APPENDICES

APPENDIX A

A. UK SURVEYS OF CHLOROPROPANOLS IN FOODS

Comprehensive surveys of 3-MCPD and 1,3-DCP levels in food and food ingredients have been conducted in the UK. Some of these surveys have covered a range of common foods and food ingredients, while other surveys have focussed specifically on soy and oyster sauces as these foods have been found to sometimes contain very high levels of 3-MCPD.

UK surveys of HVP and Soy and Oyster Sauces – 1999, 2001 and 2002

In 1999, the UK completed a survey of 3-MCPD (MAFF 1999) in a range of soy sauces and related products. Significant levels of 3-MCPD were found in some products with 58% of the samples (29) exceeding the level recommended by the UK Food Advisory Committee. In 1996, this Committee had recommended (Food Advisory Committee 1996) that the levels of 3-MCPD should be reduced to the minimum detected by the most sensitive assay method, namely, 0.01 mg/kg. Relevant industries were advised by the FSA to take steps to reduce the concentration of 3-MCPD in all foods and food ingredients to the lowest technologically achievable.

Subsequently the UK Food Standards Agency (FSA) conducted and published a survey (Food Standards Agency, 2001c, d), as a follow up to the 1999 survey, to ascertain the progress manufacturers had made in addressing the level of the contaminants. Soy and oyster sauces (100 samples) were analysed for both 3-MCPD and 1,3-DCP by the UK Central Science Laboratory (CSL (UK)) using validated methods of analysis with a limit of quantification (or limit of reporting) of 0.01 mg/kg for 3-MCPD and 0.005 mg/kg for 1,3-DCP.

This survey assessed the levels of both 3-MCPD and 1,3-DCP in soy sauces available in the UK against the then proposed EU limit of 0.02 mg/kg for 3-MCPD, based on 40% dry matter content. Subsequently, the 0.02 mg/kg limit was adopted by the European Commission and came into force in April 2002.

The survey indicated that there were still high levels of 3-MCPD in a number of soy and oyster sauce products. Of the samples analysed, 22% contained levels of 3-MCPD equal to or above 0.02 mg/kg and the highest level of 3-MCPD reported was 93.1 mg/kg. Of the samples found with chloropropanols, all contained 3-MCPD, and around two thirds of these also contained 1,3-DCP.

In addition, 1,3-DCP was quantified in 17% of samples of soy sauce and HVP based on a 40% dry matter content. There was no proposed EU limit for 1,3-DCP. 1,3-DCP was only found at quantifiable levels in those samples that also contained levels of 3-MCPD above 0.02 mg/kg.

In August 2002, survey results of soy sauce used in catering outlets were released. The results revealed significantly fewer samples containing unacceptable levels of the chemical 3-MCPD compared with a retail survey published by the FSA in 2001. Only 2% of the 273 samples surveyed contained levels of 3-MCPD above 0.02 mg/kg compared with 22% of soy sauces tested in 2001 (Food Standards Agency, 2002a).

Subsequently, in December 2002, a survey of the 3-MCPD and 1,3-DCP levels in soy sauce on sale in shops revealed a significant improvement since the 2001 retail survey. Only 6% of the 99 samples contained unacceptable levels of 3-MCPD compared with nearly a quarter of the samples tested in 2001 (Food Standards Agency, 2002b).

UK 2001 survey of 3-MCPD in food and food ingredients

In February 2001, the FSA published results of a survey of the presence of 3-MCPD in food and food ingredients, other than soy and oyster sauces (Food Standards Agency 2001a & 2001b). Three hundred retail food samples and 63 food ingredients were analysed. The survey did not include analysis for 1,3-DCP.

The 300 retail food samples were chosen from food groups that were most likely to contain 3-MCPD, based on the available information, including HVP and soy sauce studies. The survey was also designed to identify which food groups were most likely to be major contributors of 3-MCPD in the diet. No quantifiable levels of 3-MCPD were found in 70% of the samples. Three of the food groups tested, breakfast cereals, soups and confectionery, had no quantifiable levels of 3-MCPD in any of the samples analysed. Foods with quantifiable levels of 3-MCPD included breads, savoury crackers, toasted biscuits, burgers and salamis. The highest level of 3-MCPD was 0.13 mg/kg in cream crackers.

Sixty-three samples of food ingredients were also analysed for 3-MCPD including malts and malt products (malt flours, malt extracts and a malted product), breadcrumbs, enzyme HVPs, meat extracts, yeast extracts, modified starches, caramels and gelatines. There were no quantifiable levels of 3-MCPD in 78% of these samples. 3-MCPD was not found in any of the samples of yeast extract, caramels or gelatines. Food ingredients with quantifiable levels of 3-MCPD included: breadcrumbs, enzyme HVPs, meat extracts, modified starches and malt and malt-based ingredients. The highest level of 3-MCPD was 0.49 mg/kg for a modified starch (maize yellow dextrin).

References

Food Advisory Committee (1996) Press Release 6/96 Update on chloropropanols in hydrolysed vegetable protein.
Food Standards Agency (2001c), Survey of 1,3-Dichloropropanol (1,3-DCP) in Soy Sauce and Related Products Food Survey Information Sheet Number 15/01. http://www.food.gov.uk/science/surveillance/fsis-2001/13dcpsoy
Food Standards Agency (2001d) Survey of 3-Monochloropropane-1,2-diol (MCPD) in Soy Sauce and Related Products Food Survey Information Sheet No.14/01. http://www.food.gov.uk/science/surveillance/fsis-2001/3-mcpdsoy
Food Standards Agency (2002a) Catering soy sauce products surveyed.

http://www.food.gov.uk/news/newsarchive/soy_sauce

Food Standards Agency (2002b) Follow-up survey of chemical contaminants in shop bought soy sauce shows significant improvement Ref: 2002/0291.

http://www.food.gov.uk/news/newsarchive/soy

Ministry of Agriculture, Fisheries and Food (1999) Survey of 3-monochloropropane-1,2-diol (3-MPCD) in acid hydrolysed vegetable protein, Food Surveillance Information Sheet 181. London.

http://archive.food.gov.uk/maff/archive/food/infsheet/1999/no181/181mcpd.htm

APPENDIX B

B. JECFA REVIEW OF THE TOXICOLOGY DATA ON CHLOROPROPANOLS

The toxicity data on 3-MCPD and 1,3-DCP was evaluated by JECFA in 2001. The following is extracted from the Report of the 57th meeting held in 2001 (FAO/WHO, 2002b).

3-Chloro-1,2-propanediol (3-MCPD)

Absorption, distribution, metabolism and excretion

3-Chloro-1,2-propanediol crosses the blood-testis barrier and the blood-brain barrier and is widely distributed in the body fluids. The parent compound is partly detoxified by conjugation with glutathione, resulting in excretion of the corresponding mercapturic acid, and is partly oxidised to β-chlorolactic acid and further to oxalic acid. Approximately 30% is broken down to carbon dioxide and exhaled. In the studies from which these data were derived, however, much of the administered dose was not accounted for. Intermediate formation of an epoxide has been postulated but not proven. There is some indication that microbial enzymes can dehalogenate halogenated alcohols to produce glycidol, a known genotoxin *in vitro* and *in vivo*.

Toxicological studies

The median lethal dose of 3-chloro-1,2-propanediol in rats after oral administration was 150 mg/kg of body weight.

In several studies in which 3-chloro-1,2-propanediol was administered orally to rats as repeated doses of >1mg/kg of body weight per day, it decreased sperm motility and impaired male fertility. At doses of $\geq$10-20 mg/kg of body weight per day, alterations in sperm morphology and epididymal lesions (spermatocoele) were found. The compound reduced fertility in males of several other mammalian species at slightly higher doses than in the rat.

In rats and mice, oral administration of 3-chloro-1,2-propanediol at doses of $\geq$25 mg/kg of body weight per day was associated with the development of dose-related lesions of the central nervous system, particularly in the brain stem.

In several short-term studies in rats and mice, the kidney was shown to be the target organ for toxicity. In a 4-week study in rats treated by gavage at 30 mg/kg of body weight per day and in a 13-week study in rats given an oral dose of 9 mg/kg of body weight per day, 3-chloro-1,2-propanediol increased the weight of the kidneys relative to body weight.

In the pivotal long-term study in Fischer 344 rats, the absolute weight of the kidney was reported to be significantly increased by administration of 3-chloro-1,2-propanediol in drinking water, at all doses tested. The incidence of tubule hyperplasia in the kidneys of treated animals of both sexes was also higher than in controls. Although the incidence did not reach statistical significance at the lowest dose tested (1.1 mg/kg of body weight per day), JECFA concluded that it represented part of a compound-related dose-response relationship. Overt nephrotoxicity was seen at higher doses (5.2 and 28 mg/kg of body weight per day).

The results of most assays for mutagenicity in bacteria *in vitro* were reported to be positive, although negative results were obtained in the presence of an exogenous metabolic activation system from mammalian tissue. The results of assays in mammalian cells *in vitro* were also generally positive. It should be noted, however, that the concentrations used in all these assays were very high (0.1-9 mg/ml), so that their relevance might be questionable. The weight of the evidence indicates that 3-chloro-1,2-propanediol is not genotoxic *in vitro* at concentrations at which other toxic effects are not observed. The results of assays conducted *in vivo*, including a test for micronucleus formation in mouse bone marrow and an assay for unscheduled DNA synthesis in rats, were negative. JECFA concluded that 3-chloro-1,2-propanediol is not genotoxic *in vivo*.

Four long-term studies of toxicity and carcinogenicity were available. Three (two in mice and one in rats) did not meet modern standards of quality: nevertheless, none of these three studies indicated carcinogenic activity. In the fourth study, conducted in Fischer 344 rats, oral administration of 3-chloro-1,2-propanediol was associated with increased incidences of benign tumours in some organs. These tumours occurred only at doses greater than those causing renal tubule hyperplasia, which had been selected as the most sensitive end-point.

1,3-Dichloro-2-propanol (1,3-DCP)

Absorption, distribution, metabolism and excretion

Approximately 5% of an oral dose of 1,3-dichloro-2-propanol was excreted in the urine of rats as β-chlorolactate and about 1% of the dose as 2-propanol-1,3-dimercapturic acid. In another experiment, the urine of rats contained the parent compound (2.4% of the dose), 3-chloro-1,2-propanediol (0.35 of the dose) and 1,2-propanediol (0.43% of the dose). Epoxy-chloropropane (epichlorhydrin) was postulated to be an intermediate, and this compound may either undergo conjugation with glutathione to form mercapturic acid or be hydrolysed to 3-chloro-1,2-propanediol. The latter undergoes oxidation to β-chlorolactate, which is further oxidised to oxalic acid.

Toxicological studies

The median lethal dose of 1,3-dichloro-2-propanol in rats treated orally was 120-140 mg/kg of body weight.

In several short-term studies in rats, oral administration of 1,3-dichloro-2-propanol at doses of ≥10 mg/kg of body weight per day caused significant hepatic toxicity. This was associated with oxidative metabolism, which yielded intermediates that reacted with and depleted glutathione.

In a 13-week study in rats, overt hepatotoxicity, including increased liver weights, histological changes and/or increased activity of serum alanine and aspartate transaminases, was seen after oral administration of 1,3-dichloro-2-propanol at doses of ≥10 mg/kg of body weight per day. These doses also caused histopatholocial changes in the kidney, increased kidney weights and alterations in urinary parameters. The no-observable-effect level (NOEL) was 1 mg/kg of body weight per day.

1,3-Dichloro-2-propanol has been reported to be hepatotoxic in humans exposed occupationally.

1,3-Dichloro-2-propanol was clearly mutagenic and genotoxic in various bacterial and mammalian test systems *in vitro*. The only available study *in vivo* showed no mutagenic effect in a wing spot test in *Drosophila melanogaster*.

The results of the one long-term study of toxicity and carcinogenicity in rats confirmed the hepatotoxicity and nephrotoxicity seen in the 13-week study. Furthermore, it demonstrated a clear carcinogenic effect of 1,3-dichloro-2-propanol at the highest dose tested, 19 mg/kg of body weight per day. The tumours (adenomas and carcinomas) occurred in liver, kidney, the oral epithelium and tongue and the thyroid gland. No increase in tumour incidence was seen at the lowest dose tested, 2.1 mg/kg of body weight per day. Treatment-related non-neoplastic lesions of the liver were observed, sinusoidal peliosis being found in all treated groups.

References

FAO/WHO (2002b) Evaluation of Certain Food Additives and Contaminants. 57th Report of the Joint FAO/WHO Expert Committee on Food Additives (JECFA). WHO Technical Report Series No. 909. WHO 2002.

APPENDIX C

C. METHODOLOGY FOR THE FSANZ SURVEYS OF CHLOROPROPANOLS

FSANZ commissioned two major studies of the occurrence of chloropropanols (1,3-DCP and 3-MCPD) in foods. The first study, initiated in 2001, was of the levels of chloropropanols in selected soy and oyster sauces. The second, later, study was initiated in 2002 and examined a broader range of foods and was conducted in three separate stages. The methodology used for these surveys is provided below.

Analysis of chloropropanols in soy and oyster sauces

Following the June 2001 finding by the UK Food Standards Agency that high levels of 3-MCPD were still being found in soy and oyster sauces, FSANZ commissioned the testing of a range of these sauces in 2001.

Sample collection

Samples of soy and oyster sauce were collected from retail outlets in Melbourne, as this was the location of the testing laboratory. FSANZ instructed the laboratory conducting the analyses to sample products in two stages. The first stage focussed on collection of products that the UK FSA had tested and which they had advised consumers to avoid on the basis of high levels of 3-MCPD. The second stage focussed on sampling and analysis of seven Australian-made soy and oyster sauces. This sampling plan was used to confirm the UK results and to provide some information about chloropropanol levels in Australian made soy and oyster sauces. It therefore did not reflect the range of soy and oyster sauces available to Australian consumers. Samples analysed were single bottles and the results therefore represent a 'snapshot' of chloropropanols levels in these sauces.

A subset of four sauces analysed in Australia were also analysed at the UK Central Science Laboratory (CSL (UK)) for quality assurance purposes.

Method of analysis

The method used by the laboratory for quantitative analysis of both 3-MCPD and 1,3-DCP was based on the Association of Official Analytical Chemists (AOAC) method 2000.01. This method was developed by the CSL (UK), validated through an international collaborative trial and has been accepted as a first action status by the AOAC. This method of analysis is based on gas chromatography with mass spectrometric detection, after extraction of chloropropanols from the food matrix and purification steps.

In the soy and oyster sauce survey, the limit of reporting was 0.01 mg/kg for 3-MCPD. The limit of reporting for 1,3-DCP was initially 0.01 mg/kg and was reduced to 0.005 mg/kg during the course of the soy and oyster sauce survey.

Analysis of chloropropanols in other foods

Following the results of the study of chloropropanols levels in soy and oyster sauces, a further survey was initiated by FSANZ in 2002 to obtain data on the presence of chloropropanols in foods, other than soy and oyster sauces, available in Australia.

Sampling

Sampling was designed so that the results could be used to estimate overall dietary exposure to chloropropanols. Foods and food groups chosen for analysis were guided by the available information, including the results of a survey on 3-MCPD undertaken in the UK and consideration of foods likely to contain chloropropanols as a result of processing or storage conditions.

The survey was undertaken in three stages:

1. The first stage of the survey involved the analysis of 136 food samples that were principally drawn from stored samples remaining after completion of the 20th Australian Total Diet Survey (ATDS). Foods that were not included in the 20th ATDS, but which were chosen for inclusion in this survey, were purchased in five Australian capital cities and prepared to a table ready state before being analysed.

2. As a result of this testing a second stage of the survey was initiated to further examine chloropropanols levels in composited samples of raw and cooked unspecified thick sausages, raw and cooked minced beef, leg ham, fish fillets and fish fingers.

3. The third stage of the survey was initiated to examine chloropropanols levels in samples of beef steak and lamb chops both before and after cooking.

At the completion of the 20th ATDS in 2001 some samples remained in storage. As ATDS samples represent a random sample of foods available in Australia, it was decided that these samples could also be used for chloropropanols analysis. The ATDS samples were sampled according to a schedule that categorised them into core, national or regional foods. Core foods were defined as foods central to the Australian diet, such as bread, beef and eggs. Regional foods were defined as those foods that could be expected to show regional variation, such as processed meats. National foods were defined as those foods that are available nationwide and are not expected to show regional variation and included foods such as canned tuna, breakfast cereals and infant formula.

The ATDS foods had been purchased and prepared in each of the Australian States and the Northern Territory. Each sample was a composite, consisting of four purchases each for core foods or three purchases each for national and regional foods.

The remaining 20th ATDS samples that were held in storage did not cover all the foods necessary to estimate overall dietary exposure to chloropropanols and therefore additional foods were sampled to supplement the ATDS samples. These non-ATDS foods were sampled to be as representative as possible within the constraints of time and cost.

The foods were divided into national or regional foods. Those categorised as national foods, for example, peanut butter, baked beans, potato crisps and processed cheese were purchased in Sydney and composited, prepared and analysed in Sydney. Doughnuts and battered and fried fish fillets were classed as regional foods where regional variation would be expected. These were purchased in five Australian capital cities: Perth, Brisbane, Adelaide, Melbourne and Sydney and transported to the AGAL laboratory in Sydney where they were composited, prepared and analysed. Sampling instructions were that purchases should be made in different suburbs chosen at random and that the purchasing should be carried out at a range of retail outlets representing the buying habits of the majority of the community. Thus supermarkets, corner stores and delicatessens were included, as appropriate. This approach was chosen for the non-ATDS foods to mirror as much as possible the approach used to sample the ATDS foods.

For Stage 2 of the survey, five additional samples of leg ham, fish fingers and battered fish, and ten samples of raw minced beef and unspecified raw thick sausages were taken for analysis. With the exception of the fish fingers, these foods were purchased in the five Australian cities and then transported to AGAL in Sydney to be composited and prepared. All of the samples of fish fingers were purchased in Sydney. The ten composite samples each of minced meat and sausages were analysed both before and after cooking.

For Stage 3 of the survey, additional samples of beef steak and lamb chops were sampled and analysed individually both raw and cooked. These foods were purchased in Sydney and therefore the samples analysed may not be fully representative of the meats available nationally.

Method of analysis

The method used to analyse 3-MCPD and 1,3-DCP was similar to the method used to analyse 3-MCPD and 1,3-DCP in soy and oyster sauces and was based on AOAC method 2000.01. For samples containing high amounts of fat, an additional sample purification step was used. The limit of reporting (LOR) was 0.010 mg/kg for 3-MCPD and 0.005 mg/kg for 1,3-DCP. The limit of detection (LOD) for these compounds was 0.005 mg/kg and 0.003 mg/kg for 3-MCPD and 1,3-DCP respectively. Results less than the LOR but greater than the LOD are associated with a greater degree of uncertainty than results at or above the LOR.

APPENDIX D

D. SURVEY RESULTS FOR INDIVIDUAL FOOD SAMPLES FOR AUSTRALIA

Survey results for 1,3-DCP and 3-MCPD in soy and oyster sauce products[3]

SAMPLE DESCRIPTION	3-MCPD mg/kg	1,3-DCP mg/kg
Chicken marinade		
Sample 1	**0.017**	<0.01
Oyster sauce		
Sample 1	<0.01	<0.01
Sample 2	<0.01	<0.01
Sample 3	<0.01	<0.01
Sample 4	<0.01	<0.01
Sample 5	<0.01	<0.01
Sample 6	<0.01	<0.01
Soy sauce		
Sample 1	<0.01	<0.01
Sample 2	<0.01	<0.01
Sample 3	<0.01	<0.01
Sample 4	**0.014**	<0.01
Sample 5	<0.01	<0.01
Sample 6	**0.014**	<0.01
Sample 7	**3.93**	**0.108**
Sample 8	**0.226**	<0.01
Sample 9	**0.185**	<0.01
Sample 10	**0.454**	**0.02**
Sample 11	<0.01	<0.01
Sample 12	<0.01	<0.01
Soy sauce - dark		
Sample 1	**0.028**	<0.01
Sample 2	<0.01	<0.01
Soy sauce - light		
Sample 1	<0.01	<0.01
Sample 2	**0.014**	<0.01
Soy sauce - mushroom flavour		
Sample 1	<0.01	**0.005**

[3] Bolded print denotes all results that are above the level of reporting

SAMPLE DESCRIPTION	3-MCPD mg/kg	1,3-DCP mg/kg
Sample 2	<0.01	<0.01
Soy sauce - salty		
Sample 1	<0.01	<0.01
Sample 2	<0.01	<0.01
Soy sauce - shrimp flavour		
Sample 1	**0.025**	<0.01
Soy sauce - sweet		
Sample 1	<0.01	<0.01
Sample 2	**0.044**	<0.01
Soy sauce - thin		
Sample 1	<0.01	<0.01
Soy 4 seasoning sauce		
Sample 1	**91.2**	**0.5**
Sample 2	**148.2**	**0.6**
Sample 3	**73.0**	**0.3**
Sample 4	**133.6**	**0.4**
Sample 5	**61.1**	**0.3**
Sample 6	**86.9**	**0.3**
Sample 7	<0.01	<0.01
Sample 8	**0.431**	**0.05**

Survey results for 1,3-DCP and 3-MCPD in other foods – Stage 1[4]

SAMPLE DESCRIPTION	DATE OF PURCHASE	3-MCPD mg/kg	1,3-DCP mg/kg
Stage 1			
BAKED BEANS, canned in tomato sauce – not 'BBQ' or 'ham' sauce or beans with bacon or meat or 'Mexican" types			
Sample 1	June 02	<0.005	<0.003
Sample 2	June 02	<0.005	<0.003
Sample 3	June 02	<0.005	<0.003
BACON, MIDDLE RASHER, rind removed and fried – packaged and unpackaged varieties			
Sample 1	July 02	<0.005	<0.003
Sample 2	July 02	**0.019**	<0.003
Sample 3	July 02	**0.022**	<0.003
Sample 4	July 02	**0.018**	<0.003

[4] Bolded print denotes all results that are above the level of reporting

SAMPLE DESCRIPTION	DATE OF PURCHASE	3-MCPD mg/kg	1,3-DCP mg/kg
Sample 5	July 02	<0.005	<0.003
Sample 6	July 02	<0.005	<0.003
BEEF, MINCED, dry fried – 100% beef mince, not 'fat free' or 'low fat' or higher fat 'hamburger' minces			
Sample 1	December 00	<0.005	<0.003
Sample 2	November 00	<0.005	<0.003
Sample 3	November 00	<0.005	**0.031**
Sample 4	November 00	<0.005	**0.034**
Sample 5	November 00	<0.005	**0.035**
Sample 6	October 00	<0.005	**0.044**
Sample 7	November 00	<0.005	**0.063**
Sample 8	February 01	<0.005	**0.023**
BISCUITS SAVOURY – represents a range of products commonly available			
Sample 1	April 01	<0.005	<0.003
Sample 2	April 01	**0.007**	<0.003
Sample 3	April 01	<0.005	<0.003
BISCUITS SWEET PLAIN – represents a range of products commonly available, includes chocolate biscuits			
Sample 1	May 01	**0.005**	<0.003
Sample 2	April 01	<0.005	<0.003
Sample 3	April 01	<0.005	<0.003
BREAD WHITE - represents a range of products commonly available			
Sample 1	April 01	<0.005	<0.003
Sample 2	April 01	<0.005	<0.003
Sample 3	April 01	<0.005	<0.003
Sample 4	April 01	<0.005	<0.003
Sample 5	April 01	<0.005	<0.003
Sample 6	April 01	<0.005	**0.004**
Sample 7	May 01	<0.005	<0.003
Sample 8	February 01	<0.005	<0.003
BREAD MULTIGRAIN - represents a range of products, wholemeal used when multigrain was not available			
Sample 1	May 01	<0.005	**0.004**
Sample 2	April 01	<0.005	<0.003
Sample 3	April 01	**0.007**	<0.003
Sample 4	April 01	<0.005	<0.003
Sample 5	18/04/01	<0.005	<0.003
Sample 6	18/04/01	<0.005	<0.003
BREAKFAST CEREAL, mixed grain – represents a range of products commonly available			
Sample 1	April 01	<0.005	<0.003
Sample 2	April 01	<0.005	<0.003
Sample 3	April 01	<0.005	<0.003

SAMPLE DESCRIPTION	DATE OF PURCHASE	3-MCPD mg/kg	1,3-DCP mg/kg
BREAKFAST CEREAL, single grain – represents a range of products commonly available			
Sample 1	April 01	<0.005	<0.003
Sample 2	April 01	<0.005	<0.003
Sample 3	April 01	<0.005	<0.003
CHEESE, CHEDDAR – represents major brands commonly available			
Sample 1	April 01	<0.005	<0.003
Sample 2	April 01	<0.005	<0.003
Sample 3	April 01	<0.005	<0.003
Sample 4	April 01	<0.005	<0.003
Sample 5	April 01	<0.005	<0.003
Sample 6	April 01	<0.005	<0.003
CHEESE, PROCESSED– includes slices, cheese sticks or solid block; full fat varieties only			
Sample 1	June 02	<0.005	<0.003
Sample 2	June 02	<0.005	<0.003
Sample 3	June 02	<0.005	<0.003
Sample 4	June 02	<0.005	<0.003
Sample 5	June 02	<0.005	<0.003
Sample 6	June 02	<0.005	<0.003
INSTANT COFFEE, made up with boiled water – does not include decaffeinated or ground coffee			
Sample 1	June 02	<0.005	<0.003
Sample 2	June 02	<0.005	<0.003
Sample 3	June 02	<0.005	<0.003
DIM SIM, cooked – purchased from take-away outlets			
Sample 1	December 00	<0.005	<0.003
Sample 2	November 00	<0.005	<0.003
Sample 3	November 00	<0.005	<0.003
Sample 4	November 00	<0.005	<0.003
Sample 5	November 00	<0.005	<0.003
Sample 6	November 00	<0.005	<0.003
DOUGHNUTS, CINNAMON– freshly prepared			
Sample 1	June 02	<0.005	<0.003
Sample 2	June 02	<0.005	<0.003
Sample 3	June 02	<0.005	<0.003
Sample 4	June 02	<0.005	<0.003
Sample 5	June 02	<0.005	<0.003

SAMPLE DESCRIPTION	DATE OF PURCHASE	3-MCPD mg/kg	1,3-DCP mg/kg
EGGS, hard boiled – includes full range of producers			
Sample 1	December 00	<0.005	<0.003
Sample 2	November 00	<0.005	<0.003
Sample 3	November 00	<0.005	<0.003
Sample 4	November 00	<0.005	<0.003
Sample 5	November 00	<0.005	<0.003
Sample 6	October 00	<0.005	<0.003
Sample 7	November 00	<0.005	<0.003
Sample 8	May 01	<0.005	<0.003
FISH FILLETS, battered and fried – purchased from takeaway outlets			
Sample 1	June 02	<0.005	<0.003
Sample 2	June 02	<0.005	<0.003
Sample 3	June 02	<0.005	<0.003
Sample 4	June 02	<0.005	<0.003
Sample 5	June 02	<0.005	<0.003
Sample 6	June 02	<0.005	<0.003
Sample 7	June 02	<0.005	<0.003
Sample 8	June 02	<0.005	<0.003
Sample 9	June 02	<0.005	**0.024**
Sample 10	June 02	<0.005	**0.004**
FISH PORTION, CRUMBED, oven baked – packaged frozen crumbed fish, oven-baked			
Sample 1	July 00	**0.035**	<0.003
Sample 2	July 00	**0.083**	<0.003
Sample 3	July 00	<0.005	<0.003
Sample 4	July 00	**0.033**	<0.003
Sample 5	July 00	**0.037**	<0.003
Sample 6	July 00	**0.029**	<0.003
HAMBURGER – purchased from fast food outlets			
Sample 1	November 00	**0.009**	<0.003
Sample 2	November 00	**0.010**	<0.003
Sample 3	November 00	**0.010**	<0.003
Sample 4	November 00	**0.007**	<0.003
Sample 5	November 00	**0.007**	<0.003
Sample 6	November 00	**0.049**	<0.003
MIXED INFANT CEREAL, made up			
Sample 1	July 00	<0.005	<0.003
Sample 2	July 00	<0.005	<0.003
Sample 3	July 00	<0.005	<0.003

SAMPLE DESCRIPTION	DATE OF PURCHASE	3-MCPD mg/kg	1,3-DCP mg/kg
INFANT DINNER – cans or jars			
Sample 1	July 00	<0.005	<0.003
Sample 2	July 00	<0.005	<0.003
Sample 3	July 00	<0.005	<0.003
INFANT FORMULA, made up using tap water			
Sample 1	July 00	<0.005	<0.003
Sample 2	July 00	<0.005	<0.003
Sample 3	July 00	<0.005	<0.003
LAMINGTON – chocolate or pink lamington cakes, without filling			
Sample 1	NA	**0.030**	<0.003
Sample 2	NA	**0.010**	<0.003
Sample 3	NA	<0.005	<0.003
LEG HAM – packaged or unpackaged leg ham, does not include low fat varieties			
Sample 1	November 00	<0.005	<0.003
Sample 2	November 00	<0.005	<0.003
Sample 3	November 00	<0.005	<0.003
Sample 4	April 00	**0.005**	**0.059**
Sample 5	November 00	<0.005	**0.039**
Sample 6	December 00	<0.005	<0.003
MARGARINE – composite of a range of products commonly available			
Sample 1	February 01	<0.005	**0.003**
NOODLES, INSTANT, cooked – 'fried' type only; not 'dried' or '97% fat free' versions			
Sample 1	June 02	<0.005	<0.003
Sample 2	June 02	<0.005	<0.003
Sample 3	June 02	<0.005	<0.003
PEANUT BUTTER, SMOOTH – full fat and full salt varieties only			
Sample 1	June 02	<0.005	<0.003
Sample 2	June 02	<0.005	<0.003
Sample 3	June 02	<0.005	<0.003
POTATO CRISPS, plain salted – no flavoured crisps			
Sample 1	June 02	<0.005	<0.003
Sample 2	June 02	<0.005	<0.003
Sample 3	June 02	<0.005	<0.003

SAMPLE DESCRIPTION	DATE OF PURCHASE	3-MCPD mg/kg	1,3-DCP mg/kg
THICK MEAT SAUSAGES, dry fried – commonly available varieties chosen			
Sample 1	July 00	**0.012**	**0.035**
Sample 2	July 00	**0.009**	**0.015**
Sample 3	July 00	<0.005	**0.027**
Sample 4	July 00	**0.069**	**0.066**
Sample 5	July 00	<0.005	**0.045**
Sample 6	July 00	<0.005	**0.045**
TUNA CANNED – canned tuna in brine, various major and generic brands			
Sample 1	July 00	<0.005	<0.003
Sample 2	July 00	<0.005	<0.003
Sample 3	July 00	<0.005	<0.003

Survey results for 1,3-DCP and 3-MCPD in other foods – Stages 2 & 3[5]

SAMPLE DESCRIPTION	DATE OF PURCHASE	3-MCPD mg/kg	1,3-DCP mg/kg
Stage 2			
BEEF, MINCED,RAW – 100% beef mince (not 'fat free' or 'low fat' or higher fat 'hamburger' minces)			
Sample 1	August 02	<0.005	**0.033**
Sample 2	August 02	<0.005	**0.016**
Sample 3	August 02	<0.005	**0.021**
Sample 4	August 02	<0.005	**0.11**
Sample 5	August 02	<0.005	<0.003
Sample 6	August 02	<0.005	**0.033**
Sample 7	August 02	<0.005	**0.089**
Sample 8	August 02	<0.005	**0.045**
Sample 9	August 02	<0.005	**0.026**
Sample 10	August 02	<0.005	**0.007**
BEEF, MINCED, COOKED – 100% beef mince, does not include 'fat free' or 'low fat' or higher fat 'hamburger' minces, dry fried			
Sample 1	August 02	**0.007**	**0.030**
Sample 2	August 02	<0.005	**0.012**
Sample 3	August 02	**0.006**	**0.010**
Sample 4	August 02	**0.010**	**0.043**
Sample 5	August 02	<0.005	<0.003
Sample 6	August 02	<0.005	**0.033**
Sample 7	August 02	**0.008**	**0.037**
Sample 8	August 02	<0.005	**0.019**
Sample 9	August 02	**0.012**	**0.031**
Sample 10	August 02	<0.005	**0.011**
SAUSAGES, MEAT, RAW – plain, unflavoured, thick style			
Sample 1	August 02	<0.005	**0.006**
Sample 2	August 02	<0.005	<0.003
Sample 3	August 02	<0.005	**0.069**
Sample 4	August 02	**0.013**	**0.036**
Sample 5	August 02	<0.005	**0.045**
Sample 6	August 02	<0.005	<0.003
Sample 7	August 02	<0.005	**0.039**
Sample 8	August 02	**0.008**	**0.036**
Sample 9	August 02	**0.013**	**0.043**
Sample 10	August 02	<0.005	<0.003

[5] Bolded print denotes all results that are above the level of reporting

SAUSAGES, MEAT, COOKED – plain, unflavoured, thick style, dry fried			
Sample 1	August 02	<0.005	<0.003
Sample 2	August 02	<0.005	<0.003
Sample 3	August 02	<0.005	**0.026**
Sample 4	August 02	<0.005	**0.036**
Sample 5	August 02	<0.005	**0.030**
Sample 6	August 02	<0.005	<0.003
Sample 7	August 02	**0.012**	**0.031**
Sample 8	August 02	<0.005	<0.003
Sample 9	August 02	**0.010**	**0.029**
Sample 10	August 02	<0.005	<0.003
LEG HAM – packaged or unpackaged leg ham, does not include low fat varieties			
Sample 1	August 02	<0.005	<0.003
Sample 2	August 02	**0.006**	**0.014**
Sample 3	August 02	**0.027**	**0.021**
Sample 4	August 02	<0.005	<0.003
Sample 5	August 02	<0.005	<0.003
BATTERED FISH FILLETS, FRIED – purchased from takeaway outlets			
Sample 1	August 02	<0.005	<0.003
Sample 2	August 02	**0.009**	**0.006**
Sample 3	August 02	<0.005	<0.003
Sample 4	August 02	<0.005	<0.003
Sample 5	August 02	<0.005	<0.003
FISH FINGERS, FRIED– frozen packaged fish fingers fried in a minimum of vegetable oil			
Sample 1	August 02	<0.005	<0.003
Sample 2	August 02	<0.005	<0.003
Sample 3	August 02	<0.005	<0.003
Sample 4	August 02	<0.005	<0.003
Sample 5	August 02	<0.005	<0.003
Stage 3			
STEAK, BEEF, RAW – variety of cuts e.g. rump, round, blade etc			
Sample 1	August 02	<0.005	<0.003
Sample 2	August 02	<0.005	**0.070**
Sample 3	August 02	<0.005	<0.003
Sample 4	August 02	<0.005	<0.003
Sample 5	August 02	<0.005	<0.003
STEAK, BEEF, COOKED – variety of cuts e.g. rump, round, blade etc, dry fried			
Sample 1	August 02	<0.005	<0.003
Sample 2	August 02	<0.005	<0.003
Sample 3	August 02	<0.005	<0.003
Sample 4	August 02	<0.005	<0.003
Sample 5	August 02	<0.005	<0.003

CHOPS, LAMB, RAW – variety of cuts e.g. chump, neck, loin etc			
Sample 1	August 02	<0.005	<0.003
Sample 2	August 02	<0.005	<0.003
Sample 3	August 02	<0.005	<0.003
Sample 4	August 02	<0.005	<0.003
Sample 5	August 02	<0.005	**0.091**
Sample 6	August 02	<0.005	<0.003
CHOPS, LAMB, COOKED – variety of cuts e.g. chump, neck, loin etc, dry fried			
Sample 1	August 02	<0.005	<0.003
Sample 2	August 02	<0.005	<0.003
Sample 3	August 02	<0.005	<0.003
Sample 4	August 02	<0.005	<0.003
Sample 5	August 02	**0.030**	<0.003
Sample 6	August 02	<0.005	<0.003

GLOSSARY

Dextrin
Dextrins are carbohydrates which are obtained by the action of heat, acid or enzymes on starch. Dextrins are smaller in size and less complex than the starch from which they were obtained.

First action status
An analytical method that has undergone an international collaborative review but is yet to be fully accepted as an official method.

Food Standards Code
The *Food Standards Code* is a collection of individual food standards that are in general applied in New Zealand and Australia. Chapter 1 deals with general standards that apply to all foods. Chapter 2 deals with standards affecting particular classes of foods. Chapter 3 deals with food hygiene issues in Australia, and Chapter 4 establishes primary production and processing standards for agricultural commodities for Australia. The current Food Standards Code was gazetted on 20 December 2000 and became law on 20 December 2002.

Gas chromatography
A technique for separating and measuring compounds in a gaseous state by passing them through a solid column.

Genotoxic
Causes DNA damage, chromosome damage or gene mutation.

Germ cells
Germ cells are the reproductive cells: eggs and sperm.

Hepatotoxic
Toxic to the liver.

Hydrolysed vegetable protein (HVP)
A savoury ingredient which is produced by treating proteins from hydrolysed vegetables, such as soya, with hydrochloric acid.

Hyperplasia
Abnormal multiplication or increase in the number of cells in normal arrangement in a tissue or organ, resulting in an increase in the volume of the tissue or organ.

in vivo
Within a living organism.

in vitro
Outside of a living organism and in an artificial environment.

Limit of detection (LOD)
The limit of detection is the lowest concentration of a chemical that can be qualitatively detected using a specified laboratory method and/or item of laboratory equipment (i.e. its presence can be detected but not quantified).

Limit of reporting (LOR)
The limit of reporting is the lowest concentration of a chemical that can be detected and quantified, with an acceptable degree of certainty, using a specified laboratory method and/or item of laboratory equipment.

Mass spectrometry
An analytical technique where ions (charged atoms or molecules) are separated according to their ratio of charge to mass.

Modified starch
Modified starch is starch that has been altered either physically or chemically (eg. by acids or enzymes).

Nephrotoxic
Toxic to the kidneys.

Water activity
An expression of the relative availability of water in a substance.