5	3	4.2	
16C-01197	108	Cocoa, drinking chocolate	26/02/2016	6	6	6	0.5	3	4.2	
16C-01197AQA	108	Cocoa, drinking chocolate	26/02/2016	6	6	6	0.5	3	4.2	AQA duplicate
16C-01198	126	Ground nuts including peanut butter	26/02/2016	43	43	43	0.5	3	4.2	

Table 7 continued...

Sample Code	Category No	Category description	Date of analysis	Acrylamide (µg/kg)			LOD (µg/kg)	LOQ (µg/kg)	RU (%)	Comments
				measured	Lower bound[a]	Upper bound[b]				
16C-01199	127	Tree nuts	26/02/2016	7	7	7	0.5	3	4.2	
16C-01200	134	Potato crisps and potato based snacks	26/02/2016	465	465	465	0.5	3	4.2	
16C-01200AQA	134	Potato crisps and potato based snacks	26/02/2016	508	508	508	0.5	3	4.2	AQA duplicate
16C-01201	135	Other snacks (not potato based)	26/02/2016	119	119	119	0.5	3	4.2	
16C-01202	136	Desserts (unfrozen)	26/02/2016	16	16	16	0.5	3	4.2	
16C-01203	82	Meat or yeast extracts	26/02/2016	6	6	6	0.5	3	4.2	
16C-01204	83	Spreads, dressings	26/02/2016	2	0	3	0.5	3	4.2	result <LOQ
16C-01205	84	Pickles, sauces	26/02/2016	23	23	23	0.5	3	4.2	
16C-01205R	84	Pickles, sauces	07/03/2016	23	23	23	0.5	3	4.2	repeat determination

[a] values <LOD & LOQ set at 0; [b] values <LOD set at LOD & values <LOQ set at LOQ

7. References

BS ISO 7870-2:2013, Control charts. Shewhart control charts, British Standards Institution. Available at: http://shop.bsigroup.com/ (accessed March 2013)

Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption OJ L 330, 32-54.

Food Standards Agency, (2005) Analysis of total diet study samples for acrylamide. Food Survey Information Sheet 71/05, January 2005. Available at: http://tna.europarchive.org/20110116113217/http://www.food.gov.uk/multimedia/pdfs/fsis712005.pdf (accessed March 2016).

Hamlet, C. G., Andreou, A., Carbone, L., (2015) Total Diet Study – Acrylamide Investigation: Phase 1 analysis of all group samples: Report C034 prepared for the UK Food Standards Agency, High Wycombe: Premier Analytical Services.

Hamlet, C. G., Sadd, P. A., & Liang, L. (2008) Correlations between the amounts of free asparagine and saccharides present in commercial cereal flours in the UK and the generation of acrylamide during cooking. Journal of Agricultural and Food Chemistry, 56, 6145-6153.

SI 2785 Natural Mineral Water, Spring Water and Bottled Drinking Water (England) Regulations 2007

SI 3184 Water Supply (Water Quality) Regulations 2000

WHO (2006) Joint FAO/WHO Expert Committee on Food Additives (2005: Rome, Italy), Evaluation of certain food contaminants: sixty-fourth report of the Joint FAO/WHO Expert Committee on Food Additives. Geneva, WHO technical report series 930, pp. 23.