

27/02

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PAPER AND BOARD PACKAGING: NOT LIKELY TO BE A SOURCE OF ACRYLAMIDE IN FOOD

Summary

- The Food Standards Agency carried out this survey to test whether residual acrylamide is present in samples of paper and board that may be in contact with food or drink, and if so whether there is any detectable migration of this substance into food or drink. This is the latest in a series of surveys on chemicals that might contaminate paper or board and migrate from there into food.
- Acrylamide contamination of paper and board might arise from the environment, in making this type of packaging, and, in the light of recent evidence, from food. The UK independent Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the Environment advises that exposure to genotoxic carcinogens such as acrylamide should be as low as reasonably practicable.
- The main conclusion of this survey is that it is very unlikely that paper and board packaging is a source of acrylamide in food. Acrylamide was detected in a small minority of paper and board samples (12 out of 140). This substance was found in four samples of packaging at unquantifiably low levels (less than 0.03 parts per million [ppm]), in seven samples at 0.09 to 0.2 ppm and in one sample at 1.4 ppm.
- Even if all of this acrylamide were to migrate from the packaging into food or drink - an extremely unlikely event - this would have resulted only in contamination at very low levels. Acrylamide levels would have been too low to be measurable in most cases (with a limit of quantification in food of 0.006 ppm).

- Food as a possible source of acrylamide in packaging was also considered in this survey. Results showing that acrylamide can be found in some cooked foods were reported whilst the survey was being carried out. There was probably migration of acrylamide from food into packaging. In an experiment in which packaging was separated into those parts that had been in contact with food and those that had not, acrylamide was found only where the packaging had been in contact with food. The Food Standards Agency is continuing to work with stakeholders and contributing to European and other international effort to develop an understanding of acrylamide in food. The Agency has welcomed the World Health Organisation's recent initiative to create a network of international research bodies.
- Other possible sources of acrylamide in paper or board packaging - during its manufacture or from the environment - appeared to cause little contamination of paper or board with acrylamide. This substance was detected in only three out of 25 packaging samples that had not been in contact with food or drink, at less than 0.03 ppm in two samples and at 0.16 ppm in a third sample.
- The Food Standards Agency followed up the finding of 0.16 ppm of acrylamide from non-food sources in one sample that exceeded a theoretical maximum level of 0.015 ppm acrylamide in paper. The Agency worked quickly with the Paper Federation of Great Britain and the manufacturer of the product, to resolve the problem. The manufacturer has now shown that acrylamide levels in their current product are not detectable (i.e. less than 0.01 ppm).

Background

The survey

This survey was carried out to test whether residual acrylamide monomer is present in samples of paper and board that may be in contact with food or drink, and if so whether there is any detectable migration of acrylamide into food or drink. An extensive literature search found no evidence of previous work to answer these questions.

This is the latest in a series of surveys on chemical migration from paper and board, following a review to identify which substances should be surveyed.¹⁻¹¹ Several of these surveys found chemical contamination of packaging, but there was less evidence of

chemical migration. Where migration into food was found action has been taken to protect UK consumers.^{9,11} The results of this extensive series of surveys are being used to stimulate the development of European Union controls on chemical migration from paper or board in contact with food or drink.

Possible sources of acrylamide in paper and board

In theory acrylamide might be present in paper or board from:

- the use of polyacrylamides in their manufacture;
- environmental contamination; and/or
- acrylamide migration from food into packaging.

Polyacrylamide is used in the manufacture of paper and board:

- to aid retention and drainage;
- to increase the efficiency and effectiveness of water recovery systems for internal water treatments (such as the de-inking process or back water clarification) and treatment of effluent prior to disposal;
- to increase dry strength; and
- to increase the molecular weight of fixatives used as 'runnability' aids.

During the production of polyacrylamides, residual acrylamide is left in the polymer. This may leach out into water and hence into materials such as those involved in making paper or board. The residual content of acrylamide is controlled by manufacturers of polyacrylamide to below 0.1 per cent.

Environmental contamination by acrylamide and hence of paper and board might arise from several sources including mineral processing, crude oil production, soil and sand treatment, and textile production.

Acrylamide in food

Food as a possible source of acrylamide in packaging was also considered in this survey. Results showing that acrylamide can be found in some cooked foods were reported whilst the survey was being carried out.¹² Levels of up to 12 parts per million (ppm) were found in the Food Standards Agency's work on acrylamide in cooked foods.¹² The development of an analytical method for the survey reported here allowed rapid implementation of the Agency's work on cooked foods.

Acrylamide has been found to cause damage to genetic material in studies using a range of experimental systems, including cultured mammalian cells *in vitro*, and *in vivo* in rats and mice. It has also been shown to induce tumours in rats following long-term administration. Together, these observations lead to the conclusion that acrylamide is a genotoxic carcinogen, for which it is not possible to identify a safe level of exposure. Some risk should be assumed, albeit small, even at very low levels of exposure. The UK independent Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the Environment advises that exposure to genotoxic carcinogens such as acrylamide should be as low as reasonably practicable.

The Food Standards Agency is continuing to work with stakeholders and contributing to European and other international effort to develop an understanding of acrylamide in food. The Agency has welcomed the World Health Organisation's recent initiative to create a network of international research bodies.¹²

Controls on acrylamide in food packaging

There are harmonised European Union (EU) controls on acrylamide in plastics intended to come into contact with food or drink.¹³ These state that migration of this substance should not be detectable, with a detection limit of 0.01 ppm. However controls on the migration of acrylamide from other types of food packaging materials, such as paper and board, have not been harmonised across the EU. Chemical migration from paper and board into food is controlled in Great Britain under the general provisions of The Materials and Articles in Contact with Food Regulations 1987 and of the Food Safety Act 1990. Similar controls apply in Northern Ireland. The paper and board industry has informed the Food Standards Agency that the theoretical maximum level of acrylamide in paper is 0.015 ppm.

Methodology

Samples and timing

One hundred and forty samples (Table 1) were purchased in triplicate in northern England between February and April 2002. Analytical work was completed in May 2002. The results were collated, checked and reviewed in May and June 2002.

A wide variety of different samples was obtained:

- tea bags, 18 samples
- coffee filters, bags, cartridges, 11 samples
- kitchen towels, 12 samples
- greaseproof paper, 3 samples
- baking/cake cases, 3 samples
- frozen foods, 37 samples
- foods for microwave cooking, 16 samples
- food stored at room temperature, 24 samples
- pads for use in contact with foods (e.g. meat or shellfish), 16 samples

The ratio between branded goods and stores' own brands was about 60:40. Each sample was assigned a unique number. Samples were stored at ambient temperature (approximately 20°C away from sunlight), in a refrigerator (less than 10°C) or in a freezer (-20°C) as appropriate. All samples were analysed by the Central Science Laboratory, Sand Hutton, York. The analytical method was based on a previously published method.¹⁴

Standard solutions

Stock solutions of acrylamide and methacrylamide were prepared in water at 12 milligrammes per litre (mg/L) and 75 mg/L, respectively. Stock solutions were diluted with water to form calibration standards (0 - 0.05 mg/L acrylamide) each containing 0.125 mg/L methacrylamide as internal standard. Solutions were stored in amber vials at +4 °C and fresh solutions were prepared every 6 weeks.

Brominating reagent was prepared from potassium bromide (200 g), hydrobromic acid (10 mL) and bromine-saturated water (160 mL, prepared by stirring distilled water (400 mL) with bromine (15 mL) for 1 hour in an ice bath) made to a total volume of 1,000 mL with distilled water. This reagent was stored at 4°C when not in use.

Analytical method

Overview

The methodology used was in two parts:

- First, the paper or board sample was extracted with water under conditions that would extract the water-soluble acrylamide monomer if it were to be present. Hot or cold water extraction was used according to the way in which the paper or board would be used in contact with food or drink.
- Then the extract was brominated and analysed by gas chromatography-mass spectrometry (GC-MS) for any derivatised acrylamide.

Hot water extraction of paper

Following the standard BSI extraction protocol paper specimens (5g plus or minus 0.1 g) were cut into squares (1-2 cm²) and placed in an Erlenmeyer flask (250 mL).¹⁵ Distilled water was boiled and 100 mL of the hot water was added to the sample. The flask was stoppered and immersed in a water bath at 80°C plus or minus 2°C for 2 hours with occasional swirling. Following heating, the flask was cooled quickly to room temperature by standing in cold water. The aqueous extract was filtered under vacuum through a sintered-glass filter. The specimen was washed twice with a total of 25 mL of cold water, which was added to the extract. No mechanical pressing of the soaked specimen was applied.

Cold water extraction of paper

Following the standard BSI extraction protocol the hot water extraction procedure described above was followed except that distilled water (100 mL) at room temperature was added to a flask containing the sample and the extraction conditions were 23°C plus or minus 2°C for 24 hours.¹⁶

Bromination of water extracts

A portion of the filtered extract (15g plus or minus 0.1 g) was weighed into a screw cap vial. Internal standard solution was added (25 microlitre of methacrylamide stock standard). Using a measuring cylinder, brominating solution (15 mL) was added, the vial capped, shaken and placed in the dark at 4°C overnight (15 hours). Excess bromine was then neutralised by the addition of sodium thiosulphate solution (1.0 M, ca. 7 drops required to remove the bromine colour). The mixture was extracted with ethyl acetate (8 mL) on an orbital shaker for 15 minutes. Phase separation was effected by centrifugation (2,000 rpm for 5 minutes). The organic extract (ca. 4 mL) was transferred using a Pasteur pipette into a screw-cap vial (4 mL) containing anhydrous sodium sulphate

(ca. 0.5 g) and shaken for 15 minutes to dry the extract. The organic solution was decanted into a fresh vial and evaporated to less than 1 mL under a gentle stream of nitrogen at 40°C. The sample was made up to 1 mL with ethyl acetate and transferred to an autosampler vial (1 mL) for GC-MS analysis.

GC-MS analysis of extract

Brominated extracts were analysed by GC-MS using a ThermoQuest Voyager operated in selected ion monitoring (SIM) mode with electron impact ionisation, under the following conditions:

Column:	J&W DB17 (50 per cent phenyl, 50 per cent methylsilicone) 30m x 0.25mm x 0.25 micrometre.
Carrier gas:	Helium at 1 ml/min
Autosampler:	Carlo Erba A200S
Injection Volume:	1 microlitre splitless
Splitless time:	45 seconds
Injection temperature:	200 °C
Interface temperature:	280 °C
Oven programme:	85 °C hold 1 minute (min) Raise to 175 °C at 25 °C per min Hold for 6 min Raise to 240 °C at 40 °C per min Hold for 5 min
Ions monitored:	Brominated acrylamide: m/z 106, 108, 150 and 152 Brominated methacrylamide: m/z 120 and 122

Quantification

Calibration graphs for standards in distilled water and in each of the standard addition extracts were constructed by plotting the peak area ratio of m/z 152 for acrylamide versus m/z 122 for the methacrylamide internal standard, against acrylamide concentration. Results for samples were obtained by interpolation of the calibration line for standards. If the result for an extract was outside the calibration range then it was diluted and reanalysed.

Quality assurance

'Spiked' samples

The suitability of the method to determine acrylamide in paper and food was tested by analysing paper and boiled, mashed potato samples 'spiked' with acrylamide. Acrylamide stock solution was 'spiked' into paper and potato samples by adding a known volume of standard acrylamide solution and allowing the solution to infuse into the sample before starting the hot or cold water extraction procedure. A portion of the mashed potato (70 g) was placed into an Erlenmeyer flask and subjected to the hot water extraction procedure described above. Samples were prepared as five replicate specimens. Selected extracts were analysed five times by GC-MS.

Acrylamide identification and quantification

For acrylamide to be considered present in a sample extract, four criteria had to met:

- The ratios of retention time for acrylamide compared with the internal standard, had to be within 5 per cent for standards, 'spikes' and samples.
- The ion ratio for acrylamide ions 106 to 108 and 150 to 152 atomic mass units, had to be within 25 per cent for standards, 'spikes' and samples.
- When operating the GC-MS in scanning mode, the mass spectrum of any putative acrylamide peak in the sample should not contain any additional ions not seen in standards, at no more than 20 per cent abundance.
- The signal:noise ratio of any putative GC-MS peak must be greater than 3:1.

Internal quality control

A typical batch size was 15-20 samples. Each analytical batch included at least one method blank. Due to the expected instability of acrylamide on long-term storage, an in-house reference material was not produced. To compensate for this at least two 'spikes' were included with each analytical batch. An assessment of the batch recovery of acrylamide during the survey was carried out by quantifying 'spiked' samples against solvent standards. For 10 'spiked' extracts the mean recovery was 95 per cent. Sample extracts were interspersed in the sample sequence of each batch, with bracketing standards.

Check sample exercise - test for accuracy

To demonstrate the accuracy of the analysis, six samples each of paper and potato were 'spiked' with acrylamide so that they could be analysed 'blind' as a check of method accuracy. Samples were prepared at the Department of Chemistry, University of York. Portions of paper (5 g) or mashed potato (70 g) were 'spiked' with a solution of acrylamide in water (25 microgrammes/ml). The samples were then supplied to the test laboratory for extraction and analysis. The testing laboratory correctly identified the blank and the 'spiked' samples. There was a good correlation between added and determined levels of acrylamide (Table 2).

Reporting

Recovery values were measured for acrylamide in packaging or food:

- For paper 'spiked' at 0.5 ppm the analytical recovery was 94 per cent plus or minus 8 per cent for hot water extraction (n=5). For paper 'spiked' at 0.75 ppm the analytical recovery was 108 per cent plus or minus 3 per cent for cold water extraction (n=5).
- For potato 'spiked' at 0.75 ppm the analytical recovery for hot water extraction was 101 per cent plus or minus 5 per cent (n=4). For potato 'spiked' at 0.028 ppm the recovery was 89 per cent plus or minus 1 per cent (n=4). For potato 'spiked' at 0.012 ppm the recovery was 88 per cent plus or minus 2 per cent (n=4).

In all cases the acrylamide derivative showed as a strong, clean, symmetrical peak at ca. 7.2 minutes in the four selected ion channels monitored (m/z 152, 150, 108 & 106). Repeated injections of a single extract gave relative standard deviation values of about 6 per cent. Thus analytical variability was associated largely with the GC-MS determination rather than the extraction and derivatisation steps.

The limit of detection was 0.01 ppm for paper and board; the limit of quantification for paper and board was 0.03 ppm. Calibration standards prepared in distilled water over the range 0 to 0.05 mg/litre, gave a linear response (n=5, r=0.9951).

Brand names were reported as this survey was carried out in accordance with guidelines for reporting survey results published in the *Food Safety Information Bulletin* in September

1997. The absence of a particular brand from Tables 1 and 3 means only that the brand was not included in the survey.

Results, interpretation and action

Acrylamide was detected in 12 out of 140 retail samples of paper and board that may come into contact with food or drink. This substance was found at less than 0.03 parts per million [ppm] in four of these 12 samples (nos. 4, 24, 27 and 28 in Table 1), at 0.09 to 0.2 ppm in seven samples (nos. 34, 49, 74, 77, 78, 79 and 122 in Table 1), and at 1.4 ppm in sample no. 68. Even if all of the acrylamide in these samples were to migrate the levels in food would have been very low, compared to those found in some samples of cooked food.¹⁷ Indeed the levels in food resulting from complete migration from packaging - an extremely unlikely event - would have been below the limit of quantification (0.006 ppm) for all but three samples (Table 3). Therefore it is very unlikely that paper and board packaging is a source of acrylamide in food. This is due in part at least to controls applied by UK industry. These controls have had the same apparent effect, of minimising exposure to this genotoxic carcinogen via packaging, as European Union-wide controls on acrylamide in plastic used in contact with food. The toxicological basis of these EU-wide controls on plastics has been recently reconfirmed by the EC Scientific Committee on Food.¹⁸

There was probably migration of acrylamide from food into packaging. In an experiment in which packaging was separated into those parts that had been in contact with food and those that had not, acrylamide was found only where the packaging had been in contact with food. Acrylamide was not detected in parts of packaging not in contact with food, for four further examples of sample no. 68. The parts of these four packs in contact with food contained on average 1.1 ppm of acrylamide. The limit of detection was 0.03 ppm due to the small sample size available for this particular analysis.

Other possible sources of acrylamide in paper or board packaging - during its manufacture or from the environment - appeared to cause little contamination of paper or board with acrylamide. This substance was detected in only three out of 25 packaging samples that had not been in contact with food or drink. Samples nos. 24 and 27, in Table 1, contained less than 0.03 ppm of acrylamide; sample no. 34 contained 0.16 ppm.

The Food Standards Agency followed up the finding of 0.16 ppm of acrylamide from non-food sources in sample no. 34 that exceeded a theoretical maximum level of 0.015 ppm acrylamide in paper. Clearly in this case the acrylamide did not originate from contact with food. The Food Standards Agency worked quickly with the Paper Federation of Great Britain and the manufacturer of the product, to resolve the problem. The manufacturer has now shown that acrylamide levels in their current product are not detectable (i.e. less than 0.01 ppm).

References

1. *Progress report of the Working Party on Chemical Contaminants from Food Contact Materials: 1988 to 1992*. Food Surveillance Paper No. 38, HMSO, 1993.
2. MAFF/DH JFSSG *Formaldehyde in tea-bag tissue*. JFSSG Food Surveillance Information Sheet 26, 1994.
3. MAFF/DH JFSSG *Fluorescent whitening agents*. JFSSG Food Surveillance Information Sheet 47, 1995.
4. MAFF/DH JFSSG *Phthalates in paper & board packaging*. JFSSG Food Surveillance Information Sheet 60, 1995.
5. MAFF/DH JFSSG *Grease-proofing agents in paper & board*. JFSSG Food Surveillance Information Sheet 66, 1995.
6. MAFF/DH JFSSG *Curing agents in cartonboard food packaging*. JFSSG Food Surveillance Information Sheet 72, 1995.
7. MAFF/DH JFSSG *Survey of paper and board food contact materials for residual amine monomers from wet strength agents*. JFSSG Food Surveillance Information Sheet 90, 1996.
8. MAFF/DH JFSSG *Survey of pentachlorophenol in paper and board packaging used for retail foods*. JFSSG Food Surveillance Information Sheet 139, 1997.
9. MAFF/DH JFSSG *Diisopropylnaphthalenes in food packaging made from recycled paper and board*. JFSSG Food Surveillance Information Sheet 169, 1999.
10. MAFF/DH JFSSG *Survey of retail paper and board food packaging materials for polychlorinated biphenyls (PCBs)*. JFSSG Food Surveillance Information Sheet 174, 1999.
11. Food Standards Agency *Benzophenone from cartonboard*. Food Standards Agency Food Surveillance Information Sheet 6/00, 2000.

12. Information about the Food Standards Agency's work on acrylamide in food can be found at www.food.gov.uk; information from other Governmental organisations is referenced at <http://www.who.int/fsf/Acrylamide.htm>.
13. European Commission Directive 90/128/EEC, as amended, and implemented in the UK as S.I. 1998/1376, *The Plastic Materials and Articles in Contact with Food Regulations 1998*, as amended.
14. Castle, L., Determination of acrylamide monomer in mushrooms grown on polyacrylamide gel. *Journal of Agriculture and Food Chemistry*, 1993, 41, 1261-1263.
15. British Standard EN 647: 1994 Paper and board intended to come into contact with foodstuffs. Preparation of a hot water extract. BSI, Milton Keynes, UK.
16. British Standard EN 645: 1994 Paper and board intended to come into contact with foodstuffs. Preparation of a cold water extract. BSI, Milton Keynes, UK.
17. Annex 3 to the summary report of the FAO/WHO consultation on the health implications of acrylamide in food, Geneva, 25-27 June 2002, available at <http://www.who.int/fsf/Acrylamide.htm>.
18. Opinion of the Scientific Committee on Food on new findings regarding the presence of acrylamide in food (expressed on 3 July 2002). SCF/CS/CNTM/CONT/4 Final

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This is the final report of this survey. Copies of it have been placed on the Agency's website and in the library in Aviation House, 125 Kingsway, London WC2B 6NH.

Table 1: Details of samples obtained

NS = not stated on packaging

Code CSL / ACR02 /	Product	Brand	Size/ Product weight	Country of origin	Batch code	Barcode	Best before date	Date of purchase	Retail outlet
1	Kitchen Towels	Asda	60 sheets	UK	NS	W27183861G	NS	26.02.02	Asda
2	Kitchen Towels	Velvet	60 sheets	UK	NS	7310791232546	NS	26.02.02	Asda
3	Kitchen Towels	Bounty	56 sheets	UK	NS	4015400008330	NS	26.02.02	Asda
4	PG Tips Pyramids (Tea Bags)	PG	125 g	UK	Q17TE29	5000118030093	Jun-03	26.02.02	Asda
5	Round Tea Bags	Typhoo	250 g	UK	L20213	5 000183046746	Jun-03	26.02.02	Asda
6	Tea Bags	Asda	250 g	UK	13363	W20451219G	Nov-02	26.02.02	Asda
7	Household Towels (Kitchen)	Fiesta	60 sheets	UK	NS	5029053008622	NS	26.02.02	Sainsbury's
8	Economy Kitchen Towels	Sainsbury's	120 sheets	UK	L0479	1269925	NS	26.02.02	Sainsbury's
9	Economy Tea Bags	Sainsbury's	250 g	UK	A2039E	1006810	Jul-03	26.02.02	Sainsbury's
10	"D" Tea Bags	Brooke Bond	250 g	UK	017TN11	5000118001260	Jun-03	26.02.02	Sainsbury's
11	Tea Bags	Tetley	125 g	UK	2011	5000208025497	Jul-03	26.02.02	Sainsbury's
12	Tea Bags	Yorkshire Tea	250 g	UK	2009A052	5010357112061	Jun-03	26.02.02	Sainsbury's
13	Household Towels (Kitchen)	Tesco	60 sheets	UK	NS	5000436449553	NS	26.02.02	Tesco
14	Tea Bags	Quickbrew	250 g	UK	2018	5000208001507	Jul-03	26.02.02	Tesco
15	Value Tea Bags	Tesco	250 g	UK	2037S	5018374320254	Apr-03	26.02.02	Tesco
16	Darjeeling Tea Bags	Twinings	125 g	UK	L1242C7	7017701070	Feb-03	27.02.02	Costcutter
17	Family Kitchen Towels	Dixcel	60 sheets / roll	UK	NS	10195602410	NS	27.02.02	Jacksons
18	Greaseproof paper	Asda	20m x 300mm	UK	NS	G21070679M	2007	27.02.02	Asda

Table 1: Details of samples obtained (continued)

NS = not stated on packaging

Code CSL / ACR02 /	Product	Brand	Size/ Product weight	Country of origin	Batch code	Barcode	Best before date	Date of purchase	Retail outlet
19	Earl grey (Tea bags)	Asda	125 g	UK	L2022E	W27258163G	Jul-03	27.02.02	Asda
20	Green Tea with lemon tea bags	Jacksons	50 g	UK	L2003A	732217001142	Jan-05	27.02.02	Asda
21	Essentials Cake cases	Duni	100 cases	UK	0600917CL	5013617111064	NS	27.02.02	Asda
22	Fruit Punch Selection Tea Bags	London Fruit & Herb Co.	40 g	UK	2039E	5000183522738	Feb-04	27.02.02	Asda
23	Earl Grey Decaff (Tea bags)	Twinings	125 g	UK	L2004A	070177046972	Jul-03	27.02.02	Asda
24	Coffee Paper Filters	Rombouts	40 filters	UK / Netherlands	46108311	5410173007457	NS	27.02.02	Asda
25	Classic Aroma Filters	Melitta	40 filters	Europe	4501032	4006508123094	NS	27.02.02	Sainsbury's
26	Coffee filter bags- unbleached	Sainsbury's	80 filters	UK	3100126	01062465	NS	27.02.02	Sainsbury's
27	Spill Buster Towels (Kitchen)	Safeway	60 sheets	UK	NS	06448912	NS	27.02.02	Safeway
28	Red Label (Tea Bags)	Safeway	250 g	UK	L29972	05022397	Jun-03	27.02.02	Safeway
29	Economy Fish Fingers (Frozen)	Sainsbury's	500 g	UK	L2031VG	00573498	Jan-03	28.02.02	Sainsbury's
30	Fillet Fish Fingers (Frozen)	Ross	500 g	UK	L1248	5000149027383	Mar-03	28.02.02	Sainsbury's
31	Fillet Fish Fingers (Frozen)	Birdseye	300 g	UK	L20100910123	5000116040940	Jul-03	28.02.02	Sainsbury's
32	Plain Baking Cases	Co-op	100 cases	UK	1309M	50129034	NS	28.02.02	Co-op
33	Greaseproof paper	Poly-Lina	30 sheets	UK	181200	5010234043440	NS	01.03.02	Coopers
34	Ultra-Wipe (Paper Household Cloths)	KittenSoft	65 sheets	UK	K1190524	3133200131186	NS	28.02.02	Sainsbury's
35	Cod Steak (Frozen)	Youngs	440 g	UK	AA 1313C	5000149023651	May-03	05.03.02	Jack Fultons

Table 1: Details of samples obtained (continued)

NS = not stated on packaging

Code CSL / ACR02 /	Product	Brand	Size/ Product weight	Country of origin	Batch code	Barcode	Best before date	Date of purchase	Retail outlet
36	Micro Pizza (Microwave)	McCain	135 g	UK	S24090854B	5010228011943	Jun-02	05.03.02	Jack Fultons
37	Duchesse Garlic Butter Potato Shells (Frozen)	Conquest Foods	510 g	UK	L2011 CF	5030686000181	Jul-03	05.03.02	Jack Fultons
38	Rye Crispbread	Ryvita	200 g	UK	1320	5010265000108	Aug-02	05.03.02	Wigginton Village Stores
39	Tea Bags	Ringtons	250 g	UK	D1	5021438000184	Aug-03	05.03.02	Safeway
40	Individual Filter Coffees (Cartridges)	Rombouts	57 g	Belgium	NS	5010206510017	Jan-03	05.03.02	Safeway
41	Cake cases	Wilkinson Hardware store	75 cases	NS	NS	09184404	NS	02.03.02	Wilkinsons
42	Danish Cherry Bar (Frozen)	Sara Lee	NS	UK	1150	5010177786916	May-03	05.03.02	Safeway
43	Haddock cutlets (Absorbent Pad)	Safeway	334 g	UK	NZ001FE	0226927003348	Mar-02	05.03.02	Safeway
44	DisneyMovie Magic (Kitchen Towels)	Georgia Pacific	60 sheets/roll	UK	NS	5010195603141	NS	06.03.02	Tesco
45	Ultra Soft Household Towels (Kitchen)	Tesco	60 sheets/roll	UK	NS	5031021341273	NS	06.03.02	Tesco
46	Colombian Supremo Filter Coffees (Cartridge)	Tesco	57g	UK	1297	5050179011210	Oct-02	06.03.02	Tesco
47	Neopolitan Ice cream Brick (Frozen)	Tesco	1 litre	UK	2037 17:21	5031021849922	Aug-03	06.03.02	Tesco
48	Soft Slice (Frozen)	Walls	1 litre	UK	L126811020	5000116026968	Sep-03	06.03.02	Tesco
49	Drawstring (Tea Bags)	Tetley	80 bags	UK	2031	5000208002580	Jul-03	06.03.02	Tesco
50	One Cup (Tea Bags)	PG Tips	100 bags	UK	026T16Z	5000118021848	Jun-03	06.03.02	Tesco

Table 1: Details of samples obtained (continued)

NS = not stated on packaging

Code CSL / ACR02 /	Product	Brand	Size/ Product weight	Country of origin	Batch code	Barcode	Best before date	Date of purchase	Retail outlet
51	Pizza Fingers (Frozen)	McCain	300 g	UK	S121201134 8A	5010228083407	Dec-02	06.03.02	Tesco
52	Mangetout (Frozen)	Findus	200 g	UK	L1241EG2	5050093301114	01.03.03	06.03.02	Tesco
53	Microwave Popcorn	Butterkist	300 g	UK	MSCU 206 306-7 BU	5023274037300	10.09.02	15.03.02	Asda
54	Microwave Chicken Wings	Tesco	400 g	UK	L2020	5050179656381	Jan-03	06.03.02	Tesco
55	Hot Dog Sausages (Frozen)	Tesco	300 g	UK	MFA0322	5018374289780	Aug-03	06.03.02	Tesco
56	Micro Wedges (Microwave)	McCain	200 g	UK	B1711 1B	5010228016047	Nov-02	08.03.02	Londis
57	Lean Steak Mince (Absorbent Pad)	Tesco	250 g	UK	NS	5018374913302	11-Mar	06.03.02	Tesco
58	Chicken Breast Fillets (Absorbent Pad)	Marks & Spencer	260 g	UK	NS	M0210423S	06-Mar	06.03.02	M&S
59	Take It Away, Cantonese (Frozen)	Marks & Spencer	370 g	UK	NS	M0269353S	10-Mar	06.03.02	M&S
60	Chunky Chips (Frozen)	Marks & Spencer	400 g	UK	NS	M022876S	12-Mar	06.03.02	M&S
61	Deep Dish Pizza (Frozen)	Chicago Town Pizza	340 g	UK	L1345	5019312855104	15.11.02	06.03.02	Jacksons
62	Savoury Rice	Batchelors	120 g	UK	2025AK	5000118012921	Dec-03	06.03.02	Jacksons
63	Jus-Roll Vol-au-vent cases	Pillsbury	625 g	UK	L1095	5010084201205	Apr-03	06.03.02	Jacksons
64	Crumpets	Morning Fresh	8 Crumpets	UK	NS	25014662	13-Mar	07.03.02	Aldi
65	Derby Scones	Mothers Pride	6 Scones	UK	NS	5010003002890	12-Mar	07.03.02	Kwick Save
66	Scotch Pancakes	Cranshaws	6 Pancakes	UK	NS	5021490827552	10-Mar	08.03.02	Netto
67	Sliced White Bread	Rathbones	800 g	UK	NS	5011197000037	10-Mar	07.03.02	Aldi
68	Fries To Go (Microwave)	Fries To Go	90 g	UK	C2801 2	5010228012919	Jan-03	08.03.02	Netto

Table 1: Details of samples obtained (continued)

NS = not stated on packaging

Code CSL / ACR02 /	Product	Brand	Size/ Product weight	Country of origin	Batch code	Barcode	Best before date	Date of purchase	Retail outlet
69	Chicken Korma Wrap (Frozen)	Pataks	150 g	UK	SF02049 T	5011308528177	Aug-03	08.03.02	Netto
70	English Butter	Country Life	250 g	UK	LB6	5010171000018	28-Apr	08.03.02	Netto
71	Potato Waffles (Frozen)	Chef de Pomme	658 g	UK	F2050A	5021490970210	Aug-03	08.03.02	Netto
72	Chicken Curry with Rice (Microwave)	Weight Watchers	320 g	UK	C2029	5390003004460	Apr-03	07.03.02	Kwick Save
73	Economy Burgers (Frozen)	Ross	396 g	UK	2039D	5010333006223	Feb-03	07.03.02	Kwick Save
74	Dark Choc Ices (Frozen)	Fredericks Dairies	620 g	UK	2037	5010693003474	Feb-04	08.03.02	Farm Foods
75	Cheese Burgers In Buns (Microwave)	Farm Foods	460 g	UK	057 388	5036601003015	Feb-03	08.03.02	Farm Foods
76	Chips (Microwave)	Farm Foods	100 g	UK	C1309	NS	Nov-02	08.03.02	Farm Foods
77	Garlic Bread (Microwave)	McCain	135 g	UK	12022002	5010228016009	11.2002	08.03.02	Farm Foods
78	Rosti (Frozen)	McCain	570 g	UK	W060202	5010228071251	Aug-03	08.03.02	Farm Foods
79	Scotch Pies (Frozen)	Farm Foods	6 pies	UK	2015	5036601003947	03-Jun	08.03.02	Farm Foods
80	Assorted Fruit Lollies (Frozen)	Kwick Save	10 Lollies 560ml	UK	2021 L5	5000192208517	03-Jul	07.03.02	Kwick Save
81	Crispy Pancakes, Beef Bolognese (Frozen)	Findus	6 Pancakes	UK	1347GB	5050093300964	Jun-03	07.03.02	Kwick Save
82	Vegetable Burgers (Frozen)	Iceland	240 g	UK	WL 1313	5010482207151	09.05.03	07.03.02	Iceland
83	Snacks (Microwave)	Asda	135 g	UK	2043	W27204115G	Feb-03	12.03.02	Asda
84	Chips (Microwave)	McCain	100 g	UK	S2602C14	5010228012223	Nov-02	12.03.02	Asda

Table 1: Details of samples obtained (continued)

NS = not stated on packaging

Code CSL / ACR02 /	Product	Brand	Size/ Product weight	Country of origin	Batch code	Barcode	Best before date	Date of purchase	Retail outlet
85	Sausage rolls (Frozen)	Linda McCartney	312 g	UK	MFA3311	5000149027741	May-03	12.03.02	Asda
86	Chicken Thigh Fillets (Absorbent Pad)	Asda	605 g	UK	4633	W22007117G	14.03.02	12.03.02	Asda
87	Pork Steaks (Absorbent Pad)	Tesco	0.536 k	UK	1544	0233041002676	17.05.03	12.03.02	Tesco
88	Vegetable Hotpot (Frozen)	Tesco	340 g	UK	2044DC	5018374287939	Feb-03	12.03.02	Tesco
89	Microwave Popcorn	Act 2	270 g	UK	PC2023	5010892060308	Jul-03	12.03.02	Tesco
90	Pork Faggots (Frozen)	Mr Brains	378 g	UK	2 I33 16:35	5018 4552	Feb-03	15.04.02	One Stop
91	Cheese Burgers In Buns (Microwave)	Snacksters	250 g	UK	265	5023823304990	Feb-03	13.03.02	Morrisons
92	Crispy pancakes, chicken and Bacon	Green Isle	235 g	UK	2065	5011003039909	01-Dec	11.04.02	Asda
93	Whole Chicken (Absorbent Pad)	Moy Park	1.422 kg	UK	9502	2002852703540	13.03.02	13.03.02	Morrisons
94	Lamb Chops (Absorbent Pad)	Morrisons	300 g	UK	NS	286319002250	15.03.02	13.03.02	Morrisons
95	Crumpets	Asda	NS	UK	LH	G20398859M	17.03.02	15.03.02	Asda
96	Flour Tortillas	Old El Paso	326 g	UK	248	046000283265	06.04.02	15.03.02	Asda
97	Popcorn (Microwave)	Popz	300 g	USA	1731001301	5706516030146	Dec-02	15.03.02	Tesco
98	Vegetable Grills (Frozen)	Dalepak	340 g	UK	2058D	5010333001372	Aug-03	15.03.02	Tesco
99	Trout fillets (Absorbent Pad)	Safeway	0.225 kg	UK	TV001FE	0239989002259	23.03.02	19.03.02	Safeway
100	Doner Kebabs (Frozen)	Glendale	340 g	UK	NS	5013578100077	23.01.03	19.03.02	Heron
101	Boneless pork chops (Absorbent Pad)	Spar	0.286 kg	UK	GB4281	0206035001849	26.03.02	21.03.02	Spar
102	Mushroom (BAG)	Tesco	NS	UK	NS	NS	NS	22.03.02	Tesco

Table 1: Details of samples obtained (continued)

NS = not stated on packaging

Code CSL / ACR02 /	Product	Brand	Size/ Product weight	Country of origin	Batch code	Barcode	Best before date	Date of purchase	Retail outlet
103	Crinkle Cut Micro Chips (Microwave)	Tesco	100 g x 4	UK	C2034TMS	5050179559033	02.01.03	22.03.02	Tesco
104	Potato Waffles (Frozen)	Tesco	454 g	UK	2051tuwh6	5000436550693	02.01.03	22.03.02	Tesco
105	Unbleached Paper Coffee Filters	Taylors	NS	UK	NS	5010357115536	NS	25.03.02	Hunters
106	Rice Flour Pancakes	Blue Dragon	50 g	UK	NS	5010338016234	31.12.02	25.03.02	Hunters
107	Steak & Kidney Pie (Frozen)	Birds Eye	155 g	UK	L1345	5000116055371	06.01.03	25.03.02	Costcutters
108	Chicken Kiev's (Frozen)	Co-op	250 g	UK	L2022F15	5000128443067	01.01.03	25.03.02	Co-op
109	Oat & Raisin Cookies	Asda Fresh	200 g	UK	NS	0237580000896	28.03.02	27.03.02	Asda
110	Battenburg	Asda	250 g	UK	078M1	W20335762G	16.04.02	27.03.02	Asda
111	Smartprice Tarts (6 pk)	Asda	6 pack	UK	078AB	W20416041G	30.04.02	27.03.02	Asda
112	Strawberry Shortcake Cake	Asda	NS	UK	C/079	W20425258G	04.04.02	27.03.02	Asda
113	Jumbo Swiss Roll	Lyons	380 g	UK	05 6AN	5010033827098	04.08.02	27.03.02	Asda
114	Cornetto Ice Cream Cones (Frozen)	Walls	390 g	UK	L1326	8000920572504	02.01.03	27.03.02	Asda
115	Choc Coated Donuts	Entenmann's	NS	UK	15	5037780564048	31.03.02	27.03.02	Tesco
116	Coated Crossed Iced Buns	Tesco	NS	UK	NS	5050179245929	29.03.02	27.03.02	Tesco
117	Tomato & Mascarpone Piccadella Pizza (Frozen)	Tesco	240 g	UK	NS	5050179678390	01.04.02	27.03.02	Tesco
118	Melton Mowbray Pork Pies	Tesco	150 g	UK	Lj008	5018374112897	01.04.02	27.03.02	Tesco
119	Bakers Premium White Bread	Tesco	800 g	UK	2 U 42 GD7	5031021153692	01.04.02	27.03.02	Tesco
120	Lemon Cheesecake	Tesco	315 g	UK	W2065SB	5050179251418	03.01.03	26.03.02	Tesco
121	Cooked & Peeled Prawns (Absorbent Pad)	Tesco	35 g	UK	NS	5050179064391	30.03.02	26.03.02	Tesco

Table 1: Details of samples obtained (continued)

NS = not stated on packaging

Code CSL / ACR02 /	Product	Brand	Size/ Product weight	Country of origin	Batch code	Barcode	Best before date	Date of purchase	Retail outlet
122	Cheese & Ham Quiche (Frozen)	Somerfield	325 g	UK	NS	5000192192861	04.05.02	01.04.02	Somerfield
123	Vegetable Fingers (Frozen)	Dalepak	283 g	UK	2065 MF 1012	5010333005356	08.01.03	01.04.02	Somerfield
124	Fresh Baked Bread	Russel's	NS	UK	NS	NS	NS	03.04.02	Russel's
125	Cream of Cornish Ice Cream (Frozen)	Walls	500 ml	UK	L128311020	5000116052875	10.01.03	03.04.02	BP petrol st
126	Kitchen Towels	Ready Steady Cook	2 rolls 2 ply	UK	2052B	5011676096612	NS	05.04.02	Costcutters
127	Diced Beef (Absorbent Pad)	Asda	450 g	UK	NS	G20418328M	08.04.02	05.04.02	Asda
128	Lamb Steaks (Absorbent Pad)	Asda	168 g	UK	NS	0228688001632	09.04.02	05.04.02	Asda
129	Whole Chicken (Absorbent Pad)	Tesco	1.1 kg	UK	NS	255912002653	09.04.02	05.04.02	Tesco
130	Seafood Selection (Absorbent Pad)	Asda	200 g	UK	NS	W20418601	09.04.02	05.04.02	Asda
131	Coffee Cartridges (Filters)	Tesco	10 x 7.5 g	UK	2057	5018374158147	Feb-03	04.04.02	Tesco
132	Coffee Filters	Thomas & Green	40 pk	UK	NS	5 019750 420018	NS	04.04.02	Costcutter
133	Mash Tap Chicken Pie (Microwave)	MicroBake	180 g	UK	LM2032B 1515	5 010208163303	Aug-02	05.04.02	Tesco
134	Chinese Takeaway (Frozen)	Sainsbury's	340g	UK	R20022	01285772	Jan-03	11.04.02	Sainsbury's
135	Greaseproof Paper	Nisa (Holdings)	10 m	UK	NS	5010893152552	NS	04.04.02	Costcutter
136	Sliced Lamb's Liver (Absorbent Pad)	Morrisons	175 g	UK	NS	0294890000329	04.09.02	06.04.02	Morrisons
137	Coffee filter paper	Morrisons	80 pk	UK	20373	2305114300656	NS	06.04.02	Morrisons
138	Unbleached Coffee Filter Paper	Safeway	80pk	UK	54913	06033040	NS	09.04.02	Safeway
139	Chicken liver (Absorbent Pad)	Safeway	400 g	UK	2084/07	06233198	12.04.02	09.04.02	Safeway
140	Premium Blend Filter Coffee (Cartridges)	Sainsbury's	75 g	UK	2050	00396332	Feb-03	11.04.02	Sainsbury's

Table 2: Results from the check sample exercise for acrylamide analysis

Notes: ND: not detectable (limits of detection: 0.01 ppm for paper; 0.002 ppm for potato)

	'Spiking' level (ppm)	Level found (ppm)
Paper		
1	1.1	1.3
2	1.2	1.4
3	0.7	0.8
4	0	ND
5	0	ND
6	0.6	0.7
Potato		
1	0.08	0.08
2	0	ND
3	0.08	0.1
4	0.05	0.05
5	0	ND
6	0.05	0.05

Table 3: Estimation of acrylamide transfer into food

The levels of acrylamide that would occur in food if there were to be 100 per cent transfer from those samples of packaging containing quantifiable levels of acrylamide (more than 0.03 ppm), were calculated using the mass of packaging in contact with the food and the mass of food in contact with the packaging.

Sample No.	Sample	Acrylamide levels (ppm) found in packaging	If 100% transfer of acrylamide from packaging into food:	
			acrylamide levels in food (ppm)	acrylamide in food quantifiable? ¹
34	KittenSoft Ultra-Wipe paper household cloths	0.16	0.001	No
49	Tetley Drawstring Tea Bags	0.09	0.0001	No
68	Fries to Go chips (susceptor) ²	1.4	0.14	Yes
74	Fredericks Dairies Dark Choc Ices	0.20	0.005	No
77	McCain Garlic Bread: (carton top) ³	0.12	0.001	No
78	McCain Rosti meal	0.12	0.006	Possibly
79	Farm Foods Scotch Pies	0.16	0.007	Possibly
122	Somerfield Cheese and Ham Quiche (carton top only, food sits in a metal foil tray)	0.16	0.004	No

Notes: 1: The limit of quantification for acrylamide in food was 0.006 ppm; 2: The carton contained 0.11 ppm; 3: The susceptor contained less than 0.03 ppm.