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## **Supporting document 3**

Risk assessment – Proposal P1034

Chemical Migration from Packaging into Food

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### **Executive summary**

Food packaging is manufactured from a range of materials, and bulk packaging material is often modified due to the use of substances such as adhesives, protective coatings and printing inks. Several thousand chemicals are used in the manufacture of food packaging and other chemicals that come into contact with food during its production and processing.

To gain an understanding of the risk posed by chemical migration from packaging into food, FSANZ has evaluated information on the hazard characteristics of chemicals used in the production of food packaging, as well as estimated dietary exposure to these chemicals due to migration into food. Use of the threshold of toxicological concern (TTC) concept has been valuable for this work, as well as a number of analytical surveys.

The TTC approach is a risk based screening tool that categorises chemicals into various threshold levels of safe expected exposure, depending on a chemical's structure. The TTC threshold applicable to a specific chemical is compared to its estimated dietary exposure. Estimated dietary exposure below the TTC threshold indicates no safety concern, while exposure above the threshold indicates that appropriate toxicity data on the chemical, or a close structural relative, are needed in order to perform a safety assessment.

Analysis of a USFDA database of over 1300 food contact substances showed that for 86% of the substances estimated dietary exposure is below the lowest TTC for non-genotoxic substances. This figure increased to 97% taking account of a higher threshold value derived in a recent re-evaluation of the TTC for this class of compounds. For many of the chemicals with estimated dietary exposure exceeding their respective TTC thresholds, specific toxicity data were located in various databases and the published literature that support the safety of those chemicals. For some chemicals, supporting toxicity data may not be publicly available, or toxicity data on structurally related substances was used for safety assessment.

A conclusion of low risk based on the TTC analysis is supported by the results of a number of analytical surveys investigating the presence of packaging chemicals in Australian and New Zealand foods. These surveys have demonstrated that dietary exposures to chemicals migrating from packaging into food are low and below levels of concern.

The screening methodology used in the 24th Australian Total Diet Study (ATDS) to assess 30 food packaging chemicals in Australian foods and beverages identified two chemicals for which more data were needed to enable a more refined risk assessment. These chemicals were the phthalates diethylhexyl phthalate (DEHP) and diisononyl phthalate (DINP). However, a targeted follow up survey of DEHP and DINP plus five additional plasticisers in Australian foods found that estimated dietary exposures are below the tolerable daily intakes

(TDIs) for these substances and not of concern for human health.

Potential risks from the migration of chemicals in recycled paperboard, particularly mineral oil hydrocarbons (MOH), into food are not yet well characterised and research is ongoing internationally. However, FSANZ has recently completed a survey of Australian food packaging and foods and did not find widespread migration of MOH into foods. MOH was only detected at quantifiable levels in two food samples, and there was no evidence of a public health and safety concern.

A recent survey of packaging chemicals including phthalates, printing inks and photoinitiators in New Zealand foods also found that dietary exposures to these chemicals are low and not of concern for human health.

The overall conclusion based on the available data is that the human health risk posed by chemical migration from packaging into food available in Australia and New Zealand is low.

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# 1 Introduction

Food packaging is manufactured from a range of materials including glass, paper/paperboard, plastics and metals. Bulk packaging material is often modified due to the use of substances such as adhesives, protective coatings and printing inks. Several thousand chemicals are used in the manufacture of food packaging and other chemicals that come into contact with food during its production and processing. Chemicals used in the production of food contact materials include solvents, monomers, cross-linking agents, catalysts, plasticisers and antioxidants/stabilisers.

FSANZ has conducted a range of activities in order to gain an understanding of the risks posed by chemical migration from packaging into food (CMPF) for consumers in Australia and New Zealand.

This work includes analysis of information from United States Food and Drug Administration (USFDA) and European Food Safety Authority (EFSA) databases and publications as well as information in the published scientific literature. In addition, FSANZ has conducted a number of surveys investigating levels of packaging chemicals in foods and beverages available in Australia.

Much of this work has previously been reported by FSANZ, most recently in a Call for Submissions published in June 2016. Since that time FSANZ has conducted further survey work assessing the levels of plasticisers and mineral oils in Australian foods. In addition, the New Zealand Ministry for Primary Industries (MPI) has completed a survey of packaging chemicals in New Zealand foods.

This document provides a summary of these recent surveys, as well as an overview of FSANZ's previous work on CMPF.

## 2 Risk assessment of food packaging chemicals

The scientific principles that apply to the risk assessment of other chemicals in food, such as food additives, contaminants and processing aids, also apply to food packaging chemicals. An overview of these risk assessment principles is presented in the FSANZ document Risk Analysis in Food Regulation (FSANZ 2013), while detailed information is provided in FAO/WHO (2009).

The core principle in food chemical risk assessment is that risk is a function of both the intrinsic hazard characteristics of the chemical (i.e. its toxicological properties) and dietary exposure to the chemical from consuming food and beverages.

## 3 Summary of previous work

FSANZ has evaluated the risks associated with chemical migration from packaging into food using a number of approaches and sources of information. These included a threshold of toxicological concern analysis of a United States Federal Drug Administration (USFDA) database of food contact substances, as well as FSANZ surveys of the Australian and New Zealand food supply. This work is briefly summarised below, while more detailed information can be found in [Supporting Document 3 of the Call for Submissions for P1034](#).

### 3.1 Threshold of Toxicological Concern analysis

The Threshold of Toxicological Concern (TTC) approach is a risk-based tool for screening of chemicals for which only limited hazard data are available. It can be used to distinguish those

chemicals with no appreciable human health risk from those for which further data are needed for risk assessment (Kroes et al. 2000; EFSA/WHO 2016).

The TTC approach allows chemicals to be categorised into various threshold levels of safe expected exposure, dependent upon structure. In general chemicals have been categorised into one of three structural classes (class I, II, III), assigned respective TTC values of 0.03, 0.009 and 0.0015 mg/kg bw/day.

In SD3 of the Call for Submissions for P1034, these TTC values were compared against a USFDA database<sup>1</sup> containing dietary exposure information on more than 1300 food contact substances. The estimated dietary exposures for 86% of the substances (1119/1302) were below the lowest TTC value for non-genotoxic substances (structural class III: 0.0015 mg/kg bw/day). This figure increased to 97% (1260/1302) taking account of a higher threshold of 0.004 mg/kg bw/day for structural class III substances derived in a recent re-evaluation of the TTC for this class of compounds (Leeman et al. 2014).

For many of the chemicals with estimated dietary exposure exceeding their respective TTC thresholds, specific toxicity data were located in various databases and the published literature that support the safety of those chemicals. For a substantial fraction of chemicals in the database it is expected that the supporting toxicity data are unpublished, while for some chemicals the USFDA would have used read-across and/or quantitative structure-activity relationship (QSAR) approaches for safety assessment.

Overall, it was concluded that estimated dietary exposures to the majority of food contact substances are below the lowest TTC for non-genotoxic substances. This implies that repeat-dose toxicity data would not be required for the majority of substances to support a conclusion of negligible risk for the specific food contact use(s).

## 3.2 Surveys of specific packaging chemicals

A conclusion of low risk from the TTC analysis described above is supported by the findings of a number of analytical surveys investigating the presence of specific packaging chemicals in Australian foods. This information is summarised below, while more detailed information can be found in [Supporting Document 3 of the call for submissions on the P1034 proposal](#).

### 3.2.1 24th Australian Total Diet Study

In 2016 FSANZ published the second phase of the 24th Australian Total Diet Study (ATDS) which investigated the presence of 30 packaging chemicals in a total of 81 typically consumed Australian food and beverages (FSANZ 2016). This survey took a screening approach to identify whether any of the detected chemicals were of potential health and safety concern that would require further investigation. This assessment was based on a conservative, worst case exposure scenario known as the Theoretical Maximum Daily Exposure (TMDE). The TMDE for each detected chemical was calculated based on an assumption that 50% of foods and beverages consumed contain the chemical, and that the concentration of the chemical is the maximum level detected in any food sample.

Packaging chemicals assessed in Phase 2 of the 24th ATDS included bisphenol A (BPA), epoxidised soybean oil (ESBO), di-2-ethylhexyl adipate (DEHA), 14 phthalates, two perfluorinated chemicals and 11 chemicals used in printing inks. These chemicals have a range of food packaging uses including plasticisers (plastic softeners), lid-sealing agents, moisture/oil-resistant coatings and labelling. The chemicals included in the study were selected based on consultation with internal and external stakeholders, reviews of Australian

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<sup>1</sup> US FDA Cumulative Estimated Daily Intake (CEDI) Database for Food Contact Substances. This database includes dietary exposure contributions from food contact other than food packaging (e.g. conveyor belts, pipes, kitchen appliances, utensils and cookware).

and international literature and data from previous international incidents.

For all but two of the detected chemicals the TMDEs were below internationally recognised safe levels, supporting a conclusion of negligible to low health risk.

The exceptions were the phthalates diethylhexyl phthalate (DEHP) and diisononyl phthalate (DINP). For these substances the TMDE calculated for screening purposes exceeded the EFSA tolerable daily intake (TDI<sup>2</sup>) for DEHP by a factor of 4 and the EFSA TDI for DINP by 9-fold. As a result of these findings FSANZ conducted a follow-up survey of a wider range of foods to allow better estimates of dietary exposure to DEHP and DINP that could be used for risk characterisation. A summary of the results of this survey can be found in Section 4 of this report.

### **3.2.2 Additional surveys of packaging chemicals**

In addition to the 24th ATDS, FSANZ has previously conducted two targeted surveys on the presence of food packaging chemicals in Australian food and beverages. The first of these surveys focused on BPA (FSANZ 2010) while the second assessed levels of ESBO, phthalates, perfluorinated compounds, semicarbazide, acrylonitrile and vinyl chloride (FSANZ 2011). BPA and ESBO were detected at low levels in a small proportion of foods analysed, however no public health and safety risks were identified. None of the other chemicals were detected in any of the tested foods.

A recent survey of canned and bottled fruit products also found that levels of tin were well below the ML and no public health and safety concerns were identified (FSANZ 2015).

## **4 Phthalates and related plasticisers**

### **4.1 Plasticisers survey**

#### **4.1.1 Introduction**

The plasticisers' survey was conducted as a follow-up to Phase 2 of the 24th ATDS. The ATDS was undertaken as a screening study, which found that further survey work needed to be done on two phthalate plasticisers, DEHP and DINP, to enable a refined dietary exposure assessment to be conducted and to determine whether they posed any public health and safety concerns. In addition to DEHP and DINP, this survey examined the levels of several other phthalates, butyl benzyl phthalate (BBP), dibutyl phthalate (DBP), and diisodecyl phthalate (DIDP), the adipate di(2-ethylhexyl) adipate (DEHA), and the citrate acetyltributylcitrate (ATBC).

The survey was conducted as part of the Implementation Sub-Committee for Food Regulation's (ISFR) Coordinated Food Survey Plan, which is developed to facilitate bi-nationally coordinated food surveillance activities to inform food regulation policy, standards development and compliance priorities.

#### **4.1.2 Methods**

Food sample purchasing, preparation and analysis were undertaken from April to June 2016 in accordance with detailed instructions outlined in a survey procedures manual.

A total of 65 foods and beverages were sampled from five Australian jurisdictions including the Australian Capital Territory, New South Wales, South Australia, Victoria and Western

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<sup>2</sup> The TDI is an estimate of the amount of a substance in food that can be ingested daily over a lifetime without appreciable health risk.

Australia. Foods sampled included: baked beans; biscuits and cake; canned tomatoes; crisps and confectionery; dry noodles; frozen and takeaway meals; infant foods and formulas; jam; meat products; milk; oils (olive and vegetable oils); olives; peanut butter; sugar; and various cereal products (e.g. breads, breakfast cereals and bars). Foods were sampled in a variety of different packaging types including various types of plastics (rigid and flexible), metal cans, cardboard (carton board and folding cartons), paper and glass.

The food sample list was developed to enable a robust estimate of dietary exposure for Australian consumers. The purchasing of food samples took place in each participating jurisdiction in April and May 2016. Foods were sampled from a range of different retail outlets representing general availability in the Australian market. The following factors were considered in developing the food list:

- Ensuring coverage of a broad range of foods representative of typical packaged food and beverage consumption patterns for the Australian population
- Known uses of plasticisers in food packaging
- Results from phase 2 of the 24<sup>th</sup> ATDS
- International reports and surveys investigating plasticiser migration into food.

Food sample purchases were sent to the National Association for Testing Authorities (NATA) accredited food preparation laboratory, the National Measurement Institute (NMI) in Melbourne, as soon as practicable after purchase. Before analysis, all samples were prepared to a table ready state, including cooking (where required) and removal of inedible portions. Perishable foods were all prepared within 48 hours of purchase. All other foods were prepared within a week of purchase.

In preparation for analysis, three individual samples for each food and jurisdiction were combined into a single composite sample for laboratory analysis (to produce one composite sample per jurisdiction). Composite samples were sent from NMI to Eurofins WEJ Contaminants in Hamburg, Germany. The extraction and clean-up of plasticisers was carried out with solid phase extraction cartridges. Quantitative determination was conducted using LC-ESI-MS/MS<sup>3</sup> in positive ion mode via two MS/MS-transitions. This method is accredited by the regional Dutch authority<sup>4</sup> and in accordance with International Organisation for Standardisation (ISO) standards. The plasticiser concentrations were calculated using internal standards. The Limit of Detection (LOD)<sup>5</sup> and Limit of Quantitation (LOQ)<sup>6</sup> for each of the seven plasticisers are listed in Table 1 below. The Limit of Reporting (LOR)<sup>7</sup> for the results provided by the laboratory was equal to the LOD.

**Table 1 – Limits of detection and quantitation for the plasticisers in the survey**

Plasticiser	LOD (mg/kg)	LOQ (mg/kg)
DEHP	0.03	0.1
DINP	0.17	0.5
DIDP	0.17	0.5
DEHA	0.03	0.1
DBP	0.03	0.1
BBP	0.03	0.1
ATBC	0.03	0.1

<sup>3</sup> LC-ESI-MS/MS: Liquid Chromatography-Electrospray Ionization-Tandem Mass Spectrometry

<sup>4</sup> Deutsche Akkreditierungsstelle (DAkkS)

<sup>5</sup> LOD: The lowest concentration of an analyte in a sample that can be detected with acceptable reliability.

<sup>6</sup> LOQ: The lowest concentration of an analyte in a sample that can be quantitatively determined with acceptable precision.

<sup>7</sup> LOR: The lowest concentration of an analyte reported by the laboratory.

### 4.1.3 Hazard summary

Some phthalates and adipates have been the subject of concern in regard to their potential for adverse reproductive and developmental effects, as shown in laboratory animal studies. TDI values have been established for all seven substances included in this survey, as summarised in Table 2.

As several phthalates have adverse effects on the male reproductive system, consideration was given to whether a combined risk assessment should be performed for these substances. However, male reproductive effects are not the most sensitive effect for some of the substances included in the survey, and the TDIs for each substance are based on different critical effects. Therefore it was not considered appropriate to conduct a combined risk assessment for the phthalates included in the survey.

**Table 2 – TDIs for the plasticisers in the survey**

Substance	Endpoint	NOAEL* (mg/kg bw/day)	Uncertainty factor	TDI (mg/kg bw/day)	Reference
DEHP	Testicular toxicity in rats	5	100	0.05	EFSA 2005a
DINP	Liver and kidney effects in rats	15	100	0.15	EFSA 2005b
DIDP	Liver effects in dogs	15	100	0.15	EFSA 2005c
DEHA	Fetotoxicity in rats	30	100	0.3	SCF 1997
DBP	Developmental effects in rats	2 (LOAEL)	200	0.01	EFSA 2005d
BBP	Testicular toxicity and reduced anogenital distance in rats	50	100	0.5	EFSA 2005e
ATBC	Reduced body weight in rats	100	100	1.0	EFSA 2005f

\* NOAEL: No observed adverse effect level

### 4.1.4 Summary of analytical survey results

A summary of results for the plasticisers' survey is provided in One or more plasticisers were detected above the LOQ in 47 out of 65 foods tested. As indicated in **Error! Not a valid bookmark self-reference.**, DEHP was found in the highest number of foods, with 28 of 65 foods reported with concentrations above the LOQ. ATBC (23/65 foods), DEHA (17/65 foods) and DINP (11/65 foods) were also detected in a relatively high number of foods at concentrations above the LOQ. DBP (3/65 foods), DIDP (1/65 foods) and BBP (0/65 foods) were found in relatively few or no foods at concentrations above the LOQ.

The highest concentrations for individual plasticisers were reported in fatty foods including sundried tomatoes (DEHP up to 78 mg/kg and ATBC up to 30 mg/kg), hamburgers (DINP up to 13 mg/kg) and olives (ATBC up to 9.2 mg/kg). These results are not unexpected, as phthalates are known to be fat soluble, lipophilic compounds (Cao, 2010). It should be noted that, generally, these higher concentrations were limited to a relatively small proportion of all samples. Overall, the survey results indicate that the levels of these seven plasticisers in a broad range of Australian foods were generally low, with the majority of individual measured results (91%) below the LOQ.



Table 3 below. Further detailed results tables are included in Appendix 1.

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**Table 3 – Summary results for plasticisers**

Plasticiser	Number of foods:		Concentration range (mg/kg)	Foods with the highest concentrations
	Sampled	With results >LOQ		
DEHP	65	28	<LOQ-78	Sundried tomatoes; hamburger, beef; olive oil
DINP	65	11	<LOQ-13	Hamburger, beef; breakfast bars; bacon, middle cut, rind on
DIDP	65	1	<LOQ-0.74	Olive oil
DEHA	65	17	<LOQ-4.2	Beef, steak, untrimmed; olives
DBP	65	3	<LOQ-1.3	Tomato sauce
BBP	65	0	<LOQ	None
ATBC	65	23	<LOQ-30	Sundried tomatoes; olives; breakfast bars

## **4.2 Dietary exposure assessment of Plasticisers**

### **4.2.1 Approach to estimating dietary exposures to plasticisers**

Dietary exposure assessments (DEAs) require data on concentrations of the chemical of interest in food and food consumption data. The approach for this DEA was to use the median concentrations of the plasticisers analysed for each of the foods sampled in the plasticisers analytical survey as described above and combine this with food consumption data from the 2011–12 Australian National Nutrition and Physical Activity Survey (NNPAS). The population groups assessed were the Australian population (2 years and above, broken down into key life stages such as children, teenagers and adults) and 9 month old infants using a model infant diet. Two days of food consumption data were averaged to provide a better indication of longer term, or chronic, dietary exposure. The dietary exposure assessment was conducted using FSANZ's customised dietary modelling computer program, Harvest.

The foods analysed were 'mapped' to a wider number of similar foods reported as consumed in the 2011-12 NNPAS in order to estimate dietary exposure. In the 2011-12 NNPAS, foods were typically not reported with details of their packaging type, with the exception of some canned food. Due to the relatively high potential of processed foods being exposed to plasticisers in food packaging materials and processing equipment, mapping was based on the food additive classification system used in Standard 1.3.1 (Schedule 15) in the Australia New Zealand Food Standards Code (the Code) as this includes groups of processed foods. Dietary exposure results have been calculated and presented in terms of the group of the broader range of foods that the survey food represents, rather than as the individual survey food itself. Details of the mapping for the dietary exposure assessment can be found at Appendix 6.

Analytical results for some samples were 'not detected' (nd), or in other words, were below the LOR for the analytical method. In the case of the plasticisers assessed, the LOR was reported as equal to the LOD. Actual concentrations below the LOR could be anywhere between zero and the LOR. To allow for this uncertainty, the results for dietary exposure to the plasticisers were presented as a range. The lower end of the range is based on analytical concentrations below the LOR assigned a concentration of zero (nd=0), with the upper end of the range results below the LOR assigned a concentration equal to the LOR (nd=LOD).

For each of the plasticisers investigated, estimated dietary exposures in mg/kg bw/day for all age groups assessed, for the lower and upper end of the concentration range, were compared with their respective TDI. The major food contributors to dietary exposures of each of the plasticisers were also calculated.

A summary of the FSANZ approach to conducting dietary exposure assessments is at Appendix 2.

### **4.2.2 Summary of dietary exposure assessment results**

#### ***4.2.2.1 Estimated population dietary exposures compared with the TDI***

Results for the estimated mean and 90th percentile dietary exposures to plasticisers, expressed as a percentage of the TDI, are presented in Table 4. For all plasticisers examined, dietary exposures were below the TDI for all age groups assessed. Further details on estimated exposures to each of the plasticisers are presented in Appendix 4.

**Table 4 – Mean and 90th percentile estimated dietary exposure to Plasticisers as a % of the TDI for all age groups**

Plasticiser	TDI (mg/kg bw/day)	Age Group	Estimated dietary exposures to plasticisers <sup>φ</sup> <sup>ψ</sup> % of TDI			
			Mean		90 <sup>th</sup> percentile	
			nd=0	nd=LOD	nd=0	nd=LOD
DEHP	0.05	9 months <sup>υ</sup>	1	5	2	10
		2-5 years <sup>^</sup>	2	4	4	6
		6-12 years <sup>^</sup>	2	3	3	5
		13-16 years <sup>^</sup>	<1	2	2	3
		17 years & above <sup>^</sup>	<1	2	1	3
DINP	0.15	9 months <sup>υ</sup>	1	10	3	20
		2-5 years <sup>^</sup>	2	7	3	10
		6-12 years <sup>^</sup>	2	5	5	8
		13-16 years <sup>^</sup>	1	3	5	8
		17 years & above <sup>^</sup>	<1	3	2	5
DIDP	0.15	9 months <sup>υ</sup>	<1	9	<1	20
		2-5 years <sup>^</sup>	<1	6	<1	9
		6-12 years <sup>^</sup>	<1	4	<1	6
		13-16 years <sup>^</sup>	<1	2	<1	4
		17 years & above <sup>^</sup>	<1	2	<1	3
DEHA	0.3	9 months <sup>υ</sup>	<1	2	2	3
		2-5 years <sup>^</sup>	1	2	3	4
		6-12 years <sup>^</sup>	<1	1	2	2
		13-16 years <sup>^</sup>	<1	<1	2	2
		17 years & above <sup>^</sup>	<1	<1	2	2
DBP	0.01	9 months <sup>υ</sup>	<1	25	1	50
		2-5 years <sup>^</sup>	1	15	3	25
		6-12 years <sup>^</sup>	<1	10	2	15
		13-16 years <sup>^</sup>	<1	7	1	10
		17 years & above <sup>^</sup>	<1	6	1	9
BBP	0.5	9 months <sup>υ</sup>	<1	<1	<1	1
		2-5 years <sup>^</sup>	<1	<1	<1	<1
		6-12 years <sup>^</sup>	<1	<1	<1	<1
		13-16 years <sup>^</sup>	<1	<1	<1	<1
		17 years & above <sup>^</sup>	<1	<1	<1	<1
ATBC	1	9 months <sup>υ</sup>	<1	<1	<1	1
		2-5 years <sup>^</sup>	<1	<1	1	1
		6-12 years <sup>^</sup>	<1	<1	<1	<1
		13-16 years <sup>^</sup>	<1	<1	<1	<1
		17 years & above <sup>^</sup>	<1	<1	<1	<1

<sup>φ</sup> Derived using median analytical concentration.

<sup>ψ</sup> Exposures for 9 month olds are on an all respondent basis and ages 2 and above are for consumers only of the plasticiser.

<sup>υ</sup> Derived using a model diet.

<sup>^</sup> Derived using the Australian 2011-12 NNPAS (2 day average exposure).

nd – not detected

For both DEHP and DINP, the estimated mean and 90th percentile dietary exposures were below their respective TDI for all age groups assessed. The highest 90th percentile exposure to DEHP was for 9 month old infants with estimated exposure ranging from 2–10% of the TDI, followed by 2-5 year olds where 90th percentile exposures ranged from 4–6% of the TDI. The highest estimated 90th percentile exposures to DINP were 3-20% of the TDI for 9 month old infants and 3–10% of the TDI for 2-5 year olds.

The highest estimated dietary exposure as a percentage of the TDI was for DBP. The highest 90th percentile exposures for 9 month old infants ranged from 1–50% of the TDI.

Dietary exposures for 2-5 year old children from the lower end to the upper end of the 90th percentile were estimated to be 3–25% of the TDI.

Estimated dietary exposures to DIDP, DEHA, BBP and ATBC were all below their respective TDI for all age groups assessed at both the mean and the 90th percentile exposure.

For all chemicals, exposures as a percentage of the TDI were higher for infants and young children due to their higher food consumption relative to bodyweight compared to adults.

In some cases there is a large variation between the lower and upper end of the dietary exposure estimates. This can be due to a large proportion of the foods analysed for the chemical having not detected concentrations, and/or the LOR being high for the analytical method.

#### 4.2.2.2 Major foods contributing to plasticiser dietary exposures

The food category contributors to estimated plasticiser exposure were calculated from consumers' dietary exposures from all foods consumed that contained plasticisers, as determined from the analytical results. Food categories were considered to be major contributors if their contribution was  $\geq 5\%$ .

The major food contributors to plasticiser estimated dietary exposures for all age groups assessed using the median analytical concentration are presented in Table 5. Foods are shown where there was at least one age group for which it was a major contributor. More specific details on the percentage contributions to plasticiser dietary exposures for each population group are provided in Appendix 5, Table A5 1 to Table A5 7.

**Table 5 – Major food contributors to plasticiser estimated dietary exposures for all age groups**

Plasticiser	Major Food Contributors to dietary exposure*	
	Food	% contribution <sup>†</sup>
DEHP	Rice and cereal grain products	15 – 20
	Ripened cheeses, regular fat	6 – 12
	Pizzas and prepared pizza bases	6 – 10
	Seeds and tree nuts	0 – 10
	Breakfast cereal, single & mixed grain	6 – 9
	Olive Oil	6 – 7
DINP	Hamburgers (all meat types)	42 – 54
	Ripened cheeses, regular fat	11 – 23
	Pizzas and prepared pizza bases	9 – 14
	Cured or fermented deli meats	5 – 7
DIDP	Olive Oil	100
DEHA	Beef, veal, lamb and offal meats	48 – 73
	Ripened cheeses, regular fat	13 – 36
DBP	Breakfast cereal, single and mixed grain	100
BBP	Olive Oil	57 – 70
	Nut & seed butters	34 – 79
ATBC	Ripened cheeses, regular fat	57 – 70
	Commercial breads	9 – 13
	Ripened cheeses, reduced fat	5 – 7
	Olives	0 – 6

\* A major food for this report is one which contributes  $\geq 5\%$  to dietary exposures.

<sup>†</sup> Range represents all age groups assessed

## 4.3 Risk characterisation and conclusion

The highly conservative theoretical exposure estimates calculated in Phase 2 of the 24th ATDS suggested a potential that dietary exposures to DEHP and DINP may exceed their respective TDIs. However, the more refined exposure estimates derived from the present survey indicate that estimated dietary exposures to all the plasticisers included in the survey are below the respective TDIs for all age groups, for both mean and 90th percentile dietary exposures.

Based on these data, current dietary exposures of Australian consumers to the seven plasticisers included in this study are not considered to be of health concern.

## 5 Mineral oils

### 5.1 Mineral oil hydrocarbons survey

#### 5.2.1 Introduction

An analytical survey was undertaken to investigate whether mineral oil hydrocarbons (MOH) migrate from food packaging to food. This was done with a view to determine whether current food packaging regulatory measures in Australia and New Zealand are appropriate to protect public health and safety. This work was conducted to inform the FSANZ Proposal, *P1034- Chemical Migration from Packaging into Food*.

#### 5.2.2 Hazard summary

Mineral oils are complex mixtures that are generally comprised of two main forms, mineral oil saturated hydrocarbons (MOSH) and mineral oil aromatic hydrocarbons (MOAH). The composition of mineral oils varies depending on the source, but technical grades generally contain 15-35% MOAH, whereas food grade mineral oils are treated to minimise the presence of MOAH.

MOSH and MOAH are both of low acute toxicity, however in sub-chronic toxicity studies in rats MOSH exposure has been found to result in the formation of microgranulomas and inflammation in the liver. Some forms of MOAH are genotoxic and carcinogenic (EFSA 2012). No internationally agreed HBGVs are currently available for MOH, however EFSA has identified toxicological points of departure for MOSH that can be used as reference points in a margin of exposure evaluation. These reference points are based on NOAELs for liver effects in rats.

It is desirable that exposures to MOAH should be as low as reasonably achievable.

#### 5.2.3 Methods

The analytical survey was conducted in two phases; the first phase established a method for the detection and quantification of MOH in paperboard packaging. Analytical methods were developed for the two main groups of MOH, MOSH and MOAH, in accordance with the method published by the German Institute for risk assessment (BfR 2012). Phase two of this project undertook a small scale analytical survey, measuring MOSH and MOAH levels in the paperboard packaging and corresponding food samples.

Following the establishment of a robust, reliable method, a total of 61 paperboard packaging samples were analysed as part of the first phase using gas chromatography, coupled with flame ionisation detection. Phase two of the survey analysed 56 dried unprepared food samples and the associated packaging for total MOSH and MOAH. The Limit of Quantification (LOQ) for all MOHs analysed in paperboard and food was 10 mg/kg and the

Limit of Detection (LOD) was 5 mg/kg. Given white mineral oil is also a permitted processing aid as a lubricant, release and anti-sticking agent, foods were selected where detections were more likely to be a result of chemical migration from packaging, rather than from use as a processing aid or food additive.

## **5.2.4 Summary of analytical survey results**

### **5.2.4.1 Phase 1 – Quantification of MOH in paperboard packaging only**

The results from the first phase of this study indicate a strong correlation between the level of MOH detected and the proportion of recycled material used in the packaging construction (Table 6). These findings are consistent with the control packaging samples containing recycled materials. In addition, in most cases, packaging which contained recycled materials also used an inner lining as a physical barrier between the package and the food.

### **5.2.4.2 Phase 2 – Quantification of MOH in food and paperboard packaging**

Over 98% of the 56 food samples tested for total MOSH in phase two of the survey had concentration levels at or below the LOQ of 10 mg/kg (Table 7). One sample of dry chocolate cake mix was found to have a total MOSH level of 71 mg/kg.

For the food packaging analysed in phase two, MOSH was detected in over 90% of the 56 samples tested. Levels ranged from 12 to 2,900 mg/kg. Generally, higher levels of MOSH were found in packaging which was derived from recycled materials, with highest concentrations detected in packaging that used 100% recycled products.

The same 56 food samples and packaging were also analysed for total MOAH, with over 92% of food samples found to contain MOAH at or below the LOQ of 10 mg/kg. Detections above the LOQ were found in dry unprepared cous cous (85 mg/kg) and three samples of chocolate cake mix (17, 77, 150 mg/kg). Total MOAH was detected in approximately 90% of the corresponding food packaging, with concentration levels ranging from 11 to 9600 mg/kg. The composition of the packaging which had the highest concentration of MOAH detected, was not indicated.

**Table 6 – Total MOAH and MOSH concentrations in food packaging available in Australia**

Food Packaging Type (n=x)	Packaging Type used		Individual Food Packaging Concentration (mg/kg)	
	Paperboard	Internal bag	Total MOSH <sup>†</sup>	Total MOAH <sup>†</sup>
<b>Risoni (5)</b>	Not indicated	No	350, 380, 170, 360, 140	190; 230; 60, 370, 560
<b>Pasta/Spelt (4)</b>	Not indicated	No	170, 120, 3900	500, 330, 710
	Not indicated	Yes	540	320
<b>Cous Cous (6)</b>	Not indicated	No	790, 330, 500, 180, 400, 200	280, 120, 20, 290, 120, <10
<b>Oats (5)</b>	Not indicated	No	<10, 170, 120, 220, 810	30, 30, 80, 60, 210
<b>Breakfast cereal, multiple grain (5)</b>	95% recycled	Yes	970, 970, 2400, 600, 1100	460, 360, 1100, 780, 670
<b>Breakfast cereal, single grain (5)</b>	100% recycled	Yes	2400, 4900, 3800, 4000, 3400	210, 870, 880, 1100, 490
<b>Bread crumbs (5)</b>	Not indicated	No	220, 490, 60, 390, 560	200, <10, <10, 164, 110
<b>Sugar (5)</b>	Not indicated	No	880, 1000, 520, 730, 960	70, 10, 10, 100, 460
<b>Custard powder (5)</b>	Not indicated	Yes	200, 380, <10, 400, 300	90, 70, 10, 300, 910
<b>Cake mix, chocolate (3)</b>	Not indicated (1)	Yes	310	250
	95% recycled (2)	Yes	3200, 7000	440, 3200
<b>Cake mix, vanilla (2)</b>	95% recycled	Yes	6400	560
	Not indicated	Yes	5300	710
<b>Nuts/dried fruit mix (5)</b>	Not indicated	No	210, 110, 500, 160 <sup>‡</sup>	20, <10, 130, 310, 230
<b>Tea (1)</b>	95% recycled	No	7300	540
<b>Fish, battered/ frozen (3)</b>	Not indicated	No	290, 320, 430	120, 200, 70
<b>Chicken, battered/ frozen (2)</b>	Not indicated	No	320, 270	110, 70
<b>CONTROL PAPERBOARD SAMPLES</b>				
<b>Kraft + 25% recycled (5)</b>	N/A	N/A	1500, 570, 1800, 860	290, 90, 260, 870, 210
<b>100% recycled cardboard (5)</b>	N/A	N/A	5700, 4200, 5400, 4900, 4600	1200, 1500, 1000, 530, 1600
<b>100% virgin cardboard (5)</b>	N/A	N/A	110, 120, 100, 110, 90	<10, 240, 410, 610, 260

<sup>†</sup> Total values are for detects of the C10 – C35 forms; 'X' denotes the number of samples tested;

LOQ= 10 mg/kg; LOD= 5 mg/kg. <sup>‡</sup> One sample was not tested by the analytical laboratory for total MOSH



**Table 7 – Total MOSH and MOAH concentrations in food and packaging available in Australia\***

Food Type (n=X)	Sample Type	MOSH		MOAH	
		Number of Detects >LOQ	Total Food and/or Packaging Concentration Range <sup>†</sup> (mg/kg)	Number of Detects >LOQ	Total Food and/or Packaging Concentration Range <sup>†</sup> (mg/kg)
Pasta (n=5)	Food	0	-	0	-
	Packaging	5	44-420	2	54-150
Cous Cous (n=3)	Food	0	-	1	85
	Packaging	3	29-720	3	78-300
Oats (n=3)	Food	0	-	0	-
	Packaging	1	34	2	11-12
Breakfast cereal, multiple grain (n=3)	Food	0	-	0	-
	Packaging	3	61-630	3	250-660
Breakfast cereal, single grain (n=9)	Food	0	-	0	-
	Packaging	9	23-1000	9	110-9600
Bread crumbs (n=3)	Food	0	-	0	-
	Packaging	2	18-88	2	39-120
Sugar (n=3)	Food	0	-	0	-
	Packaging	3	55-160	3	100-190
Flour, Plain (n=3)	Food	0	-	0	-
	Packaging	3	54-92	3	150-180
Cake mix, chocolate (n=3)	Food	1	71	3	17-150
	Packaging	3	12-2200	3	20-320
Chicken, battered/frozen (n=3)	Food	0	-	0	-
	Packaging	1	14	3	14-47
Fish, battered/frozen (n=3)	Food	0	-	0	-
	Packaging	3	26-120	3	130-270
Sausage rolls (n=3)	Food	0	-	0	-
	Packaging	3	25-75	3	64-81
Box, Pizza, take away (n=6)	Food	0	-	0	-
	Packaging	6	110-2900	5	280-920
Eggs (n=2)	Food	0	-	0	-
	Packaging	2	180-630	2	220-370
Infant cereal (n=4)	Food	0	-	0	-
	Packaging	4	400-1400	4	430-680

<sup>†</sup> Total values are for detects of the C10 – C35 forms; 'X' denotes the number of samples tested; - indicates that there is no range as there were no detections above the LOQ; LOQ= 10 mg/kg & LOD= 5 mg/kg for all samples analysed.\* All foods were analysed raw, uncooked, dry or unprepared.

### 5.2.5 Risk characterisation and conclusion

The survey indicated that the levels of MOSH and MOAH from food packaging in Australian foods are very low and unlikely to be of public health concern. Given the low incidence of detections in sampled foods a quantitative risk assessment was not carried out.

Levels of MOAH should be kept as low as reasonably achievable. FSANZ is aware of industry efforts to minimise the migration of these substances from food packaging into food<sup>8</sup> and will continue to monitor this issue.

<sup>8</sup> [Statement of the European Printing Ink Association](#)

## 6 Survey of packaging chemicals in New Zealand foods

The MPI in New Zealand undertook a complementary study to establish concentrations of phthalates and printing inks in food/packaging combinations retailed in New Zealand.

74 food/packaging combinations were chosen for sampling, from 30 food groupings, with samples analysed for 14 different phthalate esters, the plasticiser DEHA and 11 different printing inks/photoinitiators.

Detectable concentrations were reported for two phthalates, DEHP and DINP, and/or DEHA in 15 of the sampled food/packaging combinations. Additionally five different printing inks/photoinitiators were detected in 11 of the sampled food/packaging combinations. Dietary exposure to the detected compounds was estimated through mapping to the simulated diets for different age and gender cohorts from the 2016 New Zealand Total Diet Study and the estimated worst-case dietary exposure was then characterised for health risk against the relevant health based guidance value. For substances without a health based guidance value, estimated dietary exposures were compared to the relevant Threshold of Toxicological Concern (TTC) threshold.

The dietary exposure estimates for all of the age and gender cohorts identified no health risks for the majority of the plastic migration compounds detected. Estimated dietary exposures were below the relevant health based guidance value or TTC for all but one of the compounds that were detected.

One printing ink/photoinitiator, 2,4-Diethyl-9H-thioxanthen-9-on (DETX), detected in a sample of canola oil spread, had an estimated dietary exposure that slightly exceeded the relevant TTC classification threshold, based on its structure triggering carcinogenicity alerts. Following further analysis of the toxicity of structurally similar chemicals, and taking into account the detection in only a single food/packaging combination sample and the high conservatism of the dietary exposure estimate, it was concluded that there was a negligible risk to food safety.

Based on the results of the dietary risk characterisation it was concluded that the migration of phthalates and printing inks/photoinitiators into packaged New Zealand foods is not a concern for human health.

## 7 Conclusions

FSANZ has conducted a range of activities to investigate the potential human health risks from migration of chemicals in packaging into food. Taken together, the results of these activities indicate that for Australian and New Zealand consumers dietary exposures to chemicals used in the production of food packaging are generally low and not of concern for human health.

Analysis of a USFDA database of over 1300 food contact substances showed that estimated dietary exposure for 98% of substances is less than 0.01 mg/kg bw/day. For 86% of the substances estimated dietary exposure is below the lowest TTC for non-genotoxic substances. For many of the chemicals with estimated dietary exposure exceeding their respective TTC thresholds, specific toxicity data were located in various databases and the published literature that support the safety of those chemicals.

A conclusion of low risk based on the TTC analysis is supported by the results of a number of analytical surveys investigating the presence of packaging chemicals in Australian and New Zealand foods. These surveys have demonstrated that estimated dietary exposures to chemicals migrating from packaging into food are low and below levels of concern.

The screening methodology used in the 24th Australian Total Diet Study (ATDS) to assess 30 food packaging chemicals in Australian foods and beverages identified two chemicals for which more data were needed to enable a more refined risk assessment. These chemicals were the phthalates diethylhexyl phthalate (DEHP) and diisononyl phthalate (DINP). However, a targeted follow up survey of DEHP and DINP plus five additional plasticisers in Australian foods found that estimated dietary exposures are below the TDIs for these substances and not of concern for human health.

Potential risks from the migration of chemicals in recycled paperboard, particularly MOH, into food are not yet well characterised and research is ongoing internationally. However, FSANZ has recently completed a survey of Australian food packaging and foods and did not find widespread migration of MOH into foods. MOH was only detected at quantifiable levels in two food products, and there was no evidence of a public health and safety concern.

A recent survey of packaging chemicals including phthalates, printing inks and photoinitiators in New Zealand foods also found that dietary exposures to these chemicals are low and not of concern for human health.

The overall conclusion based on the available data is that the human health risk posed by chemical migration from packaging into food and beverages available in Australia and New Zealand is low.

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# Appendix 1: Analytical results for Plasticisers

**Table A1 1: Analytical results for ATBC**

Food	No. of samples	No. of detections (>LOQ*)	Mean (<LOQ = 0)	Mean (<LOQ = LOQ)	Minimum	Maximum
Bacon, middle cut, rind on	4	2	0.22	0.27	<LOQ	0.65
Baked beans in tomato sauce	4	1	0.030	0.11	<LOQ	0.12
Beef mince and meat patties	4	2	0.080	0.13	<LOQ	0.17
Beef, steak, untrimmed	4	0	0	0.1	<LOQ	<LOQ
Beef/Chicken Takeaway	4	0	0	0.1	<LOQ	<LOQ
Biscuits, sweet and savoury	4	2	0.16	0.21	<LOQ	0.41
Bread, fancy, sweet and savoury	4	3	0.17	0.20	<LOQ	0.26
Bread, flat	4	4	0.26	0.26	0.15	0.41
Bread, white	4	3	0.16	0.19	<LOQ	0.36
Breakfast bars	4	3	1.1	1.1	<LOQ	2.9
Breakfast cereal, single and mixed grain	4	0	0	0.1	<LOQ	<LOQ
Cakes and muffins, iced	4	1	0.052	0.13	<LOQ	0.21
Cakes and muffins, uniced	4	0	0	0.1	<LOQ	<LOQ
Cheese, cream cheese, reduced fat	4	0	0	0.1	<LOQ	<LOQ
Cheese, cream cheese, regular fat	4	0	0	0.1	<LOQ	<LOQ
Cheese, processed, Cheddar (Tasty), reduced fat	4	4	0.84	0.84	0.13	1.3
Cheese, processed, Cheddar (Tasty), regular fat	4	4	0.76	0.76	0.45	1.3
Chicken products, battered or crumbed	4	2	0.12	0.16	<LOQ	0.28
Chicken products, battered or crumbed, from takeaway	3	0	0	0.1	<LOQ	<LOQ
Chicken, breast	4	0	0	0.1	<LOQ	<LOQ
Chocolate, plain milk chocolate	4	0	0	0.1	<LOQ	<LOQ
Coffee, instant	4	0	0	0.1	<LOQ	<LOQ
Confectionary, Soft candy	4	0	0	0.1	<LOQ	<LOQ
Corn chips	4	1	0.035	0.11	<LOQ	0.14
Cream, sour, full fat	4	0	0	0.1	<LOQ	<LOQ
Cream, thickened, reduced fat	4	0	0	0.1	<LOQ	<LOQ
Dip	4	0	0	0.1	<LOQ	<LOQ
Fish fillets, white fish, fresh	4	0	0	0.1	<LOQ	<LOQ
Fish portions, frozen (crumbed only) from supermarket	4	1	0.052	0.13	<LOQ	0.21
Hamburger, Beef	8	0	0	0.1	<LOQ	<LOQ
Ice cream, full fat	4	0	0	0.1	<LOQ	<LOQ
Infant dessert	4	0	0	0.1	<LOQ	<LOQ
Infant dinner	4	0	0	0.1	<LOQ	<LOQ
Infant formula, non soy-based	4	0	0	0.1	<LOQ	<LOQ
Infant formula, soy-based	4	0	0	0.1	<LOQ	<LOQ

Food	No. of samples	No. of detections (>LOQ*)	Mean (<LOQ = 0)	Mean (<LOQ = LOQ)	Minimum	Maximum
Jam	4	0	0	0.1	<LOQ	<LOQ
Milk, fresh, full fat	4	0	0	0.1	<LOQ	<LOQ
Milk, fresh, reduced fat	4	1	0.030	0.11	<LOQ	0.12
Milk, UHT, full fat	4	0	0	0.1	<LOQ	<LOQ
Noodles, instant, in cups and bowls	4	0	0	0.1	<LOQ	<LOQ
Noodles, instant, in plastic wrapping	3	0	0	0.1	<LOQ	<LOQ
Nuts, cashews	4	1	0.12	0.20	<LOQ	0.50
Oil, canola or sunflower oil	4	0	0	0.1	<LOQ	<LOQ
Oil, olive oil	4	0	0	0.1	<LOQ	<LOQ
Olives	4	4	8.3	8.3	6.7	9.2
Pasta	4	0	0	0.1	<LOQ	<LOQ
Peanut butter	4	0	0	0.1	<LOQ	<LOQ
Peas, frozen	4	0	0	0.1	<LOQ	<LOQ
Pizza, frozen from supermarket	4	0	0	0.1	<LOQ	<LOQ
Potato crisps, flavoured and unflavoured	4	2	0.092	0.14	<LOQ	0.25
Ready to eat meal, frozen from supermarket	4	0	0	0.1	<LOQ	<LOQ
Rice, single grain, uncooked	4	0	0	0.1	<LOQ	<LOQ
Sausages, beef	4	1	0.028	0.10	<LOQ	0.11
Shelf-stable peaches	4	0	0	0.1	<LOQ	<LOQ
Soft drink	4	0	0	0.1	<LOQ	<LOQ
Soup	4	1	0.042	0.12	<LOQ	0.17
Spreads, full fat, including butter and vegetable spreads	4	0	0	0.1	<LOQ	<LOQ
Spreads, reduced fat, including butter and vegetable spreads	4	0	0	0.1	<LOQ	<LOQ
Sugar, white	4	4	0.41	0.41	0.15	0.74
Sundried tomatoes	4	4	14	14	7.1	30
Tomato sauce	4	0	0	0.1	<LOQ	<LOQ
Tomatoes, canned	4	0	0	0.1	<LOQ	<LOQ
Tuna, canned	4	4	0.36	0.36	0.18	0.47
Yoghurt, full fat, flavoured and unflavoured	4	0	0	0.1	<LOQ	<LOQ
Yoghurt, low/reduced fat, flavoured and unflavoured	4	0	0	0.1	<LOQ	<LOQ

\* LOQ = 0.1 mg/kg



**Table A1 2: Analytical results for BBP**

Food	No. of samples	No. of detections (>LOQ*)	Mean (<LOQ = 0)	Mean (<LOQ = LOQ)	Minimum	Maximum
Bacon, middle cut, rind on	4	0	0	0.1	<LOQ	<LOQ
Baked beans in tomato sauce	4	0	0	0.1	<LOQ	<LOQ
Beef mince and meat patties	4	0	0	0.1	<LOQ	<LOQ
Beef, steak, untrimmed	4	0	0	0.1	<LOQ	<LOQ
Beef/Chicken Takeaway	4	0	0	0.1	<LOQ	<LOQ
Biscuits, sweet and savoury	4	0	0	0.1	<LOQ	<LOQ
Bread, fancy, sweet and savoury	4	0	0	0.1	<LOQ	<LOQ
Bread, flat	4	0	0	0.1	<LOQ	<LOQ
Bread, white	4	0	0	0.1	<LOQ	<LOQ
Breakfast bars	4	0	0	0.1	<LOQ	<LOQ
Breakfast cereal, single and mixed grain	4	0	0	0.1	<LOQ	<LOQ
Cakes and muffins, iced	4	0	0	0.1	<LOQ	<LOQ
Cakes and muffins, uniced	4	0	0	0.1	<LOQ	<LOQ
Cheese, cream cheese, reduced fat	4	0	0	0.1	<LOQ	<LOQ
Cheese, cream cheese, regular fat	4	0	0	0.1	<LOQ	<LOQ
Cheese, processed, Cheddar (Tasty), reduced fat	4	0	0	0.1	<LOQ	<LOQ
Cheese, processed, Cheddar (Tasty), regular fat	4	0	0	0.1	<LOQ	<LOQ
Chicken products, battered or crumbed	4	0	0	0.1	<LOQ	<LOQ
Chicken products, battered or crumbed, from takeaway	3	0	0	0.1	<LOQ	<LOQ
Chicken, breast	4	0	0	0.1	<LOQ	<LOQ
Chocolate, plain milk chocolate	4	0	0	0.1	<LOQ	<LOQ
Coffee, instant	4	0	0	0.1	<LOQ	<LOQ
Confectionary, Soft candy	4	0	0	0.1	<LOQ	<LOQ
Corn chips	4	0	0	0.1	<LOQ	<LOQ
Cream, sour, full fat	4	0	0	0.1	<LOQ	<LOQ
Cream, thickened, reduced fat	4	0	0	0.1	<LOQ	<LOQ
Dip	4	0	0	0.1	<LOQ	<LOQ
Fish fillets, white fish, fresh	4	0	0	0.1	<LOQ	<LOQ
Fish portions, frozen (crumbed only) from supermarket	4	0	0	0.1	<LOQ	<LOQ
Hamburger, Beef	8	0	0	0.1	<LOQ	<LOQ
Ice cream, full fat	4	0	0	0.1	<LOQ	<LOQ
Infant dessert	4	0	0	0.1	<LOQ	<LOQ
Infant dinner	4	0	0	0.1	<LOQ	<LOQ
Infant formula, non soy-based	4	0	0	0.1	<LOQ	<LOQ
Infant formula, soy-based	4	0	0	0.1	<LOQ	<LOQ
Jam	4	0	0	0.1	<LOQ	<LOQ
Milk, fresh, full fat	4	0	0	0.1	<LOQ	<LOQ
Milk, fresh, reduced fat	4	0	0	0.1	<LOQ	<LOQ
Milk, UHT, full fat	4	0	0	0.1	<LOQ	<LOQ

Food	No. of samples	No. of detections (>LOQ*)	Mean (<LOQ = 0)	Mean (<LOQ = LOQ)	Minimum	Maximum
Noodles, instant, in cups and bowls	4	0	0	0.1	<LOQ	<LOQ
Noodles, instant, in plastic wrapping	3	0	0	0.1	<LOQ	<LOQ
Nuts, cashews	4	0	0	0.1	<LOQ	<LOQ
Oil, canola or sunflower oil	4	0	0	0.1	<LOQ	<LOQ
Oil, olive oil	4	0	0	0.1	<LOQ	<LOQ
Olives	4	0	0	0.1	<LOQ	<LOQ
Pasta	4	0	0	0.1	<LOQ	<LOQ
Peanut butter	4	0	0	0.1	<LOQ	<LOQ
Peas, frozen	4	0	0	0.1	<LOQ	<LOQ
Pizza, frozen from supermarket	4	0	0	0.1	<LOQ	<LOQ
Potato crisps, flavoured and unflavoured	4	0	0	0.1	<LOQ	<LOQ
Ready to eat meal, frozen from supermarket	4	0	0	0.1	<LOQ	<LOQ
Rice, single grain, uncooked	4	0	0	0.1	<LOQ	<LOQ
Sausages, beef	4	0	0	0.1	<LOQ	<LOQ
Shelf-stable peaches	4	0	0	0.1	<LOQ	<LOQ
Soft drink	4	0	0	0.1	<LOQ	<LOQ
Soup	4	0	0	0.1	<LOQ	<LOQ
Spreads, full fat, including butter and vegetable spreads	4	0	0	0.1	<LOQ	<LOQ
Spreads, reduced fat, including butter and vegetable spreads	4	0	0	0.1	<LOQ	<LOQ
Sugar, white	4	0	0	0.1	<LOQ	<LOQ
Sundried tomatoes	4	0	0	0.1	<LOQ	<LOQ
Tomato sauce	4	0	0	0.1	<LOQ	<LOQ
Tomatoes, canned	4	0	0	0.1	<LOQ	<LOQ
Tuna, canned	4	0	0	0.1	<LOQ	<LOQ
Yoghurt, full fat, flavoured and unflavoured	4	0	0	0.1	<LOQ	<LOQ
Yoghurt, low/reduced fat, flavoured and unflavoured	4	0	0	0.1	<LOQ	<LOQ

\* LOQ = 0.1 mg/kg

**Table A1 3: Analytical results for DBP**

Food	No. of samples	No. of detections (>LOQ*)	Mean (<LOQ = 0)	Mean (<LOQ = LOQ)	Minimum	Maximum
Bacon, middle cut, rind on	4	0	0	0.1	<LOQ	<LOQ
Baked beans in tomato sauce	4	0	0	0.1	<LOQ	<LOQ
Beef mince and meat patties	4	0	0	0.1	<LOQ	<LOQ
Beef, steak, untrimmed	4	0	0	0.1	<LOQ	<LOQ
Beef/Chicken Takeaway	4	0	0	0.1	<LOQ	<LOQ
Biscuits, sweet and savoury	4	0	0	0.1	<LOQ	<LOQ
Bread, fancy, sweet and savoury	4	0	0	0.1	<LOQ	<LOQ
Bread, flat	4	0	0	0.1	<LOQ	<LOQ
Bread, white	4	0	0	0.1	<LOQ	<LOQ
Breakfast bars	4	0	0	0.1	<LOQ	<LOQ
Breakfast cereal, single and mixed grain	4	0	0	0.1	<LOQ	<LOQ
Cakes and muffins, iced	4	0	0	0.1	<LOQ	<LOQ
Cakes and muffins, uniced	4	0	0	0.1	<LOQ	<LOQ
Cheese, cream cheese, reduced fat	4	0	0	0.1	<LOQ	<LOQ
Cheese, cream cheese, regular fat	4	0	0	0.1	<LOQ	<LOQ
Cheese, processed, Cheddar (Tasty), reduced fat	4	0	0	0.1	<LOQ	<LOQ
Cheese, processed, Cheddar (Tasty), regular fat	4	0	0	0.1	<LOQ	<LOQ
Chicken products, battered or crumbed	4	0	0	0.1	<LOQ	<LOQ
Chicken products, battered or crumbed, from takeaway	3	0	0	0.1	<LOQ	<LOQ
Chicken, breast	4	0	0	0.1	<LOQ	<LOQ
Chocolate, plain milk chocolate	4	0	0	0.1	<LOQ	<LOQ
Coffee, instant	4	0	0	0.1	<LOQ	<LOQ
Confectionary, Soft candy	4	0	0	0.1	<LOQ	<LOQ
Corn chips	4	0	0	0.1	<LOQ	<LOQ
Cream, sour, full fat	4	0	0	0.1	<LOQ	<LOQ
Cream, thickened, reduced fat	4	0	0	0.1	<LOQ	<LOQ
Dip	4	0	0	0.1	<LOQ	<LOQ
Fish fillets, white fish, fresh	4	0	0	0.1	<LOQ	<LOQ
Fish portions, frozen (crumbed only) from supermarket	4	0	0	0.1	<LOQ	<LOQ
Hamburger, Beef	8	0	0	0.1	<LOQ	<LOQ
Ice cream, full fat	4	0	0	0.1	<LOQ	<LOQ
Infant dessert	4	0	0	0.1	<LOQ	<LOQ
Infant dinner	4	0	0	0.1	<LOQ	<LOQ
Infant formula, non soy-based	4	0	0	0.1	<LOQ	<LOQ
Infant formula, soy-based	4	0	0	0.1	<LOQ	<LOQ
Jam	4	0	0	0.1	<LOQ	<LOQ
Milk, fresh, full fat	4	0	0	0.1	<LOQ	<LOQ
Milk, fresh, reduced fat	4	0	0	0.1	<LOQ	<LOQ
Milk, UHT, full fat	4	0	0	0.1	<LOQ	<LOQ

Food	No. of samples	No. of detections (>LOQ*)	Mean (<LOQ = 0)	Mean (<LOQ = LOQ)	Minimum	Maximum
Noodles, instant, in cups and bowls	4	0	0	0.1	<LOQ	<LOQ
Noodles, instant, in plastic wrapping	3	0	0	0.1	<LOQ	<LOQ
Nuts, cashews	4	0	0	0.1	<LOQ	<LOQ
Oil, canola or sunflower oil	4	0	0	0.1	<LOQ	<LOQ
Oil, olive oil	4	0	0	0.1	<LOQ	<LOQ
Olives	4	0	0	0.1	<LOQ	<LOQ
Pasta	4	0	0	0.1	<LOQ	<LOQ
Peanut butter	4	0	0	0.1	<LOQ	<LOQ
Peas, frozen	4	1	0.035	0.11	<LOQ	0.14
Pizza, frozen from supermarket	4	0	0	0.1	<LOQ	<LOQ
Potato crisps, flavoured and unflavoured	4	0	0	0.1	<LOQ	<LOQ
Ready to eat meal, frozen from supermarket	4	0	0	0.1	<LOQ	<LOQ
Rice, single grain, uncooked	4	0	0	0.1	<LOQ	<LOQ
Sausages, beef	4	0	0	0.1	<LOQ	<LOQ
Shelf-stable peaches	4	0	0	0.1	<LOQ	<LOQ
Soft drink	4	0	0	0.1	<LOQ	<LOQ
Soup	4	0	0	0.1	<LOQ	<LOQ
Spreads, full fat, including butter and vegetable spreads	4	0	0	0.1	<LOQ	<LOQ
Spreads, reduced fat, including butter and vegetable spreads	4	0	0	0.1	<LOQ	<LOQ
Sugar, white	4	0	0	0.1	<LOQ	<LOQ
Sundried tomatoes	4	1	0.025	0.10	<LOQ	0.10
Tomato sauce	4	1	0.32	0.40	<LOQ	1.3
Tomatoes, canned	4	0	0	0.1	<LOQ	<LOQ
Tuna, canned	4	0	0	0.1	<LOQ	<LOQ
Yoghurt, full fat, flavoured and unflavoured	4	0	0	0.1	<LOQ	<LOQ
Yoghurt, low/reduced fat, flavoured and unflavoured	4	0	0	0.1	<LOQ	<LOQ

\* LOQ = 0.1 mg/kg

**Table A1 4: Analytical results for DEHA**

Food	No. of samples	No. of detections (>LOQ*)	Mean (<LOQ = 0)	Mean (<LOQ = LOQ)	Minimum	Maximum
Bacon, middle cut, rind on	4	0	0	0.1	<LOQ	<LOQ
Baked beans in tomato sauce	4	0	0	0.1	<LOQ	<LOQ
Beef mince and meat patties	4	1	0.23	0.30	<LOQ	0.92
Beef, steak, untrimmed	4	4	2.5	2.5	1.1	4.2
Beef/Chicken Takeaway	4	3	0.29	0.32	<LOQ	0.79
Biscuits, sweet and savoury	4	0	0	0.1	<LOQ	<LOQ
Bread, fancy, sweet and savoury	4	0	0	0.1	<LOQ	<LOQ
Bread, flat	4	0	0	0.1	<LOQ	<LOQ
Bread, white	4	0	0	0.1	<LOQ	<LOQ
Breakfast bars	4	0	0	0.1	<LOQ	<LOQ
Breakfast cereal, single and mixed grain	4	0	0	0.1	<LOQ	<LOQ
Cakes and muffins, iced	4	1	0.12	0.20	<LOQ	0.50
Cakes and muffins, uniced	4	0	0	0.1	<LOQ	<LOQ
Cheese, cream cheese, reduced fat	4	0	0	0.1	<LOQ	<LOQ
Cheese, cream cheese, regular fat	4	4	0.18	0.18	0.16	0.19
Cheese, processed, Cheddar (Tasty), reduced fat	4	3	0.18	0.20	<LOQ	0.37
Cheese, processed, Cheddar (Tasty), regular fat	4	3	0.28	0.30	<LOQ	0.65
Chicken products, battered or crumbed	4	0	0	0.1	<LOQ	<LOQ
Chicken products, battered or crumbed, from takeaway	3	1	0.033	0.1	<LOQ	0.10
Chicken, breast	4	0	0	0.1	<LOQ	<LOQ
Chocolate, plain milk chocolate	4	0	0	0.1	<LOQ	<LOQ
Coffee, instant	4	0	0	0.1	<LOQ	<LOQ
Confectionary, Soft candy	4	0	0	0.1	<LOQ	<LOQ
Corn chips	4	0	0	0.1	<LOQ	<LOQ
Cream, sour, full fat	4	4	0.24	0.24	0.22	0.30
Cream, thickened, reduced fat	4	1	0.028	0.10	<LOQ	0.11
Dip	4	0	0	0.1	<LOQ	<LOQ
Fish fillets, white fish, fresh	4	0	0	0.1	<LOQ	<LOQ
Fish portions, frozen (crumbed only) from supermarket	4	0	0	0.1	<LOQ	<LOQ
Hamburger, Beef	8	1	0.039	0.13	<LOQ	0.31
Ice cream, full fat	4	1	0.025	0.1	<LOQ	0.10
Infant dessert	4	0	0	0.1	<LOQ	<LOQ
Infant dinner	4	0	0	0.1	<LOQ	<LOQ
Infant formula, non soy-based	4	0	0	0.1	<LOQ	<LOQ
Infant formula, soy-based	4	0	0	0.1	<LOQ	<LOQ
Jam	4	0	0	0.1	<LOQ	<LOQ
Milk, fresh, full fat	4	0	0	0.1	<LOQ	<LOQ
Milk, fresh, reduced fat	4	0	0	0.1	<LOQ	<LOQ
Milk, UHT, full fat	4	0	0	0.1	<LOQ	<LOQ

Food	No. of samples	No. of detections (>LOQ*)	Mean (<LOQ = 0)	Mean (<LOQ = LOQ)	Minimum	Maximum
Noodles, instant, in cups and bowls	4	0	0	0.1	<LOQ	<LOQ
Noodles, instant, in plastic wrapping	3	0	0	0.1	<LOQ	<LOQ
Nuts, cashews	4	0	0	0.1	<LOQ	<LOQ
Oil, canola or sunflower oil	4	0	0	0.1	<LOQ	<LOQ
Oil, olive oil	4	0	0	0.1	<LOQ	<LOQ
Olives	4	1	0.28	0.35	<LOQ	1.1
Pasta	4	0	0	0.1	<LOQ	<LOQ
Peanut butter	4	0	0	0.1	<LOQ	<LOQ
Peas, frozen	4	0	0	0.1	<LOQ	<LOQ
Pizza, frozen from supermarket	4	0	0	0.1	<LOQ	<LOQ
Potato crisps, flavoured and unflavoured	4	0	0	0.1	<LOQ	<LOQ
Ready to eat meal, frozen from supermarket	4	0	0	0.1	<LOQ	<LOQ
Rice, single grain, uncooked	4	0	0	0.1	<LOQ	<LOQ
Sausages, beef	4	1	0.045	0.12	<LOQ	0.18
Shelf-stable peaches	4	0	0	0.1	<LOQ	<LOQ
Soft drink	4	0	0	0.1	<LOQ	<LOQ
Soup	4	0	0	0.1	<LOQ	<LOQ
Spreads, full fat, including butter and vegetable spreads	4	4	0.19	0.19	0.11	0.27
Spreads, reduced fat, including butter and vegetable spreads	4	1	0.030	0.11	<LOQ	0.12
Sugar, white	4	0	0	0.1	<LOQ	<LOQ
Sundried tomatoes	4	1	0.12	0.20	<LOQ	0.50
Tomato sauce	4	0	0	0.1	<LOQ	<LOQ
Tomatoes, canned	4	0	0	0.1	<LOQ	<LOQ
Tuna, canned	4	0	0	0.1	<LOQ	<LOQ
Yoghurt, full fat, flavoured and unflavoured	4	0	0	0.1	<LOQ	<LOQ
Yoghurt, low/reduced fat, flavoured and unflavoured	4	0	0	0.1	<LOQ	<LOQ

\* LOQ = 0.1 mg/kg

**Table A1 5: Analytical results for DEHP**

Food	No. of samples	No. of detections (>LOQ*)	Mean (<LOQ = 0)	Mean (<LOQ = LOQ)	Minimum	Maximum
Bacon, middle cut, rind on	4	1	0.038	0.11	<LOQ	0.15
Baked beans in tomato sauce	4	0	0	0.1	<LOQ	<LOQ
Beef mince and meat patties	4	1	0.030	0.11	<LOQ	0.12
Beef, steak, untrimmed	4	0	0	0.1	<LOQ	<LOQ
Beef/Chicken Takeaway	4	0	0	0.1	<LOQ	<LOQ
Biscuits, sweet and savoury	4	1	0.025	0.1	<LOQ	0.10
Bread, fancy, sweet and savoury	4	0	0	0.1	<LOQ	<LOQ
Bread, flat	4	1	0.038	0.11	<LOQ	0.15
Bread, white	4	0	0	0.1	<LOQ	<LOQ
Breakfast bars	4	0	0	0.1	<LOQ	<LOQ
Breakfast cereal, single and mixed grain	4	0	0	0.1	<LOQ	<LOQ
Cakes and muffins, iced	4	0	0	0.1	<LOQ	<LOQ
Cakes and muffins, uniced	4	2	0.088	0.14	<LOQ	0.20
Cheese, cream cheese, reduced fat	4	0	0	0.1	<LOQ	<LOQ
Cheese, cream cheese, regular fat	4	0	0	0.1	<LOQ	<LOQ
Cheese, processed, Cheddar (Tasty), reduced fat	4	0	0	0.1	<LOQ	<LOQ
Cheese, processed, Cheddar (Tasty), regular fat	4	0	0	0.1	<LOQ	<LOQ
Chicken products, battered or crumbed	4	1	0.038	0.11	<LOQ	0.15
Chicken products, battered or crumbed, from takeaway	3	0	0	0.1	<LOQ	<LOQ
Chicken, breast	4	1	0.03	0.11	<LOQ	0.12
Chocolate, plain milk chocolate	4	4	0.12	0.12	0.11	0.15
Coffee, instant	4	0	0	0.1	<LOQ	<LOQ
Confectionary, Soft candy	4	0	0	0.1	<LOQ	<LOQ
Corn chips	4	0	0	0.1	<LOQ	<LOQ
Cream, sour, full fat	4	0	0	0.1	<LOQ	<LOQ
Cream, thickened, reduced fat	4	0	0	0.1	<LOQ	<LOQ
Dip	4	1	0.14	0.21	<LOQ	0.55
Fish fillets, white fish, fresh	4	0	0	0.1	<LOQ	<LOQ
Fish portions, frozen (crumbed only) from supermarket	4	2	0.13	0.18	<LOQ	0.43
Hamburger, Beef	8	1	0.29	0.38	<LOQ	2.3
Ice cream, full fat	4	0	0	0.1	<LOQ	<LOQ
Infant dessert	4	0	0	0.1	<LOQ	<LOQ
Infant dinner	4	0	0	0.1	<LOQ	<LOQ
Infant formula, non soy-based	4	0	0	0.1	<LOQ	<LOQ
Infant formula, soy-based	4	0	0	0.1	<LOQ	<LOQ
Jam	4	0	0	0.1	<LOQ	<LOQ
Milk, fresh, full fat	4	0	0	0.1	<LOQ	<LOQ
Milk, fresh, reduced fat	4	0	0	0.1	<LOQ	<LOQ
Milk, UHT, full fat	4	0	0	0.1	<LOQ	<LOQ

Food	No. of samples	No. of detections (>LOQ*)	Mean (<LOQ = 0)	Mean (<LOQ = LOQ)	Minimum	Maximum
Noodles, instant, in cups and bowls	4	0	0	0.1	<LOQ	<LOQ
Noodles, instant, in plastic wrapping	3	0	0	0.1	<LOQ	<LOQ
Nuts, cashews	4	4	0.51	0.51	0.41	0.58
Oil, canola or sunflower oil	4	3	0.088	0.11	<LOQ	0.13
Oil, olive oil	4	4	1.4	1.4	0.62	2.0
Olives	4	2	0.082	0.13	<LOQ	0.20
Pasta	4	0	0	0.1	<LOQ	<LOQ
Peanut butter	4	4	0.31	0.31	0.22	0.46
Peas, frozen	4	1	0.042	0.12	<LOQ	0.17
Pizza, frozen from supermarket	4	3	0.15	0.18	<LOQ	0.31
Potato crisps, flavoured and unflavoured	4	0	0	0.1	<LOQ	<LOQ
Ready to eat meal, frozen from supermarket	4	1	0.035	0.11	<LOQ	0.14
Rice, single grain, uncooked	4	2	0.080	0.13	<LOQ	0.17
Sausages, beef	4	2	0.082	0.13	<LOQ	0.18
Shelf-stable peaches	4	0	0	0.1	<LOQ	<LOQ
Soft drink	4	0	0	0.1	<LOQ	<LOQ
Soup	4	2	0.085	0.14	<LOQ	0.20
Spreads, full fat, including butter and vegetable spreads	4	2	0.12	0.17	<LOQ	0.29
Spreads, reduced fat, including butter and vegetable spreads	4	1	0.068	0.14	<LOQ	0.27
Sugar, white	4	1	0.04	0.12	<LOQ	0.16
Sundried tomatoes	4	3	20	20	<LOQ	78
Tomato sauce	4	0	0	0.1	<LOQ	<LOQ
Tomatoes, canned	4	1	0.035	0.11	<LOQ	0.14
Tuna, canned	4	2	0.16	0.21	<LOQ	0.34
Yoghurt, full fat, flavoured and unflavoured	4	0	0	0.1	<LOQ	<LOQ
Yoghurt, low/reduced fat, flavoured and unflavoured	4	0	0	0.1	<LOQ	<LOQ

\* LOQ = 0.1 mg/kg



**Table A1 6: Analytical results for DIDP**

Food	No. of samples	No. of detections (>LOQ*)	Mean (<LOQ = 0)	Mean (<LOQ = LOQ)	Minimum	Maximum
Bacon, middle cut, rind on	4	0	0	0.5	<LOQ	<LOQ
Baked beans in tomato sauce	4	0	0	0.5	<LOQ	<LOQ
Beef mince and meat patties	4	0	0	0.5	<LOQ	<LOQ
Beef, steak, untrimmed	4	0	0	0.5	<LOQ	<LOQ
Beef/Chicken Takeaway	4	0	0	0.5	<LOQ	<LOQ
Biscuits, sweet and savoury	4	0	0	0.5	<LOQ	<LOQ
Bread, fancy, sweet and savoury	4	0	0	0.5	<LOQ	<LOQ
Bread, flat	4	0	0	0.5	<LOQ	<LOQ
Bread, white	4	0	0	0.5	<LOQ	<LOQ
Breakfast bars	4	0	0	0.5	<LOQ	<LOQ
Breakfast cereal, single and mixed grain	4	0	0	0.5	<LOQ	<LOQ
Cakes and muffins, iced	4	0	0	0.5	<LOQ	<LOQ
Cakes and muffins, uniced	4	0	0	0.5	<LOQ	<LOQ
Cheese, cream cheese, reduced fat	4	0	0	0.5	<LOQ	<LOQ
Cheese, cream cheese, regular fat	4	0	0	0.5	<LOQ	<LOQ
Cheese, processed, Cheddar (Tasty), reduced fat	4	0	0	0.5	<LOQ	<LOQ
Cheese, processed, Cheddar (Tasty), regular fat	4	0	0	0.5	<LOQ	<LOQ
Chicken products, battered or crumbed	4	0	0	0.5	<LOQ	<LOQ
Chicken products, battered or crumbed, from takeaway	3	0	0	0.5	<LOQ	<LOQ
Chicken, breast	4	0	0	0.5	<LOQ	<LOQ
Chocolate, plain milk chocolate	4	0	0	0.5	<LOQ	<LOQ
Coffee, instant	4	0	0	0.5	<LOQ	<LOQ
Confectionary, Soft candy	4	0	0	0.5	<LOQ	<LOQ
Corn chips	4	0	0	0.5	<LOQ	<LOQ
Cream, sour, full fat	4	0	0	0.5	<LOQ	<LOQ
Cream, thickened, reduced fat	4	0	0	0.5	<LOQ	<LOQ
Dip	4	0	0	0.5	<LOQ	<LOQ
Fish fillets, white fish, fresh	4	0	0	0.5	<LOQ	<LOQ
Fish portions, frozen (crumbed only) from supermarket	4	0	0	0.5	<LOQ	<LOQ
Hamburger, Beef	8	0	0	0.5	<LOQ	<LOQ
Ice cream, full fat	4	0	0	0.5	<LOQ	<LOQ
Infant dessert	4	0	0	0.5	<LOQ	<LOQ
Infant dinner	4	0	0	0.5	<LOQ	<LOQ
Infant formula, non soy-based	4	0	0	0.5	<LOQ	<LOQ
Infant formula, soy-based	4	0	0	0.5	<LOQ	<LOQ
Jam	4	0	0	0.5	<LOQ	<LOQ
Milk, fresh, full fat	4	0	0	0.5	<LOQ	<LOQ
Milk, fresh, reduced fat	4	0	0	0.5	<LOQ	<LOQ
Milk, UHT, full fat	4	0	0	0.5	<LOQ	<LOQ

Food	No. of samples	No. of detections (>LOQ*)	Mean (<LOQ = 0)	Mean (<LOQ = LOQ)	Minimum	Maximum
Noodles, instant, in cups and bowls	4	0	0	0.5	<LOQ	<LOQ
Noodles, instant, in plastic wrapping	3	0	0	0.5	<LOQ	<LOQ
Nuts, cashews	4	0	0	0.5	<LOQ	<LOQ
Oil, canola or sunflower oil	4	0	0	0.5	<LOQ	<LOQ
Oil, olive oil	4	1	0.18	0.56	<LOQ	0.74
Olives	4	0	0	0.5	<LOQ	<LOQ
Pasta	4	0	0	0.5	<LOQ	<LOQ
Peanut butter	4	0	0	0.5	<LOQ	<LOQ
Peas, frozen	4	0	0	0.5	<LOQ	<LOQ
Pizza, frozen from supermarket	4	0	0	0.5	<LOQ	<LOQ
Potato crisps, flavoured and unflavoured	4	0	0	0.5	<LOQ	<LOQ
Ready to eat meal, frozen from supermarket	4	0	0	0.5	<LOQ	<LOQ
Rice, single grain, uncooked	4	0	0	0.5	<LOQ	<LOQ
Sausages, beef	4	0	0	0.5	<LOQ	<LOQ
Shelf-stable peaches	4	0	0	0.5	<LOQ	<LOQ
Soft drink	4	0	0	0.5	<LOQ	<LOQ
Soup	4	0	0	0.5	<LOQ	<LOQ
Spreads, full fat, including butter and vegetable spreads	4	0	0	0.5	<LOQ	<LOQ
Spreads, reduced fat, including butter and vegetable spreads	4	0	0	0.5	<LOQ	<LOQ
Sugar, white	4	0	0	0.5	<LOQ	<LOQ
Sundried tomatoes	4	0	0	0.5	<LOQ	<LOQ
Tomato sauce	4	0	0	0.5	<LOQ	<LOQ
Tomatoes, canned	4	0	0	0.5	<LOQ	<LOQ
Tuna, canned	4	0	0	0.5	<LOQ	<LOQ
Yoghurt, full fat, flavoured and unflavoured	4	0	0	0.5	<LOQ	<LOQ
Yoghurt, low/reduced fat, flavoured and unflavoured	4	0	0	0.5	<LOQ	<LOQ

\* LOQ = 0.5 mg/kg

**Table A1 7: Analytical results for DINP**

Food	No. of samples	No. of detections (>LOQ*)	Mean (<LOQ = 0)	Mean (<LOQ = LOQ)	Minimum	Maximum
Bacon, middle cut, rind on	4	2	0.52	0.77	<LOQ	1.5
Baked beans in tomato sauce	4	0	0	0.5	<LOQ	<LOQ
Beef mince and meat patties	4	0	0	0.5	<LOQ	<LOQ
Beef, steak, untrimmed	4	0	0	0.5	<LOQ	<LOQ
Beef/Chicken Takeaway	4	1	0.18	0.55	<LOQ	0.70
Biscuits, sweet and savoury	4	0	0	0.5	<LOQ	<LOQ
Bread, fancy, sweet and savoury	4	0	0	0.5	<LOQ	<LOQ
Bread, flat	4	0	0	0.5	<LOQ	<LOQ
Bread, white	4	0	0	0.5	<LOQ	<LOQ
Breakfast bars	4	1	0.40	0.78	<LOQ	1.6
Breakfast cereal, single and mixed grain	4	0	0	0.5	<LOQ	<LOQ
Cakes and muffins, iced	4	0	0	0.5	<LOQ	<LOQ
Cakes and muffins, uniced	4	1	0.17	0.55	<LOQ	0.69
Cheese, cream cheese, reduced fat	4	0	0	0.5	<LOQ	<LOQ
Cheese, cream cheese, regular fat	4	0	0	0.5	<LOQ	<LOQ
Cheese, processed, Cheddar (Tasty), reduced fat	4	0	0	0.5	<LOQ	<LOQ
Cheese, processed, Cheddar (Tasty), regular fat	4	0	0	0.5	<LOQ	<LOQ
Chicken products, battered or crumbed	4	0	0	0.5	<LOQ	<LOQ
Chicken products, battered or crumbed, from takeaway	3	1	0.50	0.83	<LOQ	1.5
Chicken, breast	4	0	0	0.5	<LOQ	<LOQ
Chocolate, plain milk chocolate	4	0	0	0.5	<LOQ	<LOQ
Coffee, instant	4	0	0	0.5	<LOQ	<LOQ
Confectionary, Soft candy	4	0	0	0.5	<LOQ	<LOQ
Corn chips	4	0	0	0.5	<LOQ	<LOQ
Cream, sour, full fat	4	0	0	0.5	<LOQ	<LOQ
Cream, thickened, reduced fat	4	0	0	0.5	<LOQ	<LOQ
Dip	4	0	0	0.5	<LOQ	<LOQ
Fish fillets, white fish, fresh	4	0	0	0.5	<LOQ	<LOQ
Fish portions, frozen (crumbed only) from supermarket	4	0	0	0.5	<LOQ	<LOQ
Hamburger, Beef	8	5	5.7	5.9	<LOQ	13
Ice cream, full fat	4	0	0	0.5	<LOQ	<LOQ
Infant dessert	4	0	0	0.5	<LOQ	<LOQ
Infant dinner	4	0	0	0.5	<LOQ	<LOQ
Infant formula, non soy-based	4	1	0.16	0.54	<LOQ	0.66
Infant formula, soy-based	4	0	0	0.5	<LOQ	<LOQ
Jam	4	0	0	0.5	<LOQ	<LOQ
Milk, fresh, full fat	4	0	0	0.5	<LOQ	<LOQ
Milk, fresh, reduced fat	4	0	0	0.5	<LOQ	<LOQ
Milk, UHT, full fat	4	0	0	0.5	<LOQ	<LOQ

Food	No. of samples	No. of detections (>LOQ*)	Mean (<LOQ = 0)	Mean (<LOQ = LOQ)	Minimum	Maximum
Noodles, instant, in cups and bowls	4	0	0	0.5	<LOQ	<LOQ
Noodles, instant, in plastic wrapping	3	0	0	0.5	<LOQ	<LOQ
Nuts, cashews	4	0	0	0.5	<LOQ	<LOQ
Oil, canola or sunflower oil	4	0	0	0.5	<LOQ	<LOQ
Oil, olive oil	4	3	0.90	1.0	<LOQ	1.3
Olives	4	1	0.12	0.50	<LOQ	0.50
Pasta	4	0	0	0.5	<LOQ	<LOQ
Peanut butter	4	0	0	0.5	<LOQ	<LOQ
Peas, frozen	4	0	0	0.5	<LOQ	<LOQ
Pizza, frozen from supermarket	4	3	0.68	0.80	<LOQ	1.1
Potato crisps, flavoured and unflavoured	4	0	0	0.5	<LOQ	<LOQ
Ready to eat meal, frozen from supermarket	4	0	0	0.5	<LOQ	<LOQ
Rice, single grain, uncooked	4	0	0	0.5	<LOQ	<LOQ
Sausages, beef	4	0	0	0.5	<LOQ	<LOQ
Shelf-stable peaches	4	0	0	0.5	<LOQ	<LOQ
Soft drink	4	0	0	0.5	<LOQ	<LOQ
Soup	4	0	0	0.5	<LOQ	<LOQ
Spreads, full fat, including butter and vegetable spreads	4	0	0	0.5	<LOQ	<LOQ
Spreads, reduced fat, including butter and vegetable spreads	4	0	0	0.5	<LOQ	<LOQ
Sugar, white	4	0	0	0.5	<LOQ	<LOQ
Sundried tomatoes	4	1	0.38	0.75	<LOQ	1.5
Tomato sauce	4	0	0	0.5	<LOQ	<LOQ
Tomatoes, canned	4	0	0	0.5	<LOQ	<LOQ
Tuna, canned	4	0	0	0.5	<LOQ	<LOQ
Yoghurt, full fat, flavoured and unflavoured	4	0	0	0.5	<LOQ	<LOQ
Yoghurt, low/reduced fat, flavoured and unflavoured	4	0	0	0.5	<LOQ	<LOQ

\* LOQ = 0.5 mg/kg

## Appendix 2: Estimating dietary exposures for the Plasticisers Survey

### How the dietary modelling was conducted

A dietary exposure assessment is the process of estimating how much of a food chemical a population, or population sub group, consumes. Dietary exposure to food chemicals is estimated by combining food consumption data with food chemical concentration data (see Equation A2 1). The process of doing this is called 'dietary modelling'.

#### **Equation A2 1: Dietary exposure calculation**

$$\text{Dietary exposure} = \Sigma(\text{food chemical concentration} \times \text{food consumption})$$

FSANZ's approach to dietary modelling is based on internationally accepted procedures for estimating dietary exposure to food chemicals. Different dietary modelling approaches may be used depending on the assessment, the type of food chemical, the data available and the risk assessment questions to be answered.

For the Plasticisers Survey, dietary modelling was conducted using FSANZ's custom developed computer program Harvest, which was designed to automate dietary exposure calculations. Harvest multiplied the chemical concentration for each food consumed in the national nutrition survey with the amount of that food that each survey respondent consumed to estimate each individual's exposure to that chemical from each food. Once this had been completed for all foods determined as containing a particular chemical, the total amount of the chemical consumed from all foods was summed for each individual. Population statistics (e.g. mean and 90<sup>th</sup> percentile exposures) for each age group were derived from the individuals' ranked exposures. Where the results are expressed on a bodyweight basis, each individual's exposure from all foods was divided by their own bodyweight before population summary statistics were derived.

The use of Harvest for dietary modelling brings many benefits. Harvest enables the dietary exposure assessments to be conducted using actual diets, as recorded in national nutrition surveys, in place of the 'average' diets which were used prior to the 19<sup>th</sup> ATDS. The use of specific food consumption data greatly improves the reliability and accuracy of the dietary exposure estimates and takes account of the different eating patterns of consumers.

Once dietary exposure to the chemical from the total diet had been estimated, this is compared to relevant HBGVs to assess the potential risk to human health.

Further detailed information on conducting dietary exposure assessments at FSANZ is provided in *Principles and Practices of Dietary Exposure Assessment for Food Regulatory Purposes* (FSANZ 2009), available at:

[http://www.foodstandards.gov.au/science/exposure/documents/Principles%20 %20practices %20exposure%20assessment%202009.pdf](http://www.foodstandards.gov.au/science/exposure/documents/Principles%20%20practices%20exposure%20assessment%202009.pdf)

### Number of respondents in each of the population groups assessed

A range of population groups were assessed including infants, children and adults. *Table A2.1* shows the number of individuals in each age group assessed.

**Table A2.1: Number of respondents and mean bodyweight for each age group assessed**

Age group	No. of respondents (2 day average)	Mean bodyweight (kg)
9 months		8.9
2-5 years*	398	18
6-12 years*	715	36
13-16 years*	419	60
17 years & above*	6203	78

\* derived using the 2011–12 Australian National Nutrition and Physical Activity Survey

Dietary exposure assessments were conducted for infants and children as separate groups as they generally have higher exposures because they consume more food on a kilogram body weight basis compared to adults.

## Food consumption data

The 2011–12 Australian National Nutrition and Physical Activity Survey (NNPAS) undertaken by the Australian Bureau of Statistics is the most recent food consumption data for Australia. This survey includes dietary patterns of a sample of 12,153 Australians aged from 2 years and above. The survey used a 24-hour recall method for all respondents, with 64% of respondents also completing a second 24-hour recall on a second, non-consecutive day. The data were collected from May 2011 to June 2012 (with no enumeration between August and September 2011 due to the Census). Day 1 and Day 2 24-hour recall data for respondents were used for this assessment. There were 7735 respondents with two days of data, and these were averaged for estimating dietary exposure for this assessment. A separate set of sample weights are used for the 7735 respondents with two days of data to ensure that when using this subset, they are representative of the Australian population. Consumption and respondent data from the survey were incorporated into the Harvest program from the Confidentialised Unit Record Files (CURF) data set (ABS 2014).

As no food consumption data from the NNPAS were available for children under two years of age, a model diet was constructed to enable dietary exposure to be assessed for infants.

## Construction of the model diet for 9 month old infants

By the age of 9 months, most infants will be consuming a mixed diet and will be exposed to food chemicals from a range of foods in addition to human breast milk and/or infant formula. To enable food chemical exposures for 9 month old infants to be estimated a model diet was constructed. The model diet was based on recommended energy intakes, mean bodyweight, the proportion of milk and solid foods in the diet for a 9 month old infant and 2011-12 NNPAS data on foods consumed by a two year old child. The recommended energy intake for a 9 month old boy (FAO 2004) at the 50<sup>th</sup> percentile weight (WHO 2006) (2936 kJ/day) was used as the basis for the model diet. Boys' weights were used as boys tend to be heavier than girls at the same age and therefore have higher energy and food requirements. The bodyweight of a 50<sup>th</sup> percentile 9 month old boy was 8.9 kg.

It was assumed that 50% of energy intake was derived from infant formula and 50% from solids and other fluids (Hitchcock et al. 1986). The patterns of consumption of a two year old child from the 2011-12 NNPAS survey were scaled down and used to determine the 50% solid and other fluids portion of the 9 month old infant's diet. As two year olds consume many foods that are not appropriate for infants, these foods need to be taken out of the infant diet and the energy intake from those foods attributed to the remaining foods. Certain foods such

as nuts and coffee were removed from the diet since nuts are not recommended for infants because of choking risk (NHMRC 2012) and coffee is unsuitable for infant consumption (ACT Community Care 2000). Bran is not recommended in the diet of infants due to the potential interference with the absorption of minerals (The Children's Hospital at Westmead 2008) and to the immaturity of the infant gut (H.J Heinz 2010a). For this reason, consumption of breakfast cereals is usually assumed to be in the form of either infant cereal or single grain breakfast cereals. As no infant specific cereal was sampled for this survey, consumption of mixed grain cereals could not be substituted to it. Furthermore, as the packing type was similar and the survey's focus was on migrating chemicals from packaging, mixed grain breakfast cereals were not excluded from the model infant diet. Since cow's milk is not recommended as the main milk source for children aged less than 12 months of age (NHMRC 2012; H.J Heinz 2010b), all milk consumption was assumed to be in the form of infant formula.

As the model diet is based on mean food consumption amounts only for all nutrition survey respondents, a distribution of food consumption was not available and hence, a distribution of food chemical exposures was not able to be produced. Therefore, the 90<sup>th</sup> percentile dietary exposures were estimated using the calculation shown in Equation A2 2 below. Exposures were then compared to the HBGVs where relevant.

**Equation A2 2: 90th percentile dietary exposure calculation for the 9 month old infant model diet**

Dietary exposure = $\Sigma$ (food chemical concentration x food
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\* (WHO 1985)

## Respondents versus consumers

Estimates of dietary exposure can be calculated for all survey respondents or only for those who reported consuming a food containing the chemical on the day of the survey ('consumers'). This study reports exposure estimates for 'consumers' for the population aged 2 years and above. The model diet for infants is on an 'all respondent' basis therefore dietary exposures are for respondents.

The plasticisers investigated in this study are distributed across a wide range of foods and are frequently consumed by all members of the population.

The number and proportion of consumers in each age group is provided in Table A4.1.

## Food chemical concentrations for dietary exposure estimates

As a number of composite samples were analysed for each food in the survey, the median concentrations of each of the plasticisers for each of the foods sampled was derived and used in the dietary exposure assessment, with the exception of hamburgers and instant noodles. In these cases, the concentrations of the two different types of hamburgers (Brand A only and other fast food chain hamburgers) were analysed and reported separately because a small survey limited to hamburgers previously undertaken by FSANZ had identified one brand as having higher levels of phthalates than other brands. Concentrations for the two instant noodle types analysed (packaged in cups/bowls and plastic wrapping) were also reported separately.

For the purposes of dietary exposure estimates a median concentration was derived for all hamburgers and for all noodles, as food consumption data for each of the types of these foods could not be sufficiently differentiated by brand or packaging type (see food mapping section for further details). In some case, where more than 50% results were non-detects for

a given food, the median concentration for modelling purposes was a non-detect, whereas the mean concentration may have a numerical value.

The median concentration in an analysed food was also carried over to all of the mixed foods in which it was used as an ingredient based on FSANZs recipe dataset for mixed foods.

## **Treatment of analytical values below the Limit of Reporting (LOR)**

Some analytical results for some samples were 'not detected', or in other words, were below the LOR for the analytical method. In order to take account of these samples in the dietary exposure assessment, a numerical concentration value must be assigned to these samples. Assumptions were made about the concentration of the plasticisers in food samples where the analytical results were below the LOR or where there were no detects. In the case of contaminants that occur naturally in the environment, it is not reasonable to assume that the contaminant is not present in the food when the analytical concentrations are less than the LOR. In the case of the plasticisers assessed, the LOR was reported as equal to the LOD. Actual concentrations below the LOR could in reality be anywhere between zero and the LOR. To allow for this uncertainty, the results for dietary exposure to plasticisers were presented as a range. The lower end of the range is calculated based on the assumption that results below the LOR are equal to zero. The upper end of the range, representing a very conservative 'worst-case' estimate, is calculated on the assumption that results below the LOR are equal to the LOR.

## **Food mapping**

Mapping is the process of matching the foods analysed in the Plasticisers survey to the foods consumed in the national nutrition survey. Given that the Plasticisers survey could not survey all foods consumed in the national nutrition survey, mapping is a major step in the dietary exposure assessment process. In the 2011-12 NNPAS, foods were typically not reported with details of their packaging type, with the exception of some canned food. Therefore, in the Plasticisers survey, it was not possible to directly map analysed foods to similar foods that also had the same type of packaging. For this survey, the mapping was based on the food additive classification system used in Standard 1.3.1 in the Code. This classification system is used by FSANZ for other food additive dietary exposure assessments as food additives are specifically added to foods during processing and are therefore usually in a restricted range of processed foods and beverages. As the foods analysed for plasticisers matched closely with the food groups in this classification system, using the food additive classifications was deemed the most appropriate for estimating plasticiser dietary exposures. Due to the lack of data on packaging type in the 2011-12 NNPAS, Plasticiser survey foods which were sampled in two different packing types, (i.e. instant noodles and hamburgers), were unable to be differentiated in the mapping process so were included in the same food group for the dietary exposure assessment.

There were three types of mapping used for plasticiser dietary exposure estimates:

1. Direct mapping – where the Plasticiser survey foods were directly matched to a corresponding Food Additive Classification which contained the analysed food and comparable foods with similar packaging type, from the 2011-12 NNPAS (e.g. the Plasticiser survey food '*Bacon, middle cut, rind on*', was mapped to '*Cured meat*' and '*Fermented, uncooked, processed comminute meat products*' using the assumption that any migrating chemicals from packaging present in bacon are the same in all cured and fermented meats with similar packaging).
2. Mapping using custom classifications – where a Plasticiser survey food could not be directly mapped to a suitable Food Additive Classification, a customised classification group was developed and the appropriate 2011-12 NNPAS foods assigned to the



classification (e.g. the classification '*Canned legumes*' was created and all the 2011-12 NNPAS canned legumes such as '*Bean, cannellini, canned, drained*' and '*Chickpea, canned, drained*' were allocated to this new classification group).

3. Recipes – used where a food consumed in the 2011-12 NNPAS was composed of more than one analysed survey food (e.g. the 2011-12 NNPAS food '*Curry, commercial, beef, tomato based sauce*' is made up of the survey foods '*Beef, steak, untrimmed*', '*tomatoes, canned*' and '*Oil, Canola oil or sunflower oil*'). These mixed foods were not mapped directly but a recipe is used to disaggregate the consumption to the relevant components.

Details of the Plasticiser survey foods and the 2011-12 NNPAS foods that they represent, and the group name used for reporting purposes are provided in Appendix 6.

## Food contribution calculations

To obtain an indication of the contribution each food group made to total estimated exposures, the sum of all individuals' two day average exposures from one food group was divided by the sum of all individuals' two day average exposures from all foods containing the plasticisers assessed, and multiplied by 100. All contributors are calculated using the lower bound ND=0 scenario. In this scenario, for individual foods where more than 50% results were non-detects, a median concentration of zero was assigned so the food would not be listed as a contributor to estimated total dietary exposure.

There is no direct association between the analytical concentration of a phthalate, adipate or citrate in an analysed food and its identification as a major contributor to dietary exposure. Even if a food contains a relatively high concentration of a particular plasticiser, the amount of the food consumed, the mapping process and the number of individuals that were exposed to the plasticiser, will determine its level of contribution.

## Assumptions and limitations in dietary modelling

The aim of dietary exposure assessments is to make as realistic an estimate of dietary exposure to the food chemicals of interest as possible.

Dietary exposure assessments based on the 2011-12 NNPAS provide the best available estimates of actual consumption of foods in Australia and the resulting estimated dietary exposure to a food chemical for the population. Nevertheless, limitations still exist in dietary exposure assessment methods as well as in the data. Limitations relating to the food consumption and chemical concentration data include:

- Diets derived from one or two 24-hour food recall surveys are used as the basis for drawing conclusions on lifetime eating patterns. This normally leads to conservative dietary exposure assessments, particularly where exposure arises from the consumption of non-habitually eaten foods.
- Participants in 24-hour food recalls may over- or under- report food consumption, particularly for certain types of foods.
- The model diet used for 9 month old infants is not as specific as the data derived for other population groups from the 2011-12 NNPAS that use reports of food consumption data of individuals because the model diet includes only mean consumption amounts for the population group as a whole.
- The list of analysed foods is only a sample of the foods consumed by the population and may not accurately represent the whole diet.

- Only a small number of samples of each food was collected and analysed. These samples were then used to represent the whole range of that food or similar foods, therefore limiting the potential range of variability in concentrations captured.
- Assumptions made in the dietary exposure assessment for the Targeted Survey of Plasticisers in Australian Foods include:
  - The food chemical concentration in the analysed food was representative of the concentration of that chemical in all of the other foods to which it was mapped.
  - No contribution to dietary exposures was included for medicines or vitamin and mineral supplements.

## Appendix 3: Median plasticiser concentrations (mg/kg) in foods for dietary exposure assessment

**Table A3.1: Median plasticiser concentrations in analysed survey foods expressed in mg/kg**

Food	DEHP mg/kg		DINP mg/kg		DIDP mg/kg		DEHA mg/kg		DBP mg/kg		BBP mg/kg		ATBC mg/kg	
	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD
Bacon, middle cut, rind on	0.048	0.064	0.45	0.45	0	0.17	0	0.03	0	0.03	0	0.03	0.12	0.14
Baked beans in tomato sauce	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0.08	0.08
Beef mince and meat patties	0	0.03	0	0.17	0	0.17	0.02	0.035	0	0.03	0	0.03	0.075	0.09
Beef, steak, untrimmed	0	0.03	0	0.17	0	0.17	2.4	2.4	0	0.03	0	0.03	0	0.03
Beef/Chicken Takeaway	0.015	0.03	0.12	0.20	0	0.17	0.19	0.19	0	0.03	0	0.03	0	0.03
Biscuits, sweet and savoury	0.075	0.075	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0.16	0.16
Bread, fancy, sweet and savoury	0.06	0.06	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0.21	0.21
Bread, flat	0.045	0.06	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0.25	0.25
Bread, white	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0.15	0.15
Breakfast bars	0.075	0.075	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0.74	0.74
Breakfast cereal, single and mixed grain	0.04	0.04	0	0.17	0	0.17	0	0.03	0.05	0.05	0	0.03	0	0.03
Cakes and muffins, iced	0.075	0.075	0.28	0.28	0	0.17	0.02	0.035	0	0.03	0	0.03	0.035	0.05

Food	DEHP mg/kg		DINP mg/kg		DIDP mg/kg		DEHA mg/kg		DBP mg/kg		BBP mg/kg		ATBC mg/kg	
	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD
Cakes and muffins, uniced	0.12	0.12	0.12	0.20	0	0.17	0.02	0.035	0	0.03	0	0.03	0.045	0.045
Cheese, cream cheese, reduced fat	0	0.03	0	0.17	0	0.17	0.08	0.08	0	0.03	0	0.03	0	0.03
Cheese, cream cheese, regular fat	0.015	0.03	0	0.17	0	0.17	0.18	0.18	0	0.03	0	0.03	0	0.03
Cheese, processed, Cheddar (Tasty), reduced fat	0.055	0.055	0	0.17	0	0.17	0.16	0.16	0	0.03	0	0.03	0.97	0.97
Cheese, processed, Cheddar (Tasty), regular fat	0.02	0.035	0.12	0.21	0	0.17	0.23	0.23	0	0.03	0	0.03	0.66	0.66
Chicken products, battered or crumbed	0.08	0.08	0.24	0.24	0	0.17	0	0.03	0	0.03	0	0.03	0.09	0.1
Chicken products, battered or crumbed, from takeaway	0.04	0.04	0.38	0.38	0	0.17	0	0.03	0	0.03	0	0.03	0.07	0.07
Chicken, breast	0	0.03	0.095	0.18	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03
Chocolate, plain milk chocolate	0.12	0.12	0	0.17	0	0.17	0.05	0.05	0	0.03	0	0.03	0	0.03
Coffee, instant	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03
Confectionary, Soft candy	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0.02	0.035
Corn chips	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0.05	0.05
Cream, sour, full fat	0	0.03	0	0.17	0	0.17	0.23	0.23	0	0.03	0	0.03	0	0.03
Cream, thickened, reduced fat	0	0.03	0	0.17	0	0.17	0.094	0.094	0	0.03	0	0.03	0	0.03

Food	DEHP mg/kg		DINP mg/kg		DIDP mg/kg		DEHA mg/kg		DBP mg/kg		BBP mg/kg		ATBC mg/kg	
	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD
Dip	0.04	0.04	0	0.17	0	0.17	0.07	0.07	0	0.03	0	0.03	0	0.03
Fish fillets, white fish, fresh	0	0.03	0.085	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0.065	0.065
Fish portions, frozen (crumbed only) from supermarket	0.095	0.095	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0.09	0.09
Hamburger, Beef	0.015	0.03	4.8	4.8	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03
<i>Hamburger (Brand A)</i>	<i>0.035</i>	<i>0.035</i>	<i>11</i>	<i>11</i>	<i>0</i>	<i>0.17</i>	<i>0</i>	<i>0.03</i>	<i>0</i>	<i>0.03</i>	<i>0</i>	<i>0.03</i>	<i>0</i>	<i>0.03</i>
<i>Hamburger (other)</i>	<i>0</i>	<i>0.03</i>	<i>0.1</i>	<i>0.18</i>	<i>0</i>	<i>0.17</i>	<i>0</i>	<i>0.03</i>	<i>0</i>	<i>0.03</i>	<i>0</i>	<i>0.03</i>	<i>0</i>	<i>0.03</i>
Ice cream, full fat	0.04	0.04	0	0.17	0	0.17	0.098	0.098	0	0.03	0	0.03	0	0.03
Infant dessert	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03
Infant dinner	0.03	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03
Infant formula, non soy-based	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03
Infant formula, soy-based	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03
Jam	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03
Milk, fresh, full fat	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03
Milk, fresh, reduced fat	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03

Food	DEHP mg/kg		DINP mg/kg		DIDP mg/kg		DEHA mg/kg		DBP mg/kg		BBP mg/kg		ATBC mg/kg	
	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD
Milk, UHT, full fat	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03
Noodles, instant	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03
Nuts, cashews	0.52	0.52	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0.025	0.04
Oil, canola or sunflower oil	0.11	0.11	0.32	0.32	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03
Oil, olive oil	1.4	1.4	1.2	1.2	0.21	0.30	0.04	0.04	0	0.03	0.025	0.04	0	0.03
Olives	0.11	0.11	0.38	0.38	0	0.17	0.02	0.035	0	0.03	0	0.03	8.7	8.7
Pasta	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03
Peanut butter	0.28	0.28	0	0.17	0	0.17	0	0.03	0	0.03	0.02	0.035	0	0.03
Peas, frozen	0.08	0.08	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0.085	0.085
Pizza, frozen from supermarket	0.14	0.14	0.8	0.8	0	0.17	0.015	0.03	0	0.03	0	0.03	0	0.03
Potato crisps, flavoured and unflavoured	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0.09	0.09
Ready to eat meal, frozen from supermarket	0.045	0.045	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03
Rice, single grain, uncooked	0.09	0.09	0	0.17	0	0.17	0.015	0.03	0	0.03	0	0.03	0	0.03
Sausages, beef	0.075	0.09	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0.035	0.05

Food	DEHP mg/kg		DINP mg/kg		DIDP mg/kg		DEHA mg/kg		DBP mg/kg		BBP mg/kg		ATBC mg/kg	
	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD
Shelf-stable peaches	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03
Soft drink	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03
Soup	0.07	0.085	0	0.17	0	0.17	0.02	0.035	0	0.03	0	0.03	0.02	0.035
Spreads, full fat, including butter and vegetable spreads	0.14	0.14	0.1	0.19	0	0.17	0.18	0.18	0	0.03	0	0.03	0	0.03
Spreads, reduced fat, including butter and vegetable spreads	0.035	0.035	0.085	0.17	0	0.17	0.09	0.09	0	0.03	0	0.03	0	0.03
Sugar, white	0.02	0.035	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0.38	0.38
Sundried tomatoes	0.68	0.68	0.21	0.3	0	0.17	0.035	0.035	0	0.03	0	0.03	9.0	9.0
Tomato sauce	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03
Tomatoes, canned	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03
Tuna, canned	0.2	0.2	0.09	0.18	0	0.17	0	0.03	0	0.03	0	0.03	0.38	0.38
Yoghurt, full fat, flavoured and unflavoured	0	0.03	0	0.17	0	0.17	0.015	0.03	0	0.03	0	0.03	0	0.03
Yoghurt, low/reduced fat, flavoured and unflavoured	0	0.03	0	0.17	0	0.17	0	0.03	0	0.03	0	0.03	0	0.03

## Appendix 4: Estimated dietary exposures to plasticisers

Table A4 1: Estimated dietary exposures to plasticisers at the mean and 90th percentile, derived using median concentrations

Plasticiser	Age Group	Number of consumers <sup>†*</sup>	% consum. to respond.*	Estimated dietary exposures to plasticisers <sup>‡</sup> <sup>ψ</sup>											
				Mean						90 <sup>th</sup> percentile					
				µg/day		µg/kg bw/day		% of TDI		µg/day		µg/kg bw/day		% of TDI	
				ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD
DEHP	9 months <sup>‡</sup>			5	24	<1	2.7	1	5	10	49	1.1	5.5	2	10
	2-5 years <sup>^</sup>	398	100.0	17	36	1.0	2.1	2	4	31	53	1.8	3.2	4	6
	6-12 years <sup>^</sup>	715	100.0	25	47	<1	1.4	2	3	41	67	1.3	2.3	3	5
	13-16 years <sup>^</sup>	419	100.0	26	53	<1	<1	<1	2	47	84	<1	1.4	2	3
	17 years & above <sup>^</sup>	6201	100.0	29	60	<1	<1	<1	2	53	93	<1	1.3	1	3
DINP	9 months <sup>‡</sup>			17	134	1.9	15.0	1	10	33	267	3.8	30.1	3	20
	2-5 years <sup>^</sup>	396	99.7	55	180	3.2	10.6	2	7	88	257	4.5	16.3	3	10
	6-12 years <sup>^</sup>	715	100.0	89	242	2.7	7.3	2	5	215	424	6.8	12.7	5	8
	13-16 years <sup>^</sup>	419	100.0	118	299	2.0	5.2	1	3	464	629	7.7	11.3	5	8
	17 years & above <sup>^</sup>	6174	99.5	99	305	1.3	4.1	<1	3	227	531	2.9	7.1	2	5
DIDP	9 months <sup>‡</sup>			0.03	122	0.004	13.7	<1	9	0.06	244	0.007	27.4	<1	20
	2-5 years <sup>^</sup>	95	23.8	0.79	145	0.044	8.5	<1	6	1.28	209	0.067	12.9	<1	9
	6-12 years <sup>^</sup>	161	22.5	1.01	177	0.030	5.4	<1	4	1.93	266	0.058	8.8	<1	6
	13-16 years <sup>^</sup>	79	18.9	0.90	210	0.035	5.9	<1	2	2.06	320	0.035	5.9	<1	4
	17 years & above <sup>^</sup>	1577	25.4	1.16	233	0.015	3.1	<1	2	2.42	361	0.033	4.9	<1	3
DEHA	9 months <sup>‡</sup>			21	41	2.4	4.6	<1	2	42	81	4.7	9.1	2	3
	2-5 years <sup>^</sup>	398	100.0	66	85	3.9	5.0	1	2	161	171	10.0	11.4	3	4
	6-12 years <sup>^</sup>	715	100.0	87	111	2.6	3.3	<1	1	231	258	6.4	6.9	2	2
	13-16 years <sup>^</sup>	417	99.4	124	152	2.1	2.6	<1	<1	284	309	5.1	5.7	2	2
	17 years & above <sup>^</sup>	6182	99.7	153	185	2.0	2.4	<1	<1	386	415	5.1	5.5	2	2



Plasticiser	Age Group	Number of consumers <sup>†*</sup>	% consum. to respond.*	Estimated dietary exposures to plasticisers <sup>‡</sup> <sup>§</sup>											
				Mean						90 <sup>th</sup> percentile					
				µg/day		µg/kg bw/day		% of TDI		µg/day		µg/kg bw/day		% of TDI	
				ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD
DBP	9 months <sup>¶</sup>			0.56	22	<1	2.4	<1	25	1.1	44	<1	4.9	1	50
	2-5 years <sup>^</sup>	310	77.9	2.0	26	<1	1.5	1	15	4.3	38	<1	2.3	3	25
	6-12 years <sup>^</sup>	502	70.2	2.7	32	<1	<1	<1	10	4.9	48	<1	1.6	2	15
	13-16 years <sup>^</sup>	228	54.4	3.3	38	<1	<1	<1	7	7.9	58	<1	1.0	1	10
	17 years & above <sup>^</sup>	3479	56.1	4.5	42	<1	<1	<1	6	12	65	<1	<1	1	9
BBP	9 months <sup>¶</sup>			0.02	22	0.002	2.4	<1	<1	0.04	43	0.004	4.8	<1	1
	2-5 years <sup>^</sup>	135	33.9	0.11	26	0.006	1.5	<1	<1	0.21	37	0.013	2.3	<1	<1
	6-12 years <sup>^</sup>	227	31.7	0.16	31	0.005	<1	<1	<1	0.34	47	0.011	1.6	<1	<1
	13-16 years <sup>^</sup>	116	27.5	0.16	37	0.003	<1	<1	<1	0.50	56	0.008	1.0	<1	<1
	17 years & above <sup>^</sup>	2000	32.2	0.16	41	0.002	<1	<1	<1	0.35	64	0.005	<1	<1	<1
ATBC	9 months <sup>¶</sup>			28	47	3.1	5.3	<1	<1	56	95	6.2	10.6	<1	1
	2-5 years <sup>^</sup>	398	100.0	95	113	5.6	6.6	<1	<1	208	223	12.2	13.4	1	1
	6-12 years <sup>^</sup>	713	99.7	96	118	2.8	3.5	<1	<1	200	228	6.2	7.3	<1	<1
	13-16 years <sup>^</sup>	419	99.8	102	129	1.8	2.3	<1	<1	246	280	4.1	4.7	<1	<1
	17 years & above <sup>^</sup>	6191	99.8	99	132	1.3	1.7	<1	<1	226	262	3.0	3.4	<1	<1

<sup>†</sup> Number of Respondents for each age group were 2-5 years = 398, 6-12 years = 715, 13-16 years = 419 and 17 years & above = 6,203.

\* Derived using median lower bound concentrations.

<sup>‡</sup> Derived using median analytical concentration.

<sup>§</sup> Exposures for 9 month olds are on an all respondent basis and ages 2 and above are for consumers only of the plasticiser.

<sup>¶</sup> Derived using a model diet.

<sup>^</sup> Derived using the Australian 2011-12 NNPAS (2 day average exposure).

**Table A4 2: Estimated dietary exposures to DINP at the mean and 90th percentile for Brand-Loyal Hamburger Scenario, derived using median DINP concentration for Brand A Hamburgers**

Age Group	Number of consumers <sup>†*</sup>	% consum. to respond.*	Estimated dietary exposures to DINP <sup>φ</sup>											
			Mean						90 <sup>th</sup> percentile					
			µg/day		µg/kg bw/day		% of TDI		µg/day		µg/kg bw/day		% of TDI	
			ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD	ND=0	ND=LOD
9 months <sup>φ</sup>			28	145	3.1	16.3	2	10	56	290	6.2	32.5	4	20
2-5 years <sup>^</sup>	396	99.7	86	211	5.0	12.4	3	8	88	278	4.8	16.9	3	10
6-12 years <sup>^</sup>	715	100.0	149	302	4.5	9.1	3	6	215	614	7.1	15.8	5	10
13-16 years <sup>^</sup>	419	100.0	209	390	3.6	6.8	2	5	978	1,197	16.9	19.5	10	15
17 years & above <sup>^</sup>	6174	99.5	172	377	2.3	5.0	2	3	238	592	3.1	8.3	2	6

<sup>†</sup> Number of respondents for each age group were 2-5 years = 398, 6-12 years = 715, 13-16 years = 419 and 17 years & above = 6,203.

\* Derived using medium lower bound concentrations.

φ Derived using median analytical concentration.

φ Derived using a model diet.

^ Derived using the Australian 2011-12 NNPAS (2 day average exposure).

~ Brand Loyal Hamburger Scenario based on Brand A Hamburgers median analytical concentration value of 11 mg/kg for DINP.

## Appendix 5: Major food contributors to plasticiser dietary exposures, derived using median concentrations

Table A5 1: Contributors to DEHP dietary exposures

Major food category	Food group represented	Percentage contribution (%)				
		9 months <sup>u</sup>	2-5 years <sup>^</sup>	6-12 years <sup>^</sup>	13-16 years <sup>^</sup>	17 years & above <sup>^</sup>
<b>Beverages</b>	<b>All beverages</b>	0	0	0	0	0
<b>Cereals and cereal products</b>	<b>All cereals and cereal products</b>	39	38	38	39	32
	Breakfast cereal, single and mixed grain	9	7	6	6	7
	Cakes and muffins with icing or filling	2	3	4	3	2
	Cakes and muffins without icing	2	2	2	2	1
	Cereal bars	2	1	2	2	<1
	Commercial biscuits and crackers	6	6	6	5	2
	Flat breads, tortillas and pizza bases	1	<1	<1	<1	<1
	Rice and rice products	15	17	17	20	18
	Sweet and savoury fancy breads	<1	<1	<1	<1	<1
<b>Condiments</b>	<b>All condiments</b>	2	2	3	3	4
	Canned and dry-mix soups	2	1	3	3	4
	Dips	<1	<1	<1	<1	<1
<b>Dairy Products</b>	<b>All dairy products</b>	16	16	12	11	9
	Frozen dairy based desserts	2	2	4	3	1
	Ripened cheeses, reduced fat	2	<1	1	<1	1
	Ripened cheeses, regular fat	12	12	7	7	6
	Unripened cheeses, regular fat	<1	<1	<1	<1	<1

Major food category	Food group represented	Percentage contribution (%)				
		9 months <sup>u</sup>	2-5 years <sup>^</sup>	6-12 years <sup>^</sup>	13-16 years <sup>^</sup>	17 years & above <sup>^</sup>
<b>Fats and oils</b>	<b>All fats and oils</b>	<b>10</b>	<b>13</b>	<b>12</b>	<b>11</b>	<b>12</b>
	Olive oil	4	7	6	4	7
	Spreads, full fat, including butter and vegetable	4	4	3	3	3
	Spreads, reduced fat, including butter and vegetable	<1	<1	<1	<1	<1
	Vegetable oils (excluding olive)	1	2	2	3	2
<b>Fruits and nuts</b>	<b>All fruits and nuts</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>3</b>	<b>11</b>
	Nut and seed butters	4	1	1	1	<1
	Seeds and tree nuts	0	3	2	2	10
<b>Infant products</b>	<b>All infant products</b>	<b>&lt;1</b>	<b>&lt;1</b>	<b>0</b>	<b>0</b>	<b>&lt;1</b>
	Infant dinners	<1	<1	0	0	<1
<b>Meat, poultry, seafood and eggs</b>	<b>All meat, poultry, seafood and eggs</b>	<b>12</b>	<b>13</b>	<b>13</b>	<b>12</b>	<b>16</b>
	Canned fish	2	<1	1	3	4
	Coated chicken products	3	3	2	2	2
	Crumbed/battered fish and seafood	3	3	3	2	4
	Cured or fermented deli meats (excluded canned meats)	1	2	2	3	2
	Meat sausages and frankfurts	3	3	4	3	3
	Plain fish and seafood	0	2	0	0	0
<b>Sugars and confectionary</b>	<b>All sugars and confectionary</b>	<b>4</b>	<b>4</b>	<b>5</b>	<b>5</b>	<b>4</b>
	Chocolate and chocolate-coated confectionary	3	3	4	4	3
	Sugar	<1	<1	<1	<1	<1
<b>Takeaway foods and</b>	<b>All takeaway foods and snacks</b>	<b>10</b>	<b>9</b>	<b>13</b>	<b>14</b>	<b>10</b>

Major food category	Food group represented	Percentage contribution (%)				
		9 months <sup>□</sup>	2-5 years <sup>^</sup>	6-12 years <sup>^</sup>	13-16 years <sup>^</sup>	17 years & above <sup>^</sup>
<b>snacks</b>	Coated chicken products, takeaway	1	<1	<1	<1	<1
	Hamburgers (all meat types)	<1	<1	<1	<1	<1
	Meat & poultry based prepared dishes, takeaway	2	1	1	2	2
	Pizzas and prepared pizza bases	6	5	9	10	6
	Ready to eat frozen meals	<1	1	2	1	1
<b>Vegetables</b>	<b>All vegetables</b>	<b>2</b>	<b>2</b>	<b>&lt;1</b>	<b>2</b>	<b>2</b>
	Frozen vegetables	2	2	<1	1	1
	Olives	<1	<1	<1	<1	<1
	Sundried tomatoes	0	<1	<1	<1	<1
<b>Total</b>		<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

**Notes:**

<sup>□</sup> Derived using a model diet.

<sup>^</sup> Derived using the Australian 2011-12 NNPAS (2 day average exposure).

Major contributors (≥5%) are highlighted in grey; major food group category is indicated in bold.

All %contributors have been rounded to the nearest whole percentage.

All %contributions are expressed as a percentage of the grand total contribution.

**Table A5 2: Contributors to DINP dietary exposures**

Major food category	Food group represented	Percentage contribution (%)				
		9 months <sup>u</sup>	2-5 years <sup>^</sup>	6-12 years <sup>^</sup>	13-16 years <sup>^</sup>	17 years & above <sup>^</sup>
<b>Beverages</b>	<b>All beverages</b>	0	0	0	0	0
<b>Cereals and cereal products</b>	<b>All cereals and cereal products</b>	2	4	5	3	3
	Cakes and muffins with icing or filling	2	4	4	3	2
	Cakes and muffins without icing	<1	<1	<1	<1	<1
<b>Condiments</b>	<b>All condiments</b>	0	0	0	0	0
<b>Dairy Products</b>	<b>All dairy products</b>	21	23	12	10	11
	Ripened cheeses, regular fat	21	23	12	10	11
<b>Fats and oils</b>	<b>All fats and oils</b>	3	4	4	3	4
	Olive oil	1	2	1	<1	2
	Spreads, full fat, including butter and vegetable	<1	<1	<1	<1	<1
	Spreads, reduced fat, including butter and vegetable	<1	<1	<1	<1	<1
	Vegetable oils (excluding olive)	1	2	2	2	2
<b>Fruits and nuts</b>	<b>All fruits and nuts</b>	0	0	0	0	0
<b>Infant products</b>	<b>All infant products</b>	0	0	0	0	0
<b>Meat, poultry, seafood and eggs</b>	<b>All meat, poultry, seafood and eggs</b>	9	11	11	11	13
	Canned fish	<1	<1	<1	<1	<1
	Cured or fermented deli meats (excluded canned meats)	4	5	6	6	7
	Plain fish and seafood	<1	<1	<1	<1	<1
	Poultry and game birds	2	3	3	3	3

Major food category	Food group represented	Percentage contribution (%)				
		9 months <sup>o</sup>	2-5 years <sup>^</sup>	6-12 years <sup>^</sup>	13-16 years <sup>^</sup>	17 years & above <sup>^</sup>
<b><i>Sugars and confectionary</i></b>	<b><i>All sugars and confectionary</i></b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b><i>Takeaway foods and snacks</i></b>	<b><i>All takeaway foods and snacks</i></b>	<b>64</b>	<b>56</b>	<b>68</b>	<b>72</b>	<b>69</b>
	Coated chicken products, takeaway	3	3	2	<1	1
	Hamburgers (all meat types)	48	42	50	57	54
	Meat & poultry based prepared dishes, takeaway	4	3	3	3	4
	Pizzas and prepared pizza bases	10	9	14	12	10
<b><i>Vegetables</i></b>	<b><i>All vegetables</i></b>	<b>&lt;1</b>	<b>&lt;1</b>	<b>&lt;1</b>	<b>&lt;1</b>	<b>&lt;1</b>
	Olives	<1	<1	<1	<1	<1
	Sundried tomatoes	0	<1	<1	<1	<1
<b>Grand Total</b>		<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

**Notes:**

<sup>o</sup> Derived using a model diet.

<sup>^</sup> Derived using the Australian 2011-12 NNPAS (2 day average exposure).

Major contributors (≥5%) are highlighted in grey; major food group category is indicated in bold.

All %contributors have been rounded to the nearest whole percentage.

All %contributions are expressed as a percentage of the grand total contribution.

**Table A5 3: Contributors to DIDP dietary exposures**

Major food category	Food group represented	Percentage contribution (%)				
		9 months <sup>o</sup>	2-5 years <sup>^</sup>	6-12 years <sup>^</sup>	13-16 years <sup>^</sup>	17 years & above <sup>^</sup>
<b>Beverages</b>	<b>All beverages</b>	0	0	0	0	0
<b>Cereals and cereal products</b>	<b>All cereals and cereal products</b>	0	0	0	0	0
<b>Condiments</b>	<b>All condiments</b>	0	0	0	0	0
<b>Dairy Products</b>	<b>All dairy products</b>	0	0	0	0	0
<b>Fats and oils</b>	<b>All fats and oils</b>	100	100	100	100	100
	Olive oil	100	100	100	100	100
<b>Fruits and nuts</b>	<b>All fruits and nuts</b>	0	0	0	0	0
<b>Infant products</b>	<b>All infant products</b>	0	0	0	0	0
<b>Meat, poultry, seafood and eggs</b>	<b>All meat, poultry, seafood and eggs</b>	0	0	0	0	0
<b>Sugars and confectionary</b>	<b>All sugars and confectionary</b>	0	0	0	0	0
<b>Takeaway foods and snacks</b>	<b>All takeaway foods and snacks</b>	0	0	0	0	0
<b>Vegetables</b>	<b>All vegetables</b>	0	0	0	0	0
<b>Total</b>		100	100	100	100	100

**Notes:**

<sup>o</sup> Derived using a model diet

<sup>^</sup> Derived using the Australian 2011-12 NNPAS (2 day average exposure).

Major contributors (≥5%) are highlighted in grey.

All %contributors have been rounded to the nearest whole percentage.

All %contributions are expressed as a percentage of the grand total contribution.



**Table A5 4: Contributors to DEHA dietary exposures**

Major food category	Food group represented	Percentage contribution (%)				
		9 months <sup>u</sup>	2-5 years <sup>^</sup>	6-12 years <sup>^</sup>	13-16 years <sup>^</sup>	17 years & above <sup>^</sup>
<b>Beverages</b>	<b>All beverages</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Cereals and cereal products</b>	<b>All cereals and cereal products</b>	<b>&lt;1</b>	<b>1</b>	<b>1</b>	<b>&lt;1</b>	<b>&lt;1</b>
	Cakes and muffins with icing or filling	<1	<1	<1	<1	<1
	Cakes and muffins without icing	<1	<1	<1	<1	<1
	Rice and rice products	<1	<1	<1	<1	<1
<b>Condiments</b>	<b>All condiments</b>	<b>&lt;1</b>	<b>&lt;1</b>	<b>&lt;1</b>	<b>&lt;1</b>	<b>&lt;1</b>
	Canned and dry-mix soups	<1	<1	<1	<1	<1
	Dips	<1	<1	<1	<1	<1
<b>Dairy Products</b>	<b>All dairy products</b>	<b>36</b>	<b>45</b>	<b>31</b>	<b>25</b>	<b>20</b>
	Frozen dairy based desserts	1	1	3	1	<1
	Regular fat cream products	<1	4	4	4	4
	Ripened cheeses, reduced fat	2	<1	1	<1	<1
	Ripened cheeses, regular fat	31	36	22	18	13
	Unripened cheeses, reduced fat	<1	<1	<1	<1	<1
	Unripened cheeses, regular fat	1	3	1	2	2
	Yoghurts, regular fat	<1	<1	<1	<1	<1
<b>Fats and oils</b>	<b>All fats and oils</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>&lt;1</b>	<b>&lt;1</b>
	Olive oil	<1	<1	<1	<1	<1
	Spreads, full fat, including butter and vegetable	1	1	1	<1	<1
	Spreads, reduced fat, including butter and vegetable	<1	<1	<1	<1	<1

Major food category	Food group represented	Percentage contribution (%)				
		9 months <sup>o</sup>	2-5 years <sup>^</sup>	6-12 years <sup>^</sup>	13-16 years <sup>^</sup>	17 years & above <sup>^</sup>
<b>Fruits and nuts</b>	<b>All fruits and nuts</b>	0	0	0	0	0
<b>Infant products</b>	<b>All infant products</b>	0	0	0	0	0
<b>Meat, poultry, seafood and eggs</b>	<b>All meat, poultry, seafood and eggs</b>	56	48	60	67	73
	Beef, veal, lamb, game and offal meats (not poultry)	56	48	59	67	73
	Beef, veal, lamb, game and poultry mince	<1	<1	<1	<1	<1
<b>Sugars and confectionary</b>	<b>All sugars and confectionary</b>	<1	<1	<1	<1	<1
	Chocolate and chocolate-coated confectionary	<1	<1	<1	<1	<1
<b>Takeaway foods and snacks</b>	<b>All takeaway foods and snacks</b>	5	4	6	5	5
	Meat & poultry based prepared dishes, takeaway	5	4	5	5	4
	Pizzas and prepared pizza bases	<1	<1	<1	<1	<1
<b>Vegetables</b>	<b>All vegetables</b>	<1	<1	<1	<1	<1
	Olives	<1	<1	<1	<1	<1
	Sundried tomatoes	0	<1	<1	<1	<1
<b>Total</b>		100	100	100	100	100

**Notes:**

<sup>o</sup> Derived using a model diet.

<sup>^</sup> Derived using the Australian 2011-12 NNPAS (2 day average exposure).

Major contributors (≥5%) are highlighted in grey; major food group category is indicated in bold.

All %contributors have been rounded to the nearest whole percentage.

All %contributions are expressed as a percentage of the grand total contribution.

**Table A5 5: Contributors to DBP dietary exposures**

Major food category	Food group represented	Percentage contribution (%)				
		9 months <sup>o</sup>	2-5 years <sup>^</sup>	6-12 years <sup>^</sup>	13-16 years <sup>^</sup>	17 years & above <sup>^</sup>
<b>Beverages</b>	<b>All beverages</b>	0	0	0	0	0
<b>Cereals and cereal products</b>	<b>All cereals and cereal products</b>	100	100	100	100	100
	Breakfast cereal, single and mixed grain	100	100	100	100	100
<b>Condiments</b>	<b>All condiments</b>	0	0	0	0	0
<b>Dairy Products</b>	<b>All dairy products</b>	0	0	0	0	0
<b>Fats and oils</b>	<b>All fats and oils</b>	0	0	0	0	0
<b>Fruits and nuts</b>	<b>All fruits and nuts</b>	0	0	0	0	0
<b>Infant products</b>	<b>All infant products</b>	0	0	0	0	0
<b>Meat, poultry, seafood and eggs</b>	<b>All meat, poultry, seafood and eggs</b>	0	0	0	0	0
<b>Sugars and confectionary</b>	<b>All sugars and confectionary</b>	0	0	0	0	0
<b>Takeaway foods and snacks</b>	<b>All takeaway foods and snacks</b>	0	0	0	0	0
<b>Vegetables</b>	<b>All vegetables</b>	0	0	0	0	0
<b>Total</b>		100	100	100	100	100

**Notes:**

<sup>o</sup> Derived using a model diet.

<sup>^</sup> Derived using the Australian 2011-12 NNPAS (2 day average exposure).

Major contributors (≥5%) are highlighted in grey; major food group category is indicated in bold.

All %contributors have been rounded to the nearest whole percentage.

All %contributions are expressed as a percentage of the grand total contribution.

**Table A5 6: Contributors to BBP dietary exposures**

Major food category	Food group represented	Percentage contribution (%)				
		9 months <sup>υ</sup>	2-5 years <sup>^</sup>	6-12 years <sup>^</sup>	13-16 years <sup>^</sup>	17 years & above <sup>^</sup>
<b>Beverages</b>	<b>All beverages</b>	0	0	0	0	0
<b>Cereals and cereal products</b>	<b>All cereals and cereal products</b>	0	0	0	0	0
<b>Condiments</b>	<b>All condiments</b>	0	0	0	0	0
<b>Dairy Products</b>	<b>All dairy products</b>	0	0	0	0	0
<b>Fats and oils</b>	<b>All fats and oils</b>	21	61	53	46	66
	Olive oil	21	61	53	46	66
<b>Fruits and nuts</b>	<b>All fruits and nuts</b>	79	39	47	54	34
	Nut and seed butters	79	39	47	54	34
<b>Infant products</b>	<b>All infant products</b>	0	0	0	0	0
<b>Meat, poultry, seafood and eggs</b>	<b>All meat, poultry, seafood and eggs</b>	0	0	0	0	0
<b>Sugars and confectionary</b>	<b>All sugars and confectionary</b>	0	0	0	0	0
<b>Takeaway foods and snacks</b>	<b>All takeaway foods and snacks</b>	0	0	0	0	0
<b>Vegetables</b>	<b>All vegetables</b>	0	0	0	0	0
<b>Total</b>		100	100	100	100	100

**Notes:**

<sup>υ</sup> Derived using a model diet.

<sup>^</sup> Derived using the Australian 2011-12 NNPAS (2 day average exposure).

Major contributors (≥5%) are highlighted in grey; major food group category is indicated in bold.

All %contributors have been rounded to the nearest whole percentage.

All %contributions are expressed as a percentage of the grand total contribution.

**Table A5 7: Contributors to ATBC dietary exposures**

Major food category	Food group	Percentage contribution (%)				
		9 months <sup>u</sup>	2-5 years <sup>^</sup>	6-12 years <sup>^</sup>	13-16 years <sup>^</sup>	17 years & above <sup>^</sup>
<b>Beverages</b>	<b>All beverages</b>	0	0	0	0	0
<b>Cereals and cereal products</b>	<b>All cereals and cereal products</b>	16	16	22	22	16
	Cakes and muffins with icing or filling	<1	<1	<1	<1	<1
	Cakes and muffins without icing	<1	<1	<1	<1	<1
	Cereal bars	3	3	4	5	2
	Commercial biscuits and crackers	2	2	3	3	1
	Commercial breads (white, multigrain, wholemeal, spelt & rye)	9	10	12	13	11
	Flat breads, tortillas and pizza bases	1	<1	<1	<1	<1
	Sweet and savoury fancy breads	<1	<1	<1	<1	<1
<b>Condiments</b>	<b>All condiments</b>	<1	<1	<1	<1	<1
	Canned and dry-mix soups	<1	<1	<1	<1	<1
<b>Dairy Products</b>	<b>All dairy products</b>	73	73	64	64	63
	Ripened cheeses, reduced fat	7	3	7	2	5
	Ripened cheeses, regular fat	66	70	57	62	57
<b>Fats and oils</b>	<b>All fats and oils</b>	0	0	0	0	0
<b>Fruits and nuts</b>	<b>All fruits and nuts</b>	0	<1	<1	<1	<1
	Seeds and tree nuts	0	<1	<1	<1	<1
<b>Infant products</b>	<b>All infant products</b>	0	0	0	0	0
<b>Meat, poultry, seafood and eggs</b>	<b>All meat, poultry, seafood and eggs</b>	3	4	5	6	8
	Beef, veal, lamb, game and poultry mince	<1	<1	<1	1	1

Major food category	Food group	Percentage contribution (%)				
		9 months <sup>□</sup>	2-5 years <sup>^</sup>	6-12 years <sup>^</sup>	13-16 years <sup>^</sup>	17 years & above <sup>^</sup>
	Canned fish	<1	<1	<1	1	3
	Coated chicken products	<1	<1	<1	<1	<1
	Crumbed/battered fish and seafood	<1	<1	<1	<1	1
	Cured or fermented deli meats (excluded canned meats)	<1	<1	1	2	2
	Meat sausages and frankfurts	<1	<1	<1	<1	<1
	Plain fish and seafood	<1	<1	<1	<1	<1
<b>Sugars and confectionary</b>	<b>All sugars and confectionary</b>	<b>1</b>	<b>2</b>	<b>4</b>	<b>3</b>	<b>4</b>
	Confectionery	<1	<1	<1	<1	<1
	Sugar	1	2	4	3	4
<b>Takeaway foods and snacks</b>	<b>All takeaway foods and snacks</b>	<b>&lt;1</b>	<b>&lt;1</b>	<b>1</b>	<b>1</b>	<b>&lt;1</b>
	Coated chicken products, takeaway	<1	<1	<1	<1	<1
	Corn chips and taco shells	<1	<1	<1	<1	<1
	Crisps (chips) and savoury snacks	<1	<1	<1	<1	<1
<b>Vegetables</b>	<b>All vegetables</b>	<b>6</b>	<b>3</b>	<b>4</b>	<b>4</b>	<b>8</b>
	Canned legumes	<1	<1	<1	<1	1
	Frozen vegetables	<1	<1	<1	<1	<1
	Olives	5	2	4	3	6
	Sundried tomatoes	0	<1	<1	<1	<1
<b>Total</b>		<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

**Notes:**

□ Derived using a model diet.

^ Derived using the Australian 2011-12 NNPAS (2 day average exposure).

Major contributors (≥5%) are highlighted in grey; major food group category is indicated in bold.

All %contributors have been rounded to the nearest whole percentage.

All %contributions are expressed as a percentage of the grand total contribution.

## Appendix 6: Mapping

**Table A6 1: Mapping of Plasticiser survey foods to nutrition survey foods**

Plasticiser Survey food analysed	2011-12 NNPAS foods mapped to the survey food	Food group name for reporting	Major Food Group
Bacon, middle cut, rind on	All cured or fermented deli meats including poultry-based (excluding canned cured meat)	Cured or fermented deli meats (excluding canned meats)	Meat, poultry, seafood and eggs
Baked beans in tomato sauce	All dried and canned legumes	Canned legumes	Vegetables
Beef mince and meat patties	All minced meats including poultry-based	Beef, veal, lamb, game and poultry mince	Meat, poultry, seafood and eggs
Beef, steak, untrimmed	Beef, veal, lamb, game and offal meats (excluding poultry)	Beef, veal, lamb, game and offal meats (not poultry)	Meat, poultry, seafood and eggs
Beef/Chicken takeaway mixed dishes	All red meat and white meat based prepared dishes from takeaway outlets (e.g. curries, stir fries etc.)	Meat & poultry based prepared dishes, takeaway	Takeaway foods and snacks
Biscuits, sweet and savoury	Savoury biscuits and crackers, Commercial plain and filled sweet biscuits	Commercial biscuits and crackers	Cereals and cereal products
Bread, fancy, sweet and savoury	Fruit-, vegetable-, cheese-, or bacon-containing breads; English muffins; crumpets; buns	Sweet and savoury fancy breads	Cereals and cereal products
Bread, flat	Flat breads, tortillas and pizza bases	Flat breads, tortillas and pizza bases	Cereals and cereal products
Bread, white	White and high-fibre white breads; multigrain, wholemeal, spelt and rye breads	Commercial breads (white, multigrain, wholemeal, spelt & rye)	Cereals and cereal products
Breakfast bars	Muesli or snack bars made from breakfast cereal or puffed rice, with or without coating; meal replacement bars	Cereal bars	Cereals and cereal products

Plasticiser Survey food analysed	2011-12 NNPAS foods mapped to the survey food	Food group name for reporting	Major Food Group
Breakfast cereal, single and mixed grain	Ready to eat single and mixed grain breakfast cereals and brans; breakfast cereals containing fruits and/or nuts; hot (oat or rice etc.) porridge types	Breakfast cereal, single and mixed grain	Cereals and cereal products
Cakes and muffins, iced	Commercial plain cakes and cake-style muffins <u>with</u> icing or cream filling	Cakes and muffins with icing or filling	Cereals and cereal products
Cakes and muffins, uniced	Commercial plain cakes and cake-style muffins <u>without</u> icing or cream filling	Cakes and muffins without icing	Cereals and cereal products
Cheese, cream cheese, reduced fat	Reduced fat cream cheese, cottage cheese, ricotta cheese and quark	Unripened cheeses, reduced fat	Dairy Products
Cheese, cream cheese, regular fat	Regular fat cream cheese, cottage cheese, ricotta cheese, goat cheese and bocconcini	Unripened cheeses, regular fat	Dairy Products
Cheese, processed, cheddar, reduced fat	Reduced fat soft and hard cheeses (e.g. brie, camembert, cheddar)	Ripened cheeses, reduced fat	Dairy Products
Cheese, processed, cheddar, regular fat	Regular fat soft and hard cheeses (e.g. brie, camembert, cheddar)	Ripened cheeses, regular fat	Dairy Products
Chicken products, battered or crumbed	Poultry fillets and pieces battered, coated or crumbed, frozen	Coated chicken products	Meat, poultry, seafood and eggs
Chicken products, battered or crumbed, from takeaway	Poultry fillets and pieces, battered, coated or crumbed, from takeaway outlet or fast food chain	Coated chicken products, takeaway	Takeaway foods and snacks
Chicken, breast	Poultry & game bird fillets and pieces with or without the skin	Poultry and game birds	Meat, poultry, seafood and eggs
Chocolate, plain milk chocolate	Chocolate; chocolate bars; chocolate coated-confectionery	Chocolate and chocolate-coated confectionery	Sugars and confectionary
Coffee, instant	Coffee and Coffee substitute beverage	Coffee	Beverages
Confectionery, soft candy	Sugar confectionary, including hard, boiled, soft, jelly types; chewing gum	Confectionery	Sugars and confectionary



Plasticiser Survey food analysed	2011-12 NNPAS foods mapped to the survey food	Food group name for reporting	Major Food Group
Corn chips	Corn chips; taco shells	Corn chips and taco shells	Takeaway foods and snacks
Cream, sour, full fat	Regular fat sour cream and thickened cream	Regular fat cream products	Dairy Products
Cream, thickened, reduced fat	Reduced fat sour cream and thickened cream	Reduced fat cream products	Dairy Products
Dip	Dips, dairy or fat based	Dips	Condiments
Fish fillets, white fish, fresh	Unprocessed fish and fish fillets; Crustacea	Plain fish and seafood	Meat, poultry, seafood and eggs
Fish portions, frozen from supermarket (crumbed only)	Crumbed and battered fish and other seafood	Crumbed/battered fish and seafood	Meat, poultry, seafood and eggs
Hamburger, beef (combined Hungry Jacks and other fast food outlet burgers)	Hamburgers; chicken burgers; fish burgers	Hamburgers (all meat types)	Takeaway foods and snacks
Ice cream, full fat	Ice creams; frozen yoghurt; milk-based ice confections	Frozen dairy based desserts	Dairy Products
Infant dessert	Infant custards and yoghurts	Infant custards and yoghurts	Infant products
Infant dinner	Infant dinners, meat and/or vegetable and/or pasta based	Infant dinners	Infant products
Infant formula (non-soy)	Cow's milk infant formula	Infant formulas, non-soy based	Infant products
Infant formula, soy- based	Soy based infant formula	Infant formulas, soy-based	Infant products
Jams	Fruit and vegetable jams and spreads, pickles, chutneys and pastes	Jams, chutneys and pastes	Condiments
Milk, fresh, full fat	All regular fat flavoured & unflavoured dairy milks	Milks, flavoured & unflavoured, regular fat	Dairy Products
Milk, fresh, reduced fat	All reduced fat flavoured & unflavoured dairy milks	Milks, flavoured & unflavoured, reduced fat	Dairy Products

Plasticiser Survey food analysed	2011-12 NNPAS foods mapped to the survey food	Food group name for reporting	Major Food Group
Milk, UHT, full fat	All UHT milk including non-dairy; condensed and evaporated milk	Milks, UHT	Dairy Products
Noodles, instant, in cups and bowls and plastic wrapping	Instant noodles	Instant noodles	Cereals and cereal products
Nuts, cashews	All tree nuts except coconut; seeds	Seeds and tree nuts	Fruits and nuts
Oil, Canola oil or sunflower oil	All vegetable oils (excluding olive oil)	Vegetable oils (excluding olive)	Fats and oils
Oil, Olive oil	Olive Oil	Olive oil	Fats and oils
Olives	All vegetables in vinegar/oil/brine (e.g. olives, gherkins, onions, capers, chillies, mixed vegetables; excluding sundried tomatoes; excluding canned vegetables	Commercially sterile olives and vegetables (non-canned)	Vegetables
Pasta	Pasta; wheat and buckwheat noodles; rice stick noodles (excluding instant noodles)	Pasta	Cereals and cereal products
Peanut butter	Nut and seed butters	Nut and seed butters	Fruits and nuts
Peas, frozen	Frozen vegetables, single or mixed varieties; excludes potato oven style chips and frozen potato products	Frozen vegetables	Vegetables
Pizza, frozen from supermarket	Pizzas and prepared pizza bases, supermarket and takeaway varieties	Pizzas and prepared pizza bases	Takeaway foods and snacks
Potato crisps, flavoured and unflavoured	Potato crisps and extruded savoury snacks (excluding corn chips)	Crisps (chips) and savoury snacks	Takeaway foods and snacks
Ready to eat meal, frozen from supermarket	Meat, poultry and seafood based frozen meals	Ready to eat frozen meals	Takeaway foods and snacks
Rice, single grain, uncooked	Rice, cereal grains and flours	Rice and cereal grain products	Cereals and cereal products
Sausages, beef	All sausages; frankfurts	Meat sausages and frankfurts	Meat, poultry, seafood and eggs

Plasticiser Survey food analysed	2011-12 NNPAS foods mapped to the survey food	Food group name for reporting	Major Food Group
Shelf-stable peaches	All shelf-stable canned and packaged fruits	Commercially sterile fruits	Fruits and nuts
Soft drink	Soft drinks; flavoured mineral waters; tonic water; fruit-flavoured drinks; sports drinks; energy drinks	Soft drinks, energy drinks and mineral waters	Beverages
Soup	Canned and dry-mix soups	Canned and dry-mix soups	Condiments
Spreads, full fat, including butter and vegetable	Regular fat margarines and margarine spreads; not further specified spreads/fats; butter; vegetable based hard fats	Spreads, full fat, including butter and vegetable	Fats and oils
Spreads, reduced fat, including butter and vegetable	reduced fat margarines and margarine spreads; not further specified spreads/fats; butter; vegetable based hard fats	Spreads, reduced fat, including butter and vegetable	Fats and oils
Sugar, white	White sugar, brown sugar, raw sugar, icing sugar, maltodextrin; excludes sugar syrups (e.g. maple, glucose)	Sugar	Sugars and confectionary
Sundried tomatoes	Sundried and semi-sundried tomatoes	Sundried tomatoes	Vegetables
Tomato sauce	Sauces; gravy; condiments (e.g. barbeque, honey soy, HP, fish and soy sauces; pasta or simmer sauces; tomato salsa; marinades)	Gravy, sauces & condiments	Condiments
Tomatoes, canned	All canned vegetables	Canned vegetables	Vegetables
Tuna, canned	All canned fish products	Canned fish	Meat, poultry, seafood and eggs
Yoghurt, full fat, flavoured and unflavoured	All regular fat yoghurts (excluding frozen)	Yoghurts, regular fat	Dairy Products
Yoghurt, low/reduced fat, flavoured and unflavoured	All reduced fat yoghurts (excluding frozen)	Yoghurts, reduced fat	Dairy Products